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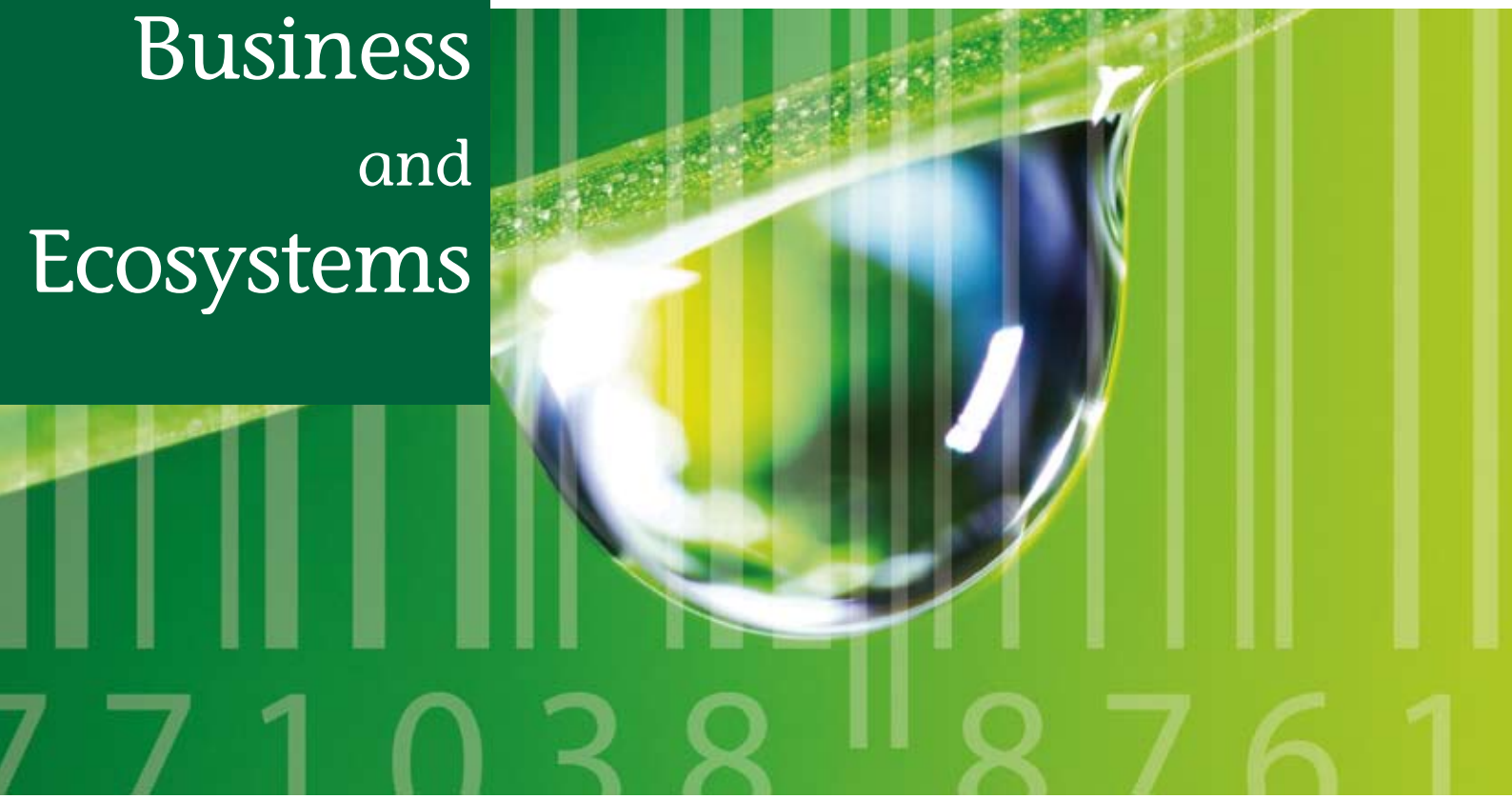

A Scoping Report I Corporate Ecosystem Valuation

World Business Council for
Sustainable Development

About the WBCSD

The World Business Council for Sustainable Development (WBCSD) brings together some 200 international companies in a shared commitment to sustainable development through economic growth, ecological balance and social progress. Our members are drawn from more than 36 countries and 22 major industrial sectors. We also benefit from a global network of 58 national and regional business councils and partner organizations.

Our mission is to provide business leadership as a catalyst for change toward sustainable development, and to support the business license to operate, innovate and grow in a world increasingly shaped by sustainable development issues.

Our objectives include:

Business Leadership – to be a leading business advocate on sustainable development;

Policy Development – to help develop policies that create framework conditions for the business contribution to sustainable development;

The Business Case – to develop and promote the business case for sustainable development;

Best Practice – to demonstrate the business contribution to sustainable development and share best practices among members;

Global Outreach – to contribute to a sustainable future for developing nations and nations in transition.

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Prepared for the World Business Council for Sustainable Development by Environment Management Group & Ecosystem Economics LLC

Main report

Corporate Ecosystem Valuation:
A scoping study

Prepared for the World Business Council for Sustainable Development
by Environment Management Group & Ecosystem Economics LLC

ECOSYSTEM ECONOMICS

Environment Management Group
strengthening environmental business performance

Table of Contents

List of boxes

List of case studies

List of figures

List of abbreviations

ARIES	Assessment and Research Infrastructure for Ecosystem Services
CESR	Corporate Environmental and Social Responsibility
CI	Conservation International
DEFRA	UK Department for Environment, Food & Rural Affairs
ENVEST	Environmental Intelligence for Tomorrow's Markets
EU	European Union
FAO	Food & Agriculture Organization of the United Nations
FFI	Fauna & Flora International
GDP	gross domestic product
IIED	International Institute for Environment and Development
InVEST	Integrated Valuation of Ecosystem Services and Tradeoffs
IUCN	International Union for the Conservation of Nature
JNCC	UK Joint Nature Conservation Committee
MEA	Millennium Ecosystem Assessment
MIMES	Multiscale Integrated Models of Ecosystem Services
NGO	non-governmental organization
NOAA	US National Oceanic and Atmospheric Administration
OECD	Organisation for Economic Co-operation and Development
OTEP	UK Overseas Territories Environment Programme
RFF	Resources for the Future
TEV	Total Economic Value
TNC	The Nature Conservancy
UNCED	United Nations Conference on Environment and Development
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
WBCSD	World Business Council for Sustainable Development
WRI	World Resources Institute
WWF	World Wide Fund For Nature

1. Introduction: Scoping the Ecosystem Valuation Initiative

Rationale

The WBCSD is preparing to develop a comprehensive Ecosystem Valuation Initiative. The topics of ecosystem impacts and dependencies have recently been addressed in detail in the WBCSD/WRI/Meridian Institute *Corporate Ecosystem Services Review*.[1] This provides a tool to help managers develop strategies to manage business risks and opportunities arising from their company's dependence and impact on ecosystems. Its scope does not however extend to ecosystem valuation or to financial analysis and reporting. There is thus a clear opportunity for the WBCSD to build on the process and steps identified in the *Corporate Ecosystem Services Review*, and to develop and apply a toolbox for quantifying these ecosystem risks and opportunities in monetary terms.

The interest in ecosystem valuation stems from the recognition by many WBCSD members that while their operations may impact on ecosystems and ecosystem services they also depend heavily on them. Not only does the loss of ecosystem services pose substantial risks to corporate profits and production, ecosystem services can also present lucrative new business opportunities. However, while leading companies acknowledge the importance of tackling these issues, many are still struggling to identify exactly how to integrate such information into their management decisions and financial reporting.

Economic valuation provides one approach that could have the potential to help in addressing this challenge. By quantifying ecosystem relationships and expressing them in monetary terms, it provides a series of measures that can in principle be integrated with conventional financial measures and linked directly to a company's bottom line.

The application of ecosystem valuation techniques to business concerns is, however, still at an embryonic stage. An important question therefore arises as to whether and how the discipline, as currently practiced, lends itself to use by the corporate sector. As yet there is little guidance available on this topic.

Focus

With the aim of filling these knowledge gaps and informing the design of the Ecosystem Valuation Initiative, the WBCSD has commissioned an exercise to scope out the needs, niches and opportunities to use ecosystem valuation for business. The following document reports on this scoping study, and aims to answer the following questions:

- What is the current state of play as regards ecosystem valuation methods, practices and applications?
- How far are these experiences and techniques relevant for business?
- In the light of the above, what are the needs, gaps, opportunities and ways forward in developing the WBCSD Ecosystem Valuation Initiative?

Coverage

Several clarifications about the approach and coverage of the scoping study need to be made at the start of this document. First, and most importantly, its focus is strictly on ecosystem valuation, in the sense of efforts to place a monetary value on ecosystem dependencies and impacts. The document does not look at tools and frameworks that are concerned with integrating ecosystem services into corporate planning and management more generally, or developing prices and markets for ecosystem services – except in so far as they explicitly contain a valuation component. This is because the goal of the scoping study was very specific: to identify gaps, needs, niches and ways forward in developing the WBCSD Ecosystem Valuation Initiative. There is already a relatively large body of literature on ecosystems, corporate planning and decision-making that does not need to be repeated. The aim of the current document is to address a particular topic that has as yet received little or no attention: business and ecosystem valuation.

A second point to emphasize is that this document is concerned primarily with the use of ecosystem valuation to meet "hard" business goals, in other words financial or profit aspects of the bottom line. It is not so much concerned with "softer" philanthropy and corporate environmental and social responsibility, even though these do influence business decisions via social and environmental aspects of the bottom line (although it does not exclude these applications of corporate ecosystem valuation). The scoping study is

concerned principally with the use of ecosystem valuation as a tool for business planning and management to improve company financial performance and profits.

Third, the scoping study has suffered both from an avalanche of information and from a real paucity of usable data. The avalanche relates to the huge number of initiatives, organizations and literature that deal with “mainstream” ecosystem valuation: ecosystem valuation as conventionally applied by public sector, multilateral and non-governmental agencies, research institutes and academia to secure social benefits and further the public interest. It has been something of a challenge to reduce this mountain of information to a coherent set of general principles and conclusions. In contrast, the study found very little documentation on ecosystem valuation for and by business. This reflects both the relative newness of the field and its lack of attention to date, as well as the fact that many corporate documents are simply not available in the public domain.

Finally, it should be made clear that this document is not a toolkit, guidebook or advocacy document. These types of materials will be produced as part of the Ecosystem Valuation Initiative, when it takes off. Rather, it is a scoping study of the current state of play in ecosystem valuation, and its applicability to business. The document identifies, synthesizes, reviews and draws conclusions about what is currently available and being done in ecosystem valuation, and how it can guide the WBCSD’s planned project. As such it is more of a “dry” report than a popularized one. The document is therefore, inevitably, somewhat technical and detailed in parts. This is unavoidable, given the scoping study’s aims and coverage, as well as the topic it addresses.

2. The background: How ecosystem valuation came about

Before we delve more deeply into the process and practice of ecosystem valuation, it is useful to consider its background and conceptual basis. This has great bearing on why, how, and to what ends the discipline has evolved and is now being applied (the topic of Chapters 3, 5 and 6). It will also help to understand better the opportunities and niches that exist for corporate ecosystem valuation (dealt with in Chapters 4 and 7).

The root of the problem – Ecosystem under-valuation

Under-valuation provides the raison d'être for ecosystem valuation. Ecosystem valuation as a discipline has evolved in response to the fact that although ecosystems function as valuable assets or stocks of natural capita, which generate economically important services, most ecosystem services are not priced and do not have a market. Without some form of outside intervention, ecosystems therefore do not usually enter into the monetary calculations of profit and loss that determine how people choose to produce, consume, trade and invest. This means that individuals, households, firms and even governments tend to pay little attention to ecosystems – or even ignore them altogether – when they make economic decisions.

On the one hand, the lack of markets and prices means that ecosystems can often be used, exploited or damaged at low or zero cost to the individual (unless, of course, we are dealing with market commodities such as timber or minerals, or there are charges and penalties that have been imposed externally by the state such as claims for damage compensation, pollution fines or requirements for offsets). In fact, in many cases it remains more profitable (or less costly) for people to deplete, pollute or over-use ecosystems than to conserve them and use them sustainably – unless their actions are driven by broader social goals. The costs of ecosystem degradation are usually incurred by other groups and individuals or to the wider economy, not by the individuals who are causing it. The lack of markets and prices for ecosystem services also means that there are few opportunities for individuals or firms to gain in material terms from environmentally responsible behavior – despite the fact that it is frequently in the public economic interest for them to do so.

This gives rise to what economists term "externalities": the negative or positive consequences of an economic activity that is experienced by unrelated third parties. These occur when ecosystem costs are imposed by one party on another without any compensation being paid, or, alternatively, ecosystem benefits are generated by one party for others without any reward or recompense being given. Basically, public and private costs and benefits tend to diverge in the case of ecosystems – there are few private economic incentives for individuals or firms to act to the public good, and little economic disincentive for them to avoid actions that cause broader public harm. The public good nature of many ecosystem services (essentially their non-excludability, non-rivalry and unclear property rights) also often means that they do not fit easily into private equations of profit and loss.

A very simple example serves to illustrate this point. A landowner may choose to clearcut forest in order to capture the profits from selling timber, or to plant high-value cash crops. Even though many households and industries located downstream depend on the watershed protection services of this forest, and will suffer substantial economic costs and losses from deteriorations in waterflow and quality, the landowner has no personal motivation to take these impacts into account when he performs his financial calculations to determine the land use in which he should choose to engage. As he cannot "sell" any watershed protection services he may generate (however valuable they may be to others), it is hardly surprising that the landholder would focus on the business opportunities that will yield him the greatest immediate profits. He has no obvious reason to account for, and internalize, the costs of his actions to others.

Ecosystem valuation aims to overcome these price and market failures, and correct the externalities to which they give rise. The perceived need to articulate the monetary costs and benefits associated with changes in the supply or quality of ecosystem services is thus tied intimately to a wish to make private decision-making better reflect broader public interests and economic gains: in the interests of both equity and efficiency, as well as (in some cases) the belief that "nature" has an inherent right that needs to be protected.

It is therefore hardly surprising that the primary focus and application of ecosystem valuation has been in the domain of decision-making, which is being carried out in the public interest (whether this is by government or by other entities who have the broader social good as their goal). As we will describe a little later in this document, this also means that many of the ecosystem valuation techniques that have been developed towards these ends have only minimal relevance and utility from a profit-oriented perspective, where a

concern with maximizing public benefits and economy-wide gains needs also to be combined with financial goals.

How ecosystem valuation has evolved over time – From brown to green to ecosystems

The basics of ecosystem valuation have been around for a long time. Although it might seem to be a buzzword of the 21st century, in fact ecosystem valuation has its roots in concepts that extend back to the neoclassical economists of the late 1800s and early 1900s. The discipline of environmental economics, however, only really first emerged in the 1950s and 1960s, largely prompted by the introduction of new environmental regulations in the United States and later in Europe. For the first time, it became necessary to assess the environmental costs and benefits of (mainly government-instigated) large infrastructure projects, as well as to compare public policies and market-based interventions such as effluent charges and pollution fees. Over this period, major advances were made in techniques to assess the economic value of environmental impacts, particularly in relation to "brown" sector issues such as air and water pollution.

Environmental valuation grew in popularity as the "Limits to Growth" movement of the 1970s and the vision of sustainable development articulated in "Our Common Future" in 1987 took hold. The 1970s, in particular, saw a major shift from the use of solely scientific data to support environmental arguments to the inclusion of economic reasoning.[2] By the end of the 1980s, environmental valuation had become a relatively common tool used to assess public programs and overseas development projects. Over the 1970s and 1980s governments and development agencies in many countries produced guidelines or standardized procedures for dealing with environmental values in economic and financial cost benefit analysis, addressing topics such as methods of valuation, ways of treating environmental impacts, and debates over the use of various measures of project performance and analysis tools[3].

Towards the end of the 1980s and into the 1990s, "green" issues associated with nature conservation became a major focus of valuation work. This was motivated in no small part by the UNCED "Earth Summit" of 1992 and the "Rio Conventions" on biodiversity, climate change and desertification that came out of it. Suddenly, countries all over the world had a series of ecosystem and biodiversity conservation goals they had committed to reach, and realized that it was necessary to develop the economic tools to support them. Ecosystem valuation became a popular research topic among academics, and a suite of guidelines and toolboxes on environmental valuation were produced by governments, overseas aid agencies, development banks and conservation NGOs (many of these are listed in Figure 4 of the next Chapter).

As interest in ecosystem valuation expanded, so the 1990s saw a growing body of literature emerge – ecosystems were valued in most parts of the world and in most major biomes, and considerable attention was paid to pushing forward methodological boundaries so as to allow an ever-increasing range of ecosystem benefits to be valued more accurately. Most recently, the 2005 Millennium Ecosystem Assessment (MEA)[4] has spurred a renewed interest in ecosystem valuation, and a slight shift in perspective – now, there is increasing concern to articulate the economic links between ecosystem services and human well-being more generally (the links between the MEA framework and ecosystem valuation tools are described in a later section of this chapter).

We can therefore see that ecosystem valuation as a discipline has evolved largely in response to the perceived need to ensure that public policies and projects take account of environmental costs and benefits, and to find ways of reflecting social costs and benefits in economic decision-making. In turn, the valuation frameworks and methods that are now standard practice among environmental economists are primarily concerned with categorizing and monetizing the full range of "public good" aspects of ecosystem services that are not otherwise reflected in market prices. We will describe these commonly used ecosystem valuation techniques and tools in the next three sections of this chapter.

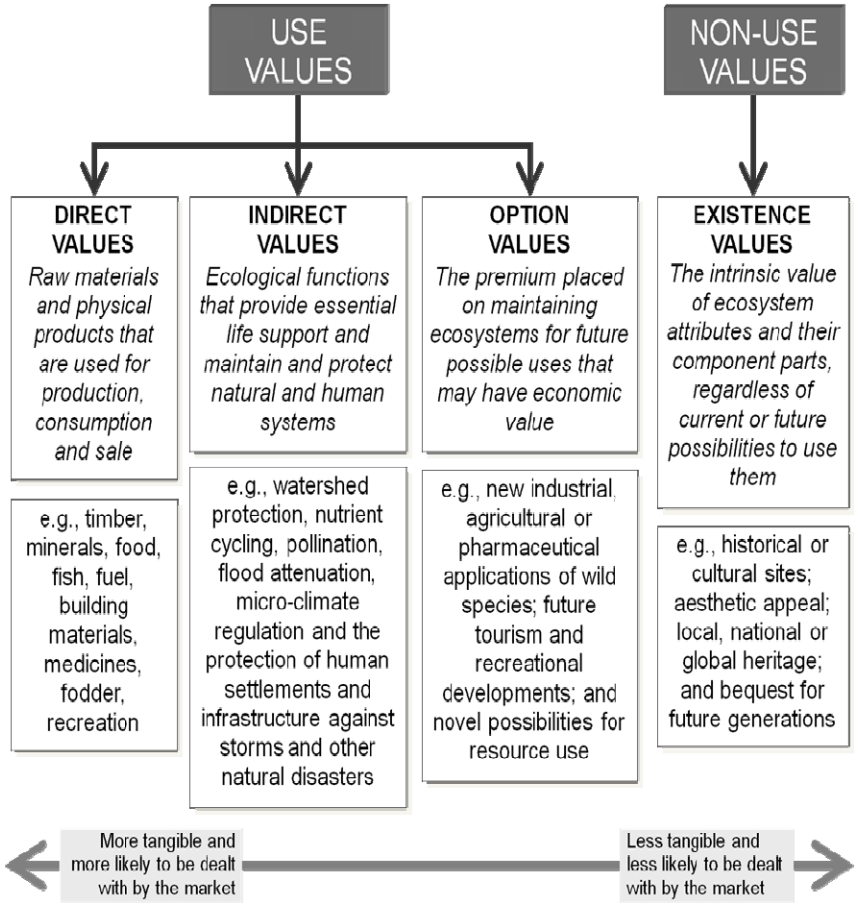
Total economic value – The overarching framework for ecosystem valuation

Since it was first developed in the late 1980s and early 1990s,[5] "Total Economic Value" (commonly shortened to TEV) has become the standard and most widely applied framework used to categorize ecosystem values. The major innovation of TEV is that it extends beyond the marketed and priced commodities to which economists have conventionally limited their analysis, to consider the full gamut of economically important goods and services associated with ecosystems.

As illustrated in Figure 1, looking at the total economic value of an ecosystem involves considering its complete range of characteristics as an integrated system – resource stocks or assets, flows of environmental services, and the attributes of the ecosystem as a whole,[6] including:

- **Direct values**: raw materials and physical products that are used directly for production, consumption and sale such as those providing energy, shelter, foods, agricultural production, water supply, transport and recreational facilities.
- **Indirect values**: the ecological functions that maintain and protect natural and human systems through services such as maintenance of water quality and flow, flood control and storm protection, nutrient retention and micro-climate stabilization, and the production and consumption activities they support.
- **Option values**: the premium placed on maintaining a pool of species and genetic resources for future possible uses, some of which may not be known now, such as leisure, commercial, industrial, agricultural and pharmaceutical applications and water-based developments.
- **Existence values**: the intrinsic value of ecosystems and their component parts, regardless of their current or future use possibilities, such as cultural, aesthetic, heritage and bequest significance.

Figure 1: Total economic value



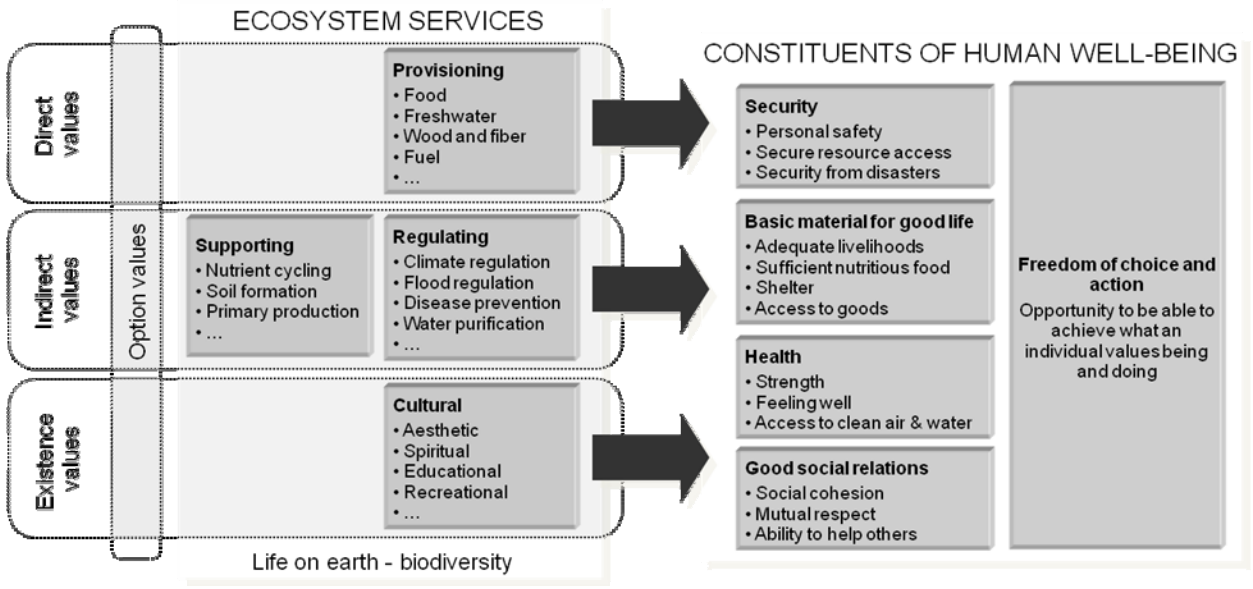
The Millennium Ecosystem Assessment: Linking ecosystem values to human well-being

As mentioned above, the 2005 publication of the Millennium Ecosystem Assessment[7] has shifted somewhat the way in which ecosystem values are commonly conceptualized and presented. This rephrasing of ecosystem services in terms of human well-being outcomes has not, however, led to any substantive changes in how basic ecosystem valuation frameworks and methods are used and applied. The categorization of total economic value, described in the preceding section, is still dominant. It has, however, brought human well-being concerns to the forefront of ecosystem valuation.

The MEA defines ecosystem services as provisioning, regulating, supporting and cultural services (which, in turn, support various components of human well-being). These different categories of ecosystem services fit

neatly into the total economic value framework: as illustrated in Figure 2, each type of ecosystem service corresponds to a different component of total economic value.

Figure 2: Ecosystem services, economic values and human well-being



Commonly used methods for valuing ecosystem services

The basic aim of valuation is to determine people's preferences: how much they are willing to pay for ecosystem services, and how much better or worse off they would consider themselves to be as a result of changes in their supply. This introduction would not be complete without mention of the techniques that are most commonly used by economists to value ecosystem services. As was described in the first section of this chapter, most ecosystem services do not have a market or a price. For this very reason, conventional valuation approaches – which are based principally on ascertaining the market price of commodities – obviously only have very limited application in the case of ecosystem services.

So a suite of tools for quantifying non-market values in monetary terms have been developed over the last two decades to meet the demands of ecosystem valuation. It lies beyond the scope of this document to describe these methods in any detail, as many are fairly complex in terms of their data and analytical requirements, and in-depth guidance is available elsewhere.[8] Figure 3, however, provides an overview of ecosystem valuation techniques that are in common usage, including approaches that elicit people's preferences directly as well as those that use indirect methods to impute people's preferences through their purchase of related services, or look at the physical losses or damage costs arising from ecosystem degradation and loss. The main point to make is that, today, a toolbox of accepted techniques is available with which to articulate the monetary worth of most ecosystem services in terms of their "real" value to society and the economy. Chapter 4 investigates in further detail the relevance of these techniques to business goals.

Figure 3: Commonly-used techniques for ecosystem valuation

Revealed preference approaches: Look at the way in which people reveal their preferences for ecosystem services through market production and consumption	Market prices	Market prices	How much it costs to buy an ecosystem good or service, or what it is worth to sell – e.g., the price of timber or minerals
	Production function approaches	Effect on production	Relates changes in the output of a marketed good or service to a measurable change in ecosystem goods – e.g., the reduction in lifespan of a hydropower dam due to siltation resulting from deforestation
	Surrogate market approaches	Travel costs	The amount of time and money people spend visiting an ecosystem for recreation or leisure purposes – e.g., the transport and accommodation costs, entry fees and time spent to visit a National Park
		Hedonic pricing	The difference in property prices or wage rates that can be ascribed to the different ecosystem qualities or values – e.g., the difference in house prices between those overlooking an area of natural beauty and those without a view of the landscape
Cost-based approaches:		Replacement	The cost of replacing an ecosystem good or service with artificial or man-

Look at the market trade-offs or costs avoided of maintaining ecosystems for their goods and services	costs	made products, infrastructure or technologies, in terms of expenditures saved – e.g., the costs of flood protection infrastructure after the loss of catchment protection forest
	Mitigative or avertive expenditures	The expenditures be required to mitigate or avert the negative effects of the loss of ecosystem services, in terms of expenditures saved – e.g., additional purification infrastructure required to maintain water quality standards after the loss of natural wetlands
	Damage costs avoided	The costs incurred to property, infrastructure and production when ecosystem services which protect economically valuable assets are lost, in terms of expenditures saved – e.g., the damage to roads, bridges, farms and property resulting from increased flooding after the loss of catchment protection forest
Stated preference approaches: Ask consumers to state their preference directly	Contingent valuation	Infer ecosystem values by asking people directly what is their willingness to pay (WTP) for them or their willingness to accept (WTA) compensation for their loss saved – e.g., how much would you be willing to contribute towards a fund to clean up and conserve a river?
	Conjoint analysis	Elicits information on preferences between scenarios involving ecosystem services between which the respondent would have to make a choice, at different prices or costs saved – e.g., the relative value of wildlife, landscape and water quality attributes of a river under different conservation scenarios, relative to the status quo.
	Choice experiments	Presents a series of alternative resource or ecosystem use options, each defined by various attributes including price, and asks respondents to evaluate these “sets”, which each contain different bundles of ecosystem services – e.g., respondents’ preferences for conservation, recreational facilities and educational attributes of natural woodlands.

3. The current state of play in ecosystem valuation: Mainstream topics and applications

Against this backdrop, ecosystem valuation has now become a burgeoning field. It continues to grow as environmental regulations become more stringent, popular concern about nature and the environment escalates, producers and consumers move more and more towards greener practices, more and more businesses embrace a triple bottom-line philosophy, and market-based solutions are increasingly promoted as a response to environmental issues.

This chapter examines what has evolved to become the "mainstream" approach to ecosystem valuation as it is widely applied and used today. The "mainstream" approach is taken as the one which has been most commonly applied to date – mainly as part of efforts to secure social benefits and further the public interest, and where public sector, multilateral and non-governmental agencies, research institutes and academia have been the dominant players.

We focus our attention on the first question posed in the introduction to this document: What is the current state of play as regards ecosystem valuation methods, practices and applications? As we will see, the main thrust remains a preoccupation with serving the broader public interest and the global good. The inclusion of corporate players and business concerns is still very much an emerging field, as we will go on to describe in Chapters 4, 5 and 6.

Who is engaged in ecosystem valuation?

It is logical to begin by identifying the main actors in ecosystem valuation. Of necessity, the following focuses more on regional and global initiatives than on country-specific efforts, as the latter are too numerous to elaborate comprehensively. Suffice it to say that a growing number of governments and national organizations now have dedicated environmental economics agencies and work programs in place to deal with ecosystem valuation.

One example of a dedicated government department is the US Environmental Protection Agency's National Center for Environmental Economics (yosemite.epa.gov/ee/epa/eed.nsf/webpages/homepage), whose mandate is to offer a centralized source of expertise to the EPA as well as to other Federal Agencies and Congress. Several other governments have this type of specialized agency, or have appointed task forces or working groups to advise them on ecosystem valuation issues. The China Committee for International Cooperation on Environment and Development's Working Group on Environmental Economics is an example of the latter (www.cciced.org/node_7040746.htm). On an as-needs basis, the Working Group forms Task Forces. These have, to date, provided technical, policy and strategic advice to the Chinese government on ecosystem valuation in relation to topics such as environmental protection and economic planning, environmental and natural resources pricing and taxation, financial mechanisms for environmental protection, and eco-compensation mechanisms. In many countries state research institutes are also funded to run long-term programs on ecosystem valuation, such as Australia's national science agency CSIRO's Ecosystem Services Project, which is studying in detail the economic value of ecosystem services (www.ecosystemservicesproject.org).

Among regional and multilateral organizations, the Organisation for Economic Co-operation and Development (OECD) was an early proponent of ecosystem valuation. Since the early 1990s, the OECD has conducted a series of programs on the economic valuation of natural resources, pollution, biodiversity and ecosystems. The World Bank's Policy and Economics Team, too, was instrumental in the development of ecosystem valuation in the 1980s and 1990s, and continues this work today. The United Nations Environment Programme (UNEP) also has a relatively long track record in the discipline via its Economics and Trade Branch and, most recently, its Green Economy Initiative. These three programs of work are described below in Box 1.

Several international conservation organizations have strong programs in environmental economics, which have in many cases been significant players in the application of valuation techniques to natural ecosystems (see Box 1). WWF's Macroeconomics for Sustainable Development Program Office was formed in 1991, and IUCN established a Global Biodiversity Economics Programme in 1995. More recently, Conservation International (CI) and The Nature Conservancy (TNC) have established initiatives dealing with the use of economic valuation for conservation planning: the Natural Capital Project and ARIES model are described in

more detail later in this Chapter. Perhaps unsurprisingly, given that these organizations are concerned primarily with nature conservation, the major focus of their ecosystem valuation work has been on the value of biodiversity and nature.

Last but not least, a growing number of research centers and universities have established themselves as leaders in ecosystem valuation. Much of the original work carried out in the 1980s and 1990s on the total economic value of ecosystems originated from University College London, via the London Environmental Economics Centre and later the Centre for Social and Economic Research on the Global Environment, which continues to have a strong focus on valuation (www.uea.ac.uk/env/cserge/enviro_valuation.htm). The International Institute for Environment and Development (IIED) in the UK (www.iied.org/theme/6/Environmental+Economics) and Resources for the Future (RFF) in the USA (www.rff.org) also stand out as long-time leaders. Other well-known and well-established centers of ecosystem valuation in academia include Sweden's Beijer Institute of Ecological Economics and Göteborg University Environmental Economics Unit, the Universities of Edinburgh and York in the UK, and the Universities of Maryland and Rhode Island, and Harvard and Duke Universities in the US.

Box 1: Ecosystem valuation programs in international organizations

IUCN	The International Union for the Conservation of Nature formed the Global Biodiversity Economics Programme in 1996 (www.iucn.org/what/issues/economics/index.cfm), and now also runs environmental economics programs in several of its country and regional offices around the globe. Biodiversity valuation has long been a focus of these activities, and over recent years there has been a growing focus on working with business and the private sector.
OECD	The Organisation for Economic Co-operation and Development has, since the early 1990s, conducted programs on the economic valuation of natural resource, pollution, biodiversity and ecosystems (www.oecd.org/). Various documents and toolkits have been produced, and several member countries (notably Australia, Austria, Canada, Czech Republic, Finland, France, Hungary, Norway, Switzerland, and the United Kingdom) have conducted national case studies and applications of ecosystem valuation.
TNC	The Nature Conservancy (www.tnc.org) has a number of environmental economists on staff and has, over recent years, piloted some innovative applications of ecosystem valuation to its project sites in the US, Asia and Latin America. A particular focus has been on demonstrating the economic value of ecosystem services, so as to justify increased budgets and innovative financing mechanisms for conservation. A joint TNC initiative on ecosystem valuation, the Natural Capital Project, is mentioned below.
UNEP	The United Nations Environment Programme has been working on ecosystem valuation for some time, initially through its Economics and Trade Branch (www.unep.ch/etb/index.php). UNEP has also recently launched a new "Green Economy Initiative" (www.unep.ch/etb/initiatives/GreenEconomy.php), which will make recommendations and provide policy advice on greening national economies, greening jobs, and on the transition from a brown to a green economy for enterprises and workers.
World Bank	Work on environmental economics and indicators is done by the Policy and Economics Team, including building capacity and piloting projects in environmental valuation. Many of the documents produced pm this topic are available from the World Bank's environmental valuation website (web.worldbank.org/WBSITE/EXTERNAL/TOPICS/ENVIRONMENT/EXTEEI/0,,contentMDK:20998765~menuPK:2770701~pagePK:210058~piPK:210062~theSitePK:408050,00.html).
WWF	The World Wide Fund for Nature formed the Macroeconomics for Sustainable Development Program Office in 1991 (www.panda.org/mpo/), and was the first international conservation organization to devote a program specifically to environmental and economic issues. As of 2004, WWF's Conservation Science Program (www.worldwildlife.org/science/) has joined this program of work, which currently uses ecosystem valuation as one tool to raise awareness of the importance of the environment to human well-being, and as an input for formulating and implementing policies and payments that create incentives for conservation. A joint WWF initiative on ecosystem valuation, the Natural Capital Project, is mentioned below.

Ecosystem valuation in cost-benefit analyses of public policies and programs

Assessing the environmental impacts of economic and development projects – which, as we described in Chapter 2, provided much of the original stimulus for the development of environmental economics – remains a major focus of ecosystem valuation, particularly as it is applied by governments and overseas development agencies. Valuation of ecosystem benefits also helped to determine the choice of technology for flood control in Belgium,[9] for example, and in Denmark was used to justify the use of public and private resources for the restoration of the Skjern River in terms of social and economic benefits.[10] Travel cost techniques were applied to value the success of efforts to mitigate the environmental impacts of agriculture under the US's Conservation Reserve Program, as described in Box 2.

Box 2: Using ecosystem valuation to evaluate the Conservation Reserve Program[11]

The Conservation Reserve Program (CRP) in the United States aims to mitigate the environmental effects of agriculture. A study was carried out to see how non-market valuation models could help in targeting conservation programs such as the CRP. One component of this study focused on the impacts of improved environmental quality on freshwater recreation. This study was based on data generated by surveys that had been carried out to ascertain the value of water-based recreation, fishing, hunting and wildlife. These surveys sampled 1,500 respondents in four sub-State regions who were asked to recall the number of visits made over the last year to wetlands, lakes and rivers where water was an important reason for their trip. The cost of these trips was imputed using the travel cost method. The influence of the CRP on improved environmental quality and on consumer welfare was then modeled. The study found that the combined benefit of all freshwater-based recreation in the US was worth slightly over US$ 37 billion a year. The contribution of CRP efforts to environmental quality, as reflected in recreational travel values, was estimated at just over US$ 35 million, or about US$ 2.57 per hectare.

Ecosystem valuation is also used by governments to assess and shape public policy. Quite sophisticated estimates of the monetary value of air pollution damage have for example been developed by the Norwegian government, and are being used to help determine the country's policy stance on Europe-wide acid rain and on domestic environmental issues.[12] The Swedish National Institute of Economic Research has carried out work to estimate the likely macroeconomic impacts of achieving different levels of reduction in CO_2 emissions.[13] In Canada valuation has been used to show that five industries account for nearly 80% of all of environmental protection expenditures (Mining, Pulp and paper, Primary metals, Petroleum refining, and Energy utilities), allowing policy-makers to identify the industries and communities that would be most affected by new environmental policies, and to design measures to assist them if necessary.

Numerous toolkits, guidelines and procedures have been developed for the use of ecosystem valuation in project and policy appraisal, many of which are listed at the end of this chapter in Figure 4. For example, guidelines for ecosystem valuation in relation to physical projects on infrastructure, water and urban renewal have been drawn up in the Netherlands, and the UK's Department for Environment, Food and Rural Affairs has recently produced an introductory guide to valuing ecosystem services. The National Center for Environmental Economics of the US Environmental Protection Agency, too, has developed detailed guidelines for the monetary valuation of ecosystem costs and benefits, as has the National Oceanic and Atmospheric Administration, US Army Corps of Engineers and US Forest Service.

Ecosystem valuation to assess environmental liabilities and damages

In several countries, most notably the United States and those in Europe, environmental legislation and directives address, and to some extent demand, the use of ecosystem valuation. Thus we can see ecosystem valuation being used in the context of enforcing the provisions for natural resource damage assessment and compensation embodied in laws such as the Comprehensive Environmental Response, Compensation and Liability Act of 1980, the Oil Pollution Act of 1990 and the National Marine Sanctuaries Act of 1996 in the United States, and the EU Environmental Liability Directive of 2004. One application of ecosystem valuation for calculating environmental damage compensation, due from a private sector oil company, is described in Box 3.

Box 3: Valuing the ecosystem impacts of the Arthur Kill oil spill[14]

The Arthur Kill is a waterway located between Staten Island, New York, and the New Jersey coastline near Newark airport. In January 1990, a pipeline rupture beneath the Arthur Kill spilled 567,000 gallons of home heating oil, resulting in the oiling of approximately 125 acres of salt marsh and mudflats, and killing wetland vegetation and the birds, fish, crabs and other organisms living in the marsh. In this case, ecosystem valuation was used by both the US Government National Oceanic and Atmospheric Administration and the company responsible for the spill, in order to evaluate environmental losses and calculate compensation requirements. The company responsible for the spill addressed three types of interrupted or lost services in their valuation exercise: fishing and boating access, near-water recreation, and wetlands services. The parties were able to reach a negotiated settlement based on these estimates, and damages of just over US$ 11 million were awarded.

Monetizing environmental damage costs and losses is very much an evolving practice with evolving regulations. To a large extent both the scientific and the economic assessment techniques to be used in support of the EU Directive are still under development and debate (Member States have three years to transpose it into domestic law). In the US a variety of monetary and non-monetary methods have been developed and used at different times and by different agencies. Early methods mostly used simple approaches that looked at the market value of resource affected by environmental damage (mainly based around the market price of land). Over time, there has been growing demand for procedures to also account

for less tangible and non-marketed environmental values, and this has been accompanied by the use of a wider range of valuation methods (such as contingent valuation). Since the mid-1990s there has been a general shift from calculating the monetary value of damages that could be paid as compensation, to a focus on determining what the environmental loss was and how to restore it through in-kind compensation.

Currently, the procedures for natural resource damage assessment have moved more towards resource compensation and resource-to-resource (or service-to-service) approaches to determining the scale of compensatory restoration. These approaches basically allow the party responsible for environmental damage to substitute "equally valued" resources of the same type, quality and comparable value for the degraded ones (rather than just paying monetary compensation). In line with this shift in focus, resource equivalency analysis and habitat equivalency analysis have gained ground to become common methods for determining the appropriate amount of compensatory restoration needed to make up for the temporary loss of a resource. The objective of habitat equivalency is to find one aspect of a habitat – a metric – that accounts for several different types of lost services. Once established, the metric is used to assess other habitats and to find comparable replacements.

As well as being used to enforce compliance with environmental compensation regulations, ecosystem valuation has come to play a part in the development of the various fees, fines and taxes associated with the use of environmental goods and services, and the pollution or degradation of the natural environment. Although the use of valuation is by no means universal, and is rarely the sole factor, in designing environmental fees and fiscal instruments, it is often used to guide the process based on calculations of the environmental benefits and costs associated with particular products, services or economic activities.

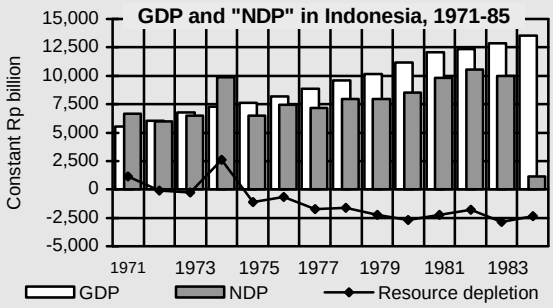
Ecosystem valuation to adjust national income accounts

A third focus of ecosystem valuation, again largely driven by governments, has been to incorporate environmental measures into estimates of gross domestic product (GDP). This is a response to several perceived flaws in the System of National Accounts, as defined by the United Nations and used internationally. One critique is that expenditures on environmental remediation or protection are counted as increases in GDP, even though the expenditure is not economically productive. Also misleading is the fact that some valuable environmental goods remain unmarketed, and are thus not reflected in measures of national income. Still another problem is that national income accounts treat the depreciation of manufactured capital and natural capital differently; the former is depreciated in accordance with conventional business accounting principles, while all consumption of natural capital is accounted for as income. Thus the accounts of a country that uses its ecosystems and natural resources unsustainably will show high income for a few years, but will not reflect the destruction of the productive assets. These techniques, originally developed in the context of reforming national income accounts, have more recently begun to be adapted for application to the corporate sector, as will be described in Chapters 5 and 6 of this document.

By 2003, around 20 countries had made efforts to construct "green" or "environmental" accounts.[15] Norway, for example, has detailed physical environmental accounts, linked to its conventional national income accounts, that show the relationship between economic activities and the depletion of renewable and non-renewable natural resources. Developed by the Dutch, the National Accounting Matrix, including Environmental Accounts, identifies pollutant emissions by economic sector, permitting the government to determine the economic cost of avoiding environmental degradation in the first place, as well as to compare costs and benefits of different measures for environmental protection.[16] Several tropical countries have also experimented with developing national environmental accounts. India, for example, has (under the "Green Accounting for Indian States & Union Territories Project") built a system of environmentally adjusted national income accounts. "Green" national accounting exercises have also been carried out in Botswana, Costa Rica, Ecuador, Indonesia, Mexico, Papua New Guinea, Philippines, Swaziland, Tanzania, Thailand, Uganda, Zimbabwe. The application of environmental accounting techniques in Indonesia is described in Box 4.

Box 4: Constructing environmentally-adjusted national income accounts for Indonesia[17]

One of the earliest green accounting exercises was carried out in Indonesia, and attempted to incorporate changes in the stocks of oil, forests and soil in the country's capital and flow accounts. The three natural resource accounts were aggregated into a single measure of "natural capital domestic investment", which was added to the official GDP as conventionally measured to come up with "NDP". This shows the natural resource-adjusted measure of NDP to be consistently lower than GDP, as it takes resource depletion into account. The two exceptions were for 1971 and 1974, owing to oil discoveries and price changes.



Ecosystem valuation to make the case for ecosystem conservation

Conservation organizations, in particular, have made it a priority to use ecosystem valuation to justify and argue for higher budgets, more land, and more appropriate policies and resource management regimes in support of natural ecosystems. There are now a great many studies, reviews and policy briefs documenting the high economic value of particular species, sites and ecosystem services – and even a very famous effort to calculate the economic value of the whole world's ecosystem services (which came up with a total of US$ 33 trillion a year)[18]. Most recently, the EU project on The Economics of Ecosystems and Biodiversity[19] (described later in this document) estimates that the natural capital lost annually to the world is anywhere between €1.35 X 10^{12} and €3.10 X 10^{12}.

Several guidance documents and toolkits have been produced aiming to equip environmental managers with the economic valuation methods and arguments to advocate for their sector. The focus of these efforts has primarily been directed at the public sector, to enable government conservation planners to target their arguments to central finance ministries and treasuries, and donor development agencies. Recent examples include a "primer" on making the economic case for mainstreaming environment into national development planning that has been produced by the UNDP-UNEP Poverty and Environment Initiative (www.unpei.org/), and The Nature Conservancy's recent guide to valuing nature for Protected Area managers (conserveonline.org/workspaces/patools/documents/valuing-nature).

Some of the more recent initiatives in ecosystem valuation being carried out by conservation NGOs and universities have elaborated further on this theme, moving from general arguments to specific tools for justifying the inclusion of ecosystem values in land and resource planning. A series of quite sophisticated and innovative web-based tools and software models are currently being developed for incorporating ecosystem values into spatial planning and decision-making. Four ongoing projects are described in Box 5 (none of which are yet complete): ARIES, EcoValue, InVEST and MIMES. These are based on valuing the contribution of ecosystem services to human well-being as defined by the MEA: as provisioning, regulating, supporting and cultural services.

Box 5: Recently developed web-based tools and software models for ecosystem valuation

ARIES	(Assessment and Research Infrastructure for Ecosystem Services - ecoinformatics.uvm.edu/projects/aries.html**).** Developed by the Gund Institute for Ecological Economics at the University of Vermont, in collaboration with the Ecoinformatics Collaboratory, Earth Economics, and Conservation International, this web-based tool aims to facilitate rapid ecosystem service assessment and valuation in a given site, so as to make decision-making easier and more effective. Its output is an environmental asset portfolio that describes in depth the spatial distribution of ecosystems and ecosystem services in the selected site, their potential and realized economic values, likely trends for future values, and the causal relationships that link the values to each other and to actual or potential policies. A map and summary statistics of economic value for the area can also be built. ARIES can also be used to search for previously published data for the study site, as well as retrieving data from other comparable locations.
EcoValue	(ecovalue.uvm.edu/evp/default.asp). Based out of the University of Vermont, the project is developing a web-based, interactive decision support system for assessing and reporting the economic value of ecosystem services. This combines peer-reviewed valuation literature, GIS and regional database technology to provide interactive maps, graphs and statistics, The project is currently working in New Zealand and the US, but aims for eventual global coverage.
InVEST	(Integrated Valuation of Ecosystem Services and Tradeoffs - naturalcapitalproject.org.. The Natural Capital Project is a joint venture between The Nature Conservancy (TNC), WorldWide Fund for Nature (WWF) and The Woods Institute for the Environment at Stanford University. The project has developed a software tool, InVEST which models and maps the delivery, distribution, and economic value of ecosystem services and biodiversity across the world. It assists users to visualize the impacts of land-use choices by identifying tradeoffs and compatibilities between environmental, economic, and social benefits.

MIMES	(Multiscale Integrated Models of Ecosystem Services - www.uvm.edu/giee/mimes/valuation.htm). The Gund Institute for Ecological Economics at the University of Vermont developed a suite of dynamic ecological economic computer models that quantifies the effects of varying environmental conditions derived from land-use change. MIMES evaluates land use changes and subsequent effects on ecosystem services on global, regional and local levels. MIMES submodels are organized into five different spheres - Atmosphere, Lithosphere, Hydrosphere, Biosphere and Anthroposphere - that are synthesized and interrelated. MIMES uses input data to develop relationships among the spheres to demonstrate how development, management and land-use decisions will affect natural, human and built capital. MIMES also intends to develop and apply new valuation techniques for ecosystem services that can be integrated with the models.

Disseminating information on ecosystem values and valuation techniques

Almost all of the organizations and initiatives described in this chapter have made efforts to disseminate tools, techniques, procedures and lessons learned. There is now a great deal of data available on ecosystem valuation methods and applications, via reports, papers, books, manuals and guidelines, which are listed in Figure 4. Many of these are available online, including via a number of websites dedicated specifically to providing ecosystem valuation databases (Figure 5).

One recent initiative, which is currently ongoing, aims specifically to provide guidance on economic valuation tools that can be used to assess and manage the risks of ecosystem loss in business sectors (among others: it also targets policy-makers, administrators, consumers and citizens). The Economics of Ecosystems and Biodiversity is being run under the auspices of the German Federal Ministry for the Environment and the European Commission, and has already produced a series of documents and calls for case studies (ec.europa.eu/environment/nature/biodiversity/economics/index_en.htm). The first phase of operation, recently completed, assessed current knowledge on the value of biodiversity and ecosystem services. The second phase (running through 2009 and 2010) is structured around producing reports targeted towards specific groups of potential users of evaluation tools – including the private sector. The aim is to articulate a compelling vision of economic and market transformation, together with a practical framework to help business managers and financiers make the transition to ecologically sustainable development.

Figure 4: Ecosystem valuation guidelines

	Publisher	Date	Coverage
Guidelines for biodiversity valuation			
An Exploration of Tools and Methodologies for Valuation of Biodiversity and Biodiversity Resources and Functions	Convention on Biological Diversity	2007	Global
Making Economic Valuation Work for Biodiversity Conservation	Department of Environment and Heritage, Land & Water Australia	2005	Australia
Handbook of Biodiversity Valuation: A Guide for Policy Makers	Organisation for Economic Co-operation & Development (OECD)	2002	OECD countries
Valuation of Biodiversity	Organisation for Economic Co-operation & Development (OECD)	2001	OECD countries
The Valuation of Biological Diversity for National Biodiversity Action Plans and Strategies: A Guide for Trainers	United Nations Environment Programme (UNEP)	2000	Global
Economic Valuation of Biological Diversity	Convention on Biological Diversity	1996	Global
The Economic Value of Biodiversity	International Union for Conservation of Nature (IUCN)	1994	Global
Economic Value of Ecosystems: 3 - Biological Diversity	International Institute for Environment & Development (IIED)	1991	Global
Guidelines for ecosystem services & environmental valuation			
An introductory guide to valuing ecosystem services	UK Department for Environment, Food & Rural Affairs (DEFRA)	2007	United Kingdom
Valuation for Environmental Policy: Ecological Benefits	US Environmental Protection Agency	2007	United States
The Economic, Social and Ecological Value of Ecosystem Services	UK Department for Environment, Food & Rural Affairs (DEFRA)	2005	United Kingdom
Estimating the Cost of Environmental Degradation: A Training Manual in English, French and Arabic	World Bank	2005	Global
Valuing Ecosystem Benefits: Readings and Case Studies on the Value of Conservation	World Bank, International Union for Conservation of Nature (IUCN), and The Nature Conservancy (TNC)	2005	Global

Figure 4: Ecosystem valuation guidelines

	Publisher	Date	Coverage
How Much is an Ecosystem Worth ? Assessing the Economic Value of Conservation	International Union for Conservation of Nature (IUCN), The Nature Conservancy (TNC) and the World Bank	2004	Global
Assessing the Economic Value of Ecosystem Conservation	World Bank and International Union for Conservation of Nature (IUCN)	2004	Global
Environmental Valuation A Worldwide Compendium of Case Studies	United Nations Environment Programme (UNEP)	2000	Global
Environment and Economics in Project Preparation	Asian Development Bank	1999	Asia
Economic Analysis and Environmental Assessment Sourcebook Update No. 23, 1998	World Bank	1998	Global
A Review of Economic Appraisal of Environmental Goods and Services: With a Focus on Developing Countries	International Institute for Environment & Development (IIED)	1996	Developing Countries
Monetary Measurement of Environmental Goods and Services: Framework and Summary of Techniques for Corps Planners	US Army Corps of Engineers	1996	United States
Review of Monetary and Non-Monetary Valuation of Environmental Investments	US Army Corps of Engineers	1995	United States
Economic Values & the Environment	United Nations Environment Programme (UNEP)	1994	Global
The Measurement of Environmental and Resource Values: Theory & Methods.	Resources for the Future (RFF)	1993	Global
Economic Valuation and the Natural World	World Bank	1992	Global
Policy Appraisal and the Environment	UK Department of the Environment	1991	United Kingdom
Values for the Environment	UK Overseas Development Administration (ODA)	1991	Global
Economic Analysis of the Environmental Impacts of Development projects	Asian Development Bank	1986	Asia
Guidelines for Preparing Economic Analyses	US Environmental Protection Agency	2000/2008	United States
Guidelines for forest valuation			
Using Economic Valuation to Promote Forest Biodiversity Conservation: A Toolkit	International Union for Conservation of Nature (IUCN)	2004	Eastern and Southern Africa
Valuing Forests: A Review of Methods and Applications in Developing Countries	International Institute for Environment and Development (International Institute for Environment & Development (IIED))	2003	Developing countries
Herramientas para la valoración y manejo forestal sostenible de los bosques sudamericanos	International Union for Conservation of Nature (IUCN)	2003	South America
Economic Valuation of Forests and Nature: A support tool for effective decision-making	Wageningen University	2002	Global
The Value of Forest Ecosystems	Convention on Biological Diversity	2001	Global
Forest Valuation for Decision Making	Food & Agriculture Organization of the United Nations (FAO)	1997	Global
Valuing the Hidden Harvest: Methodological approaches for local-level economic analysis of wild resources	International Institute for Environment & Development (IIED)	1997	Developing countries
Economic Value of Ecosystems: 2 - Tropical Forests	International Institute for Environment & Development (IIED)	1991	Global
Guidelines for marine & coastal valuation			
Valuing the Environment in Small Islands	UK Overseas Territories Environment Programme (OTEP) and the UK Joint Nature Conservation Committee (JNCC)	2007	Global
Economic Valuation of Natural Resources: A Guidebook for Coastal Resources Policymakers	National Oceanic and Atmospheric Administration (NOAA)	1995	United States
Economic Value of Ecosystems: 4 - Coral Reefs	International Institute for Environment & Development (IIED)	1992	Global
Guidelines for Protected Areas valuation			
Valuing Nature: Assessing Protected Area Benefits	The Nature Conservancy (TNC) and Convention on Biological Diversity	2008	Global
The Use off Economic Valuation for Protected Area Management: A Review of Experiences and Lessons Learned	International Union for Conservation of Nature (IUCN)	2001	Global

Figure 4: Ecosystem valuation guidelines

	Publisher	Date	Coverage
Economic Values of Protected Areas: Guidelines for Protected Area Managers	International Union for Conservation of Nature (IUCN)	1998	Global
Guidelines for watershed & wetland valuation			
Watershed Valuation as a Tool for Biodiversity Conservation	The Nature Conservancy (TNC)	2007	Latin America
Valuing wetlands: Guidance for valuing the benefits derived from wetland ecosystem services	Ramsar Convention and Convention on Biological Diversity	2006	Global
Tools for Wetland Valuation	International Union for Conservation of Nature (IUCN)	2005	Southern Africa
Value: Counting Ecosystems as an Economic Part of Water Infrastructure	International Union for Conservation of Nature (IUCN)	2004	Global
Economic Value of Ecosystems: 1 - Tropical Wetlands	International Institute for Environment & Development (IIED)	1989	Global

Figure 5: Online databases of ecosystem valuation references

Database	Publisher	Web
Biodiversity valuation library	International Union for Conservation of Nature (IUCN) & World Wide Fund for Nature (WWF)	biodiversityeconomics.org/valuation
Coastal environmental economics extension network	National Oceanic and Atmospheric Administration (NOAA) & Sea Grant	www.mdsg.umd.edu/programs/extension/valuation/
Conservation value map	Conservation International (CI)	www.consvalmap.org/
Ecosystem Valuation	Dennis M. King & Marisa Mazzotta	www.ecosystemvaluation.org/
Envalue	New South Wales Department of Environment and Climate Change	www.environment.nsw.gov.au/envalue/
Environmental valuation and cost benefit website	The Cost-Benefit Group	www.costbenefitanalysis.org/ envirovaluation.org/
Environmental Valuation Reference Inventory	Environment Canada	www.evri.ca/
Environmental Valuation Source List for the UK	UK Department of Environment, Food and Rural Affairs	www.defra.gov.uk/environment/economics/evslist/
Nature Valuation and Financing Casebase	Nature Valuation and Financing Network	www.eyes4earth.org/casebase/
New Zealand Non Market Valuation Database	Lincoln University	learn.lincoln.ac.nz/markval/
ValueBase[SWE]	Beijier Institute	www.beijer.kva.se/valuebase.htm

4. Taking stock: the business applicability of mainstream ecosystem valuation

Chapters 2 and 3 have shown us that there is now a substantial community of practice with 2 decades or more experience in the use of economic valuation techniques specifically for ecosystem management, and something approaching 50 years' track-record in the broader application of valuation to environmental issues. We have termed this the "mainstream approach": ecosystem valuation as conventionally applied by public sector, multilateral and non-governmental agencies, research institutes and academia, primarily with the aim of securing social benefits and furthering public interest goals. Box 6 summarizes the key characteristics of how, by whom, and to what ends ecosystem valuation has most commonly been applied to date.

Box 6: Characteristics of the "mainstream" approach to ecosystem valuation

Main practitioners:	public sector, multilateral and non-governmental agencies, research institutes and academia (see Chapter 3).
Main focus:	articulating the value of non-market ecosystem services for public or social decision-making purposes, in order to better secure social benefits and further public interest goals (see Chapter 3).
Primary framework:	Total Economic Value, with an increasing focus on incorporating human well-being indicators as laid out in the Millennium Ecosystem Assessment (see Chapter 2).
Widely-used methods:	revealed preference, cost-based and stated preference approaches (see Chapter 2).
Common applications:	project, program and policy appraisal; environmental liability and damage assessment; design of financial and economic instruments; calculation of adjusted national income accounts; making the case for conservation; integrated land and resource planning; awareness and information dissemination (see Chapter 3).

Having reviewed these current initiatives and trends, it is now time to take a brief step back, and refocus on the second question that this document aims to answer: how far are these experiences and techniques relevant for business?

The short answer is that ecosystem valuation, as it has been applied to date, would seem to be only of very limited relevance to the corporate sector (this point is elaborated more fully in Chapter 7). This is not because the "mainstream" approach to ecosystem valuation in any way lacks credibility or rigor, either conceptually or in terms of the ways it is practiced, but is essentially to do with the conceptual basis, and mandates, upon which it was founded and has subsequently evolved. Although some of the techniques that have been developed to value ecosystems (and are described in Chapter 2) could, in principle, be useful and applied by business and towards business goals (as outlined in Box 7) – and many are already in common usage in relation to non-ecosystem values - there is as yet very little body of experience to guide these applications.

Box 7: Business applications of commonly-used ecosystem valuation tools

revealed preference approaches:	*market prices* have obvious applicability, as they provide a means of gauging the sales and purchase value of ecosystem services, either as inputs to production or as potential sources of income and earnings. These methods already provide the primary measures for valuation as it is applied by businesses. *effect on production* also has clear relevance for business applications, for example to measure the likely impact on company output and profits that would arise from a change in the quantity or quality of ecosystem services. As with market prices, it is a techniques that is already used widely by business. *travel costs* potentially provide useful techniques for calculating the opportunity to introduce fees or charges for the use of company-owned ecosystem assets for recreational or amenity purposes. *hedonic pricing* offers a tool by which to assess the potential impacts of making investments in ecosystem improvement, with a view to adding price premiums to products. In many instances these types of techniques are already used by companies in order to provide information for pricing decisions.
cost-based approaches:	*replacement costs, mitigative or avertive expenditures and damage costs avoided* are all of great potential relevance to business, as they provide the means of assessing the likely cost increases or expenditure requirements for companies that would arise from ecosystem degradation. A key point however revolves around the question of whether these method describe real investment options for companies, rather than merely hypothetical scenarios of potential courses of action which in reality the company would not be likely to implement. These techniques are primarily of relevance in the first instance.
stated preference approaches:	*contingent valuation, conjoint analysis and choice experiments* are all valuation tools which are based on those already used by the private sector for product and marketing research and development. Their use in the context of ecosystem services is wide-ranging, especially for identifying and assessing the potential for new markets, products or pricing structures, in relation to real consumer demand and preferences.

The progress that has been made in ecosystem valuation in response to the changing demands and issues facing public decision-makers should not however be underestimated. The discipline has certainly come a long way towards being integrated into mainstream thinking, among research economists as well as economic and environmental planners. These successes and advances, as well as the focus of ecosystem valuation itself, however, remain largely confined to public sector decision-makes and to organizations concerned with sustainable development and nature conservation towards the greater public good. As yet, there has however been little active involvement of the corporate sector, and few attempts to align with business goals.

Two recurrent themes as regards business applicability therefore emerge from the review of the current state of play in ecosystem valuation.

First, the overriding rationale behind, and focus of, most of the tools, initiatives and applications that are currently in use is on better identifying non-market ecosystem values in order to secure public benefits and economy-wide gains. Business, in contrast, does not operate with the sole aim of maximizing social goals and public benefits – aside from corporate social and environmental responsibility initiatives, which converge more with the interests of mainstream ecosystem valuation.

Second, where market, pricing and business elements have been incorporated into valuation initiatives, the private sector is treated more as a passive player than as a client, user or active participant. Ecosystem valuation is used as a tool to determine companies' liabilities and compensation requirements, to set the charges and taxes that are levied on them, or to try and convince them to improve their environmental track record. The focus is on furthering public, not business, interests.

One of the most interesting findings of this review is that although they have been largely sidelined by mainstream ecosystem valuation, businesses themselves have taken the initiative to develop and use valuation tools that can help them better respond to ecosystem dependencies and impacts. These approaches and applications, and their drivers and end uses, however, have very little in common with what we term "mainstream" ecosystem valuation. The next Chapter reviews ecosystem valuation tools that have been developed by or for business, and goes on to present examples of how they have actually been applied to key issues, needs and decisions facing the corporate sector.

5. Ecosystem valuation for business: Some recent developments in an emerging field

Despite the relatively long history of ecosystem valuation, it is only very recently that we have seen a suite of tools emerging that have been designed within the realms of the private sector, or that have business interests as their specific focus. So far, these remain very limited in number – the review identified only six current tools and initiatives that could strictly be defined as ecosystem valuation tools developed by or for business. These are clustered around four areas of practice: corporate environmental accounting, environmental and financial performance assessment, company valuation and share valuation and risk management.

Corporate Environmental Accounting and the Biodiversity Accountability Framework

With a very similar rationale to the "green" national accounting initiatives described in Chapter 3, interest in corporate environmental accounting stems from the fact that conventional accounting practices, developed to service financial reporting requirements, rarely illuminate environmental costs or stimulate better environmental performance[20]. Here, it is important to distinguish between mandatory and voluntary environmental reporting, between public disclosure requirements and management accounting for internal purposes. Work on corporate environmental accounting has focused primarily on the latter: on identifying, collecting and analyzing information on environmental costs principally to strengthen internal management decision-making, identify areas of cost-saving, and improve "eco-efficiency".

As in so many other aspects of environmental valuation, the United States government was an early initiator of corporate environmental accounting. In 1992, the Environmental Protection Agency partnered with the Tellus Institute (a not-for-profit research and policy organization) to initiate an environmental accounting project for business (www.emawebsite.org), in collaboration with the Institute for Management Accountants, the American Institute for Certified Public Accountants, the US Chamber of Commerce, the Business Roundtable, and the American Association of Cost Engineers. Their focus was on modifying managerial accounting and capital budgeting processes to account for environmental costs, with the intention that closer tracking of these costs would enable businesses to identify opportunities to reduce or eliminate environmental costs, improve environmental performance, gain a comparative advantage, and achieve cost savings or increased revenues. Detailed benchmarking and case studies were carried out with 24 companies, including those in the telecommunications,[21] electricity,[22] window manufacturing,[23] chemical and oil,[24] hydropower[25] and health[26] sectors.

Further work on corporate environmental accounting in the United States, partially funded by the Environmental Protection Agency, was carried out in the mid-1990s by the World Resources Institute (www.wri.org/publication/green-ledgers-case-studies-corporate-environmental-accounting). This project resulted in a publication that gives practical steps in corporate accounting[27], illustrated by case studies of nine companies[28]. Some interesting findings came out of this review. Managers at Heath Tecna, a composite materials manufacturer, found that by changing their production processes they could improve profitability and reduce environmental risk by making materials use more efficient, reducing hazardous waste generation, and minimizing costs. At Cascade Cabinet, a decision to switch from nitrocellulose lacquer – a hazardous material and source of air pollution – to a more benign varnish also cut manufacturing costs significantly. A better understanding of environmental costs was also shown to affect pricing decisions: when Dow Chemical faced a stark choice between shutting down a product line or investing in cleaner technology, its industrial customers accepted slightly higher prices in return for a guaranteed supply of the product.

A third and more recent corporate environmental accounting initiative is being led by the Environmental Protection Authority of Victoria, in conjunction with the Department of the Environment and Heritage and the Institute of Chartered Accountants in Australia. The Environmental Management Accounting Project (www.epa.vic.gov.au/bus/accounting/default.asp) focuses on providing information for decision-making within businesses, with the aim of improving business profitability while achieving better environmental outcomes. Four companies have been working with the project to pilot environmental accounting procedures[29].

Others have followed these leads. In 2004 the United Nations Conference on Trade and Development (UNCTAD) issued guidelines on corporate environmental accounting (so far adopted by Ciba Speciality Chemicals). The Biodiversity Accountability Framework, part of the European Commission-supported

Business and Biodiversity Initiative, has been under development since 2005. The two institutions mainly responsible for this framework are the Institut Français de la Biodiversité and Orée – Entreprises, Territoires et Environnement. The framework (www.oree.org/en/integratingbiodiv.html) provides an interdisciplinary accounting system structured to revisit both corporate and national accounting systems as well as the performance and development indicators that rely on them.

Environmental and financial performance assessment: TruCost

In 2005, PricewaterhouseCoopers published a document reporting on a study to examine how, and to what extent, mainstream financial analysts consider social, ethical or environmental information important to their work[30]. They concluded that, despite the increased prominence in the use of this information by a variety of stakeholders, mainstream financial analysts often remain skeptical about the incorporation of environmental information into their financial valuations. This remains the case even though the "hard data" provided by businesses is important in substantiating their social, ethical or environmental value, and that by integrating financial and extra-financial information companies would ultimately be serving their own best interests.

One response to this kind of demand has been recent work carried out by Trucost plc, a UK-based environmental research organization (www.trucost.com), has recently developed a set of tools to assist companies and investors to understand the environmental impacts of business activities. Environmental valuation, via an external cost methodology, is used by Trucost as a tool to present financial information on companies' environmental impacts. Assessments of the environmental damage costs resulting from an organization's direct and indirect emission of pollutants or extraction of raw materials are made using conventional economic tools such as marginal damage costs, abatement costs, environmental taxes and productive losses. These calculations look at gross costs: they do not subtract any efforts at remediation or mitigation by the company. In addition to carrying out environmental cost calculations on companies, Trucost is currently developing a pilot framework to measure the links between corporate sustainable development performance, financial performance and the bottom line.

The information generated by these tools is used to produce a series of benchmarks and statements on corporate performance and impacts. These target both internal management decision-making and external disclosure. Products geared at businesses include environmental registers, analysis of corporate footprints, and analysis of supply chain footprints. For fund managers and analysts, Trucost produces environmental benchmarking and reporting on over 4,500 companies worldwide, including complete coverage of the FTSE All-Share, S&P 500, Nikkei 225, DJ STOXX and MSCI indices.

Company valuation and share valuation: The sdEffect™

Various analytical approaches have been used to try and relate corporate environmental and financial performance, but until recently these have focused mainly on non-monetary indicators. Recently there has been growing interest in looking at company and share value, including via approaches that construct environmental rating systems based on correlation of environmental performance and management indicators to returns to stocks, and the use of "event studies" to show that new information regarding environmental performance or liability affects a company's stock price[31].

One approach that is explicitly targeted at assessing up with these financial indicators is the sdEffect™ (www.sdeffect.com/), an innovative new analytical framework developed by three Canadian consulting firms serving the corporate sector: Yachnin & Associates (a management consulting group), Sustainable Invesment Group (a consulting firm specializing in finance and sustainable development) and Corporate Knights Inc (a media and publishing company). The framework can be used to demonstrate how corporate sustainable development practices can be translated into financial valuation measures to help isolate effects on share price appreciation and company valuations. The primary audience for the sdEffect™ tool is corporations and the executives within these organizations that deal with investment decisions (and need to communicate the financial value implications of their sustainable development practices), and commercial and investment bankers and retail and institutional investors (who may require data on the additive value of corporate sustainable development).

The innovative aspect of the tool lies in it expressing the effects of corporate sustainable development via commonly accepted and widely used corporate and investment valuation techniques. To these ends, the framework applies five standard financial valuation methods to sustainable development metrics – Ratio Analysis, Discounted Cash Flow, Rules of Thumb Valuation, Economic Value Added and Option Pricing, to

demonstrate how business aspects traditionally viewed as “soft” by analysts can be translated into hard company and share valuations.

Among the users of the tool are five Canadian-based mining companies – Alcan, INCO, Noranda/ Falconbridge, Placer Dome and Teck Cominco. Some interesting findings, on both social and environmental aspects of corporate sustainable development practice, come out of these applications. Noranda/Falconbridge energy savings and greenhouse gas emissions increases per share value by CAN$ 1.62 to CAN$ 2.44 – equivalent to an improvement in nickel prices of US$ 0.19/lb or an improvement in copper prices of US$ 0.05/lb. For INCO, waste diversion saves the company CAN$ 2.4 million per year, which is equivalent to just over 1 cent per share. These savings are worth CAN$ 31 million in total shareholder value (using discounted cash flow valuation), or between CAN$ 0.06-0.16 per share in total value (using price to cash flow per share ratio).

Risk management: The Ecosystem Services Benchmark and ENVEST

Risk management in relation to environmental conditions has emerged as a key issue facing the corporate sector. A number of initiatives have developed that provide tools with which to assess the potential impact of environmental pressures and liabilities on shareholder value and investors’ risk, in financial frameworks consistent with those used for other business decision-making processes.

The Ecosystem Services Benchmark has been developed as part of the Natural Value Project (www.naturalvalueinitiative.org), a collaborative initiative involving Fauna & Flora International (FFI), UNEP’s Finance Initiative, and the Brazilian business school FGV. It focuses specifically on the food, beverages and tobacco industries. The benchmark evaluates the extent to which companies have systems in place that adequately identify and control the material business risks associated with their dependencies on ecosystem services. Ecosystem valuation comes in as a means of quantifying the relationship between ecosystem services and business, in relation to the ways in which corporate impacts and dependency on ecosystem services generate business risk. The tool is still currently under development, but is in the process of being tested by thirty-one companies in which the initiative’s six collaborating investors[32] hold investments.

The World Resources Institute’s program on Environmental Intelligence for Tomorrow’s Markets (ENVEST – www.wri.org/project/envest) is similarly looking at the financial implications of environmental opportunities and risks. It has a particular focus on the investment community, and is being carried out in partnership with Generation Investment Management LLP, Goldman Sachs Center for Environmental Markets and JPMorgan. The rationale for the program is that environmental considerations are not incorporated into the overall frameworks for financial analysis that are used by most actors in the capital markets. As such, investors do not posses sufficient information to assess how environmental factors may impact companies’ risk/return tradeoffs. The program involves collaboration with the investment community to quantify and value the financial implications of environmental risks and opportunities, as well as calling for greater disclosure of environmental risks and data by companies and regulators.

6. Ten cases studies of how ecosystem valuation has been applied by business

This chapter summarizes ten case studies of how companies have used ecosystem valuation to inform business decision-making. The case studies cross cut different business sectors (including timber, pulp and paper in cases 1 and 3; minerals, oil and gas in cases 2, 8 and 10; energy in cases 6, 7 and 9; beverages in case 4; and chemicals in case 5), and include examples taken from countries with varying economic and development conditions (including Brazil, Canada, Ecuador and the US).

The common factor between the different case studies is their triple bottom-line motivation: while there is an element to public environmental interest, all however attempt to generate decision-support information that has a strong focus on corporate financial goals and the financial bottom-line. In other words, they are driven by a wish to identify ways of managing business risks and capturing business opportunities in ways that at the least do no harm to ecosystems, and in most cases optimize conservation goals. Their basic aim is to quantify company ecosystem dependencies and impacts in monetary terms, and to factor this information into company financial and investment planning, and management reporting.

Together the case studies cover the four areas of practice outlined in Chapter 5 (corporate environmental accounting, environmental and financial performance assessment, company valuation and share valuation, and risk management). They can be grouped around six main issues relating to managing business risks and capturing business opportunities: identifying new investments, markets, prices and products (cases 1 and 2); managing risk (cases 3 and 4); highlighting opportunities for saving costs, reducing taxes and sustaining revenues (cases 5, 6 and 7); assessing environmental liability and compliance (case 8); articulating environmental performance and costing environmental impacts (case 9); and reassessing company and share value (case 10).

One of the most striking conclusions from the case studies is that almost all use a mix of conventional ecosystem valuation techniques tools (as referred to in Chapter 2), ecosystem valuation tools developed for and by business (as described in Chapter 5), and the traditional corporate financial analysis tools that have long been used for business planning and reporting outside the environmental sector. We therefore see a wide range of techniques, tools and models being “borrowed” from these different approaches and then applied to ecosystem valuation, including market prices, eco-assets, financial analysis, cost-effectiveness analysis, environmental cost accounting, damage costs avoided, contingent valuation, discounted cash flow, price to cash flow per share ratio, and option pricing valuation. In many ways the case studies are thus defined by their lack of adherence to a single valuation model, or set of valuation techniques: they mix and match available methods as suits their particular purpose and the particular context in which they are being carried out.

Case 1: Assessing the potential to charge for the use of corporate eco-assets (Potlatch)

Valuation methods:	Market valuation of fee and income potential
Business motivation:	To reimburse land management costs and turn a profit for shareholders
Outcome:	Implementation of a fee-to-access program for recreational users of company lands
Case study source:	Northwest Natural Resources Group LLC. 2007. An Assessment of Need for the Idaho Forest Legacy Program in Idaho. Report prepared for the Office of the Governor and the Idaho Department of Lands; Associated Press. 2007. Potlatch to charge ATV riders to use land; Spokane Spokesman Review. 2007. Potlatch to charge recreation fee.

The shifting economics of the forest products industry have created unprecedented changes in timberland ownership. In the past, what are generally referred to as industrial timber lands were owned by fully integrated companies that owned land, timber and mills and depended on their land base to provide material for the mills. Many of these traditional fully integrated timber companies have now reorganized or sold into Timber Investment Management Organizations (TIMOs) and Real Estate Investment Trusts (REITs). Many of these company real estate divisions have designated “highest and best use” lands that are being sold on the open market, and are working to develop new revenues from non-forestry uses of the lands that they choose to keep.

Potlatch Corporation is one such example. The company produces and sells timber, and manufactures wood products such as fiber, lumber and panels. It also conducts real estate sales and development business through its REIT subsidiary, owning approximately 1.6 million acres of forestland in Arkansas, Idaho, Minnesota and Wisconsin.

In Idaho, for example, Potlatch is the largest private landowner in the State. Potlatch studied the potential of introducing user fees for recreational users. Valuation of income earning opportunities shower strong potential, so the company initiated a series of charges and began capturing fees in 2007. In addition to maximizing gains from these forest lands, the company states that the motivation for opening this new the fee-to-access market includes ensuring that the land stays open to the public, reimbursing Potlatch for costs associated with vandalism from public use and illegal dumping, as well as being set up to turn a profit for Potlatch's shareholders.

Commencing 1 April 2007, the company started charging for recreational access to more than 600,000 acres of company-owned

Case 1: Assessing the potential to charge for the use of corporate eco-assets (Potlatch)

timberland, including thousands of miles of trails and roads used by hikers, birdwatchers, hunters, anglers and trail riders. Users now have to buy an annual pass, priced according to the type of use and ranging from US$ 100 for a motor home, US$ 50 for trucks, cars, camp trailers and SUVs, to US$ 25 for a motorcycle or ATV, to US$ 25 for horse riders and US$ 10 per person for walkers or cyclists.

These moves in Idaho mimic initiatives already undertaken by Potlatch in their forest lands in other parts of the country. Recreation fees already generate more than US$ 1 million annually for Potlatch from company lands in Minnesota and Arkansas. The firm also leases its hybrid poplar farm in Eastern Oregon to private groups who use it for whitetail deer hunts.

Case 2: Assessing the potential to generate new revenues from reclaimed mine lands (TXU Energy)

Valuation methods:	Eco-asset model
Business motivation:	To earn revenue from reclaimed mine lands
Outcome:	Identification of eco-assets that could generate income via mitigation credits that would be equal or greater to alternative uses or sale values
Case study source:	Hester, G., Smith, S. and C. Ivy. Undated. Applications of an Eco-Asset Model at the TXU Monticello Mine. Electric Power Research Institute, Palo Alto, CA

TXU Energy provides electricity and related services to more than 2 million customers in Texas. The company operates three surface coalmines in East Texas and mines approximately 1,800 acres each year.

In addition to their ecological and societal values, natural ecosystems may have monetary or “credit” value. Yet these values are seldom maximized in land reclamation efforts. In the United States, State and Federal regulations mandate that permitted impacts to wetlands, streams, threatened and endangered species plus other ecological assets be compensated for through mitigation. Likewise, impacts to threatened or endangered species and nutrient loads in streams and lakes may require mitigation in the form of credits that can carry a high value, depending on the type of ecological asset and local or regional markets for mitigation credits.

TXU Energy has long been a leader in the reclamation of Title V mine lands, having reclaimed nearly 50,000 acres since it began surface mining in 1971 (about half of which has been returned to forest). The company recently decided to explore new opportunities to develop multiple ecological assets on current mine sites and previously reclaimed sites. To accomplish this, TXU worked with the Electric Power Research Institute's (EPRI) Eco-Solutions Program to identify existing and potential ecological assets. EPRI's STREAM (Strategic Eco-Asset Manager) model was used to identify the most financially promising opportunities.

Forest, streams, and wetlands were identified as eco-assets that could potentially be developed on this land. The STREAM analysis demonstrated that these have the potential to provide value to TXU equaling or exceeding that of reclamation of the properties for pasture or of post-reclamation sale of the properties. Planning reclamation with eco-asset development in mind and dividing properties into parts best suited to development of different eco-assets were identified as two strategies for maximizing potential value. Use of the STREAM model provided a means of taking a business-oriented approach to eco-asset development.

Analysis was carried out on two parcels of land that TXU had surface mined. This analysis consisted of two stages. The first was to identify and characterize the potential ecological assets on the two sites. This was done by performing an initial assessment through on-site examination combined with application of knowledge regarding regional conditions such as soil types, meteorology, natural plant communities and ecosystems, etc. The second activity was to perform a financial analysis of the options available to the company for developing eco-assets on the two sites. This required gathering data on the costs of developing the eco-assets on the sites, the quantities of these eco-assets that could be developed, and the revenues that TXU could obtain for these assets in the future. Similar data were also gathered regarding the continued use of reclaimed lands as pastureland that appears to be the primary alternative to developing eco-assets. The STREAM model was then used to analyze the potential uses of the two sites in terms of the net present value of the streams of costs and revenues to TXU over a 30-year period. This analysis will enable the company to evaluate the potential uses of these sites in a way that is comparable to the approaches widely used by businesses to evaluate investments in productive assets.

The first site encompasses 1,294 acres that had been reclaimed and converted to pastureland after mining. The primary existing condition on the site was 1,114 acres of upland pasture, 8.6 acres of forested wetlands, 62.8 acres of non-forested wetlands, 2.7 acres of streams and 105.9 acres of open water. The site had significant potential for the development of ecosystems, including planting hardwood or pine forests on 1,100 acres of uplands and expansion of wetland areas by 15-20 percent. In addition, remeandering of the stream on the site could increase its length by several thousand feet, expanding wildlife habitat. The second site had been more recently mined and was not reclaimed; the primary surface was mining spoil. In addition, the site was relatively dry compared to the first site. Nonetheless, the analysis identified potential for 60 acres of upland, 3 acres of open water, 6 acres of wetlands and 1 acres of stream. Note that the second site was much smaller at 70 acres total.

The company and EPRI worked with the US Army Corps of Engineers (which manages wetland mitigation in the US) to assess the market for mitigation credits. Happily, the local market was robust and the district in which the credits were fungible was relatively large. Mining companies and the Texas Department of Transportation created demand in the market. Wetland mitigation credits were valued between US$ 3,000 and US$ 5,000 per acre, while stream mitigation credits were worth US$ 100-200 per linear foot. In addition, carbon sequestration potential was estimated at 117 tons plus forest products revenue of US$ 3,817 in year 30.

This information was then input into EPRI's STREAM model to calculate the net present value of different site management choices under different assumptions. The analysis suggested that the lowland area on both sites would be optimally converted to stream and wetland mitigation credits. The NPV of this management option was calculated at US$ 1,413 per acre on the first site and US$ 14,263 on the second. Notably, the second site was more valuable for mitigation because its baseline condition (unreclaimed), was lower. Upland areas created the highest value if they were planted for carbon sequestration and limited wood product harvest. The value of carbon sequestration credits was estimated at US$ 375 to US$ 400 per acre for both sites.

Case 3: Integrating future environmental risks into financial and investment measures (US pulp and paper industry)

Valuation methods:	Financial analysis
Business motivation:	To improve the ability of investors to make sound choices
Outcome:	Identified the financial implications of future environmental risks to companies
Case study source:	Repetto, R. and D. Austin. 2000. Pure Profit: the Financial Implications of Environmental Performance. World Resources Institute, Washington DC.

Environmental issues generate business risks that have to be carefully managed. Regulations aimed at protecting human health and the environment constantly evolve and often create uncertainties for firms, with significant implications for their financial performance. At the same time, rich rewards are increasingly available to companies able to transform environmental concern into market opportunity or competitive advantage. Some companies have recognized new demands for "green" products and established new market niches. Some companies find their reputations are enhanced and their earnings increased by adopting cleaner production techniques or facilities. Companies have even made a changing regulatory framework into a source of competitive advantage by pre-empting environmental regulations and voluntarily going beyond compliance on their own terms, knowing that rivals will likely be compelled to react later. In many different ways, the environment is directly affecting the bottom line, often with very different consequences for companies even within the same sector. All these risks and opportunities carry directly over into the capital markets.

Given these trends, investors knowledgeable enough to discern good environmental performers from bad should see a better return on their portfolio. There is, however, a problem for investors who seek to respond to environmental issues. Even as capital markets come to recognize the importance of environmental matters for financial performance, environmental issues remain outside the mainstream of financial analysis and valuation that provide the foundations for investment decisions and corporate strategy. For the most part, fundamental tools of financial analysis and investment decision-making are not being applied to environmental issues, impeding the ability of investors to make sound choices when the environment poses financial risk or opportunity. In particular, no approach has adequately translated environmental risks into the dollars-and-cents terms with which investors and businesses are used to working.

For the pulp and paper industry, environmental developments will significantly affect future materials and energy costs, earnings and balance sheets. This is partly because the industry depends on forest harvests and recycled paper for its raw materials, and thus the stock of forests is essential to its future production. Also, it is one of the most energy-intensive of all industries, emits a wide range of toxic and conventional pollutants to air, water and land, and is one of the largest contributors to the solid waste stream. For these reasons, the pulp and paper industry is identified in the public mind with pollution and resource degradation, is subject to an enormous range of environmental and natural resource regulation and litigation, and must therefore allocate significant portions of investment and operating outlays to environmental control programs. To an extent equaled in few others sectors, the environment can significantly affect the financial results of companies in the pulp and paper industry.

Applying a methodology derived from fundamental principles of financial analysis to 13 companies in the US pulp and paper industry shows how environmental issues can successfully be integrated into financial analysis. This provides information that investors and analysts could use to evaluate how uncertainties associated with future environmental issues can be translated into financial terms and integrated into established decision-making frameworks. The methodology deals explicitly with uncertainties regarding future environmental policies and other environmental pressures on the firm, rather than merely assessing past and present levels of environmental performance. It uses standard techniques of financial analysis to derive measures of expected environmental impacts on share values and financial measures of environmental risk.

The results from the US pulp and paper industry demonstrate very clearly that companies within this industry face environmental risks that are of material significance and that vary widely in magnitude from firm to firm. These risks are not evident in companies' financial statements nor are they likely to be incorporated in current market valuations. The analysis also overturns the commonly-held assumption by companies that regulations will affect other firms in the industry equally. The results in this paper demonstrate that such statements are erroneous and potentially misleading. The same environmental standards are likely to have quite different impacts across companies in the industry.

One important finding is that future environmental scenarios would have substantially different financial implications across companies. For some firms, should a particular scenario come to pass, the financial impact would be significant; for others, the impact would be insignificant or even opposite in direction. A few companies can reasonably expect an insignificantly small positive or negative effect on their share value of impending environmental issues – less than three percent one way or the other. At the other extreme, three companies could, at this point, expect quite a significant negative impact – greater than 10% of their total market value. The others face a most likely impact of between 4-8% of share value.

The range of potential outcomes also varies greatly from one company to another. The variance of impacts, as a measure of financial risk arising from exposure to these environmental issues, is less than 1% of share value for three companies in the group. At the other extreme, it is greater than 9% of share value for two other companies. The former group is effectively hedged against environmental risk, in the sense that its future earnings will not be highly sensitive to the outcome of the issues it faces. The latter companies are greatly at risk – their earnings will depend heavily on the way these issues develop.

Case 4: Reducing the risk of ecosystem service degradation through watershed protection (Coca Cola)

Valuation methods:	Cost effectiveness analysis
Business motivation:	To minimize costs and maximize cost effectiveness of production by reducing ecosystem water service risks, and to deliver local social and environmental benefits.
Outcome:	Highlighted the financial, social and environmental rationale for investing in source protection
Case study source:	GEMI. The Coca-Cola Company: Using Source Protection Planning to Identify Source Vulnerabilities. Water Sustainability Work Group, Global Environmental Management Initiative. www.gemi.org/water/coca-cola.htm

The Coca-Cola Company oversees the operation of more than a thousand beverage manufacturing plants in nearly 200 countries

Case 4: Reducing the risk of ecosystem service degradation through watershed protection (Coca Cola)

around the world. Water is an essential ingredient to their products. To assure high quality water in production, Coca-Cola plants operate a complete multiple-barrier water treatment system, with source ecosystem protection forming an important part. To assure a continuous supply of high quality freshwater, all facilities are expected to evaluate the reliability of water sources on which they depend. Watershed management initiatives are seen as a way of reducing treatment costs by improving the quality of the water inputs at the source. Reduced microbial load and lower concentration of nutrients, which will generate less algae, limit the need for expensive treatment steps.

The Coca-Cola Company has recently undertaken source protection planning, a cost-effective program to improve the safety of their water treatment systems, without increasing treatment costs. Source protection plans must include a comprehensive assessment of potential sources of contamination, strategies to protect wellheads and aquifer recharge zones, and active participation in local watershed management efforts. A self-assessment tool was developed to support long term planning of water use for the bottling operations as well as for their broader hydrographic basins.

One example of the application of these tools and approaches is in the watershed for the Jundiaí bottling plant in Brazil. This is the world's largest Coca-Cola plant in terms of production capacity. Since 1995, more than US$ 2 million has been invested in partnership with the municipality and other businesses to protect the Jundiaí River watershed, the primary source of water for both the city and for Coca Cola's bottling plant. As a result, two key sanitation projects (a new solid waste landfill and a new wastewater treatment plant) were built, dramatically improving the quality of the water reaching the reservoir. The plant also improved water use efficiency by lowering its usage ratio from 2.9 to 1.7 liters of water per liter of beverage.

Case 5: Reducing waste management expenditures (DuPont)

Valuation methods:	Environmental cost accounting
Business motivation:	To enhance regulatory compliance and desire to increase profitability and shareholder returns
Outcome:	Highlighted cheaper and more effective waste management options
Case study source:	Ditz, D., Ranganathan, J. and R.D. Banks. 1995. Green Ledgers: Case Studies in Corporate Environmental Accounting. World Resources Institute, Washington DC; Southwest Zero Waste Network Case Study: E. I. du Pont de Nemours & Company www.zerowastenetwork.org/success/story.cfm?StoryID=68&RegionalCenter=

DuPont is a science-based products and services company. Operating in more than 70 countries, the company employs more than 60,000 people worldwide and has a diverse array of product offerings, including agriculture, nutrition, electronics, communications, safety and protection, home and construction, transportation and apparel. In 2005, the Company ranked 66th in the Fortune 500 on the strength of nearly US$ 28 billion in revenues and US$ 1.8 billion in profits. Opened in 1956 to manufacture chemicals for the Grasselli Chemicals Department, DuPont's La Porte site in Texas produces a broad range of chemicals serving industries from agricultural products to clothing.

In the 1990s, La Porte developed a series of new environmental programs as part of DuPont's goal of zero waste and zero emissions. These efforts were informed at least in part by DuPont's efforts to develop an environmental cost accounting system at the La Porte facility, including calculating the environmental costs of producing a particular agricultural pesticide. This cost accounting exercise provided important management information both for cheaper and more effective waste management decisions. This proved to be very timely information, at a point when DuPont was concentrating on reducing fixed costs and improving asset turnover, so as to increase profitability and shareholder returns in a fiercely competitive global market.

The La Porte facility pioneered the development of an environmental cost accounting system that is relatively unique within DuPont. Baseline determination of environmental costs involves a two-stage process. First, all costs labeled as "environmental" are isolated. Many of the obvious costs relate to waste management involving incinerators, bio-treatment, steam strippers, deep-wells, environmental service contracts, and off-site waste handling, as well as regulatory compliance costs. Second, environmental costs which are hidden in other costs (and which would not be identified by traditional accounting systems) are identified. These include, for example, the time spent by non-environmental management on recurring environmental activities. This two stage process is thought to identify about 90% of environmental costs. After environmental costs are identified, they are separated into fixed and variable components, to determine how they vary. Finally, costs are divided into controllable and non-controllable categories. While some costs are incurred directly to strategic business units (the structure under which DuPont facilities are organized and managed, of which Agriculture Products – the unit which produces pesticides – is one), others are shared (such as the costs from the Environmental Control area). These shared costs are allocated between different strategic business units in proportion to projected waste flows.

Using this environmental cost accounting information, DuPont was able to develop cost-benefit measures for evaluating various options for improving waste management, and other aspects of environmental performance, in the production of an agricultural pesticide. Manufacture of this agricultural pesticide at the La Porte facility generated liquid wastes, solid residues, and air emissions. Options for wastewater disposal were the focus of the exercise. The La Porte site has several alternatives for wastewater treatment and disposal, and the criteria for determining which to use include cost per pound, effect on their Toxic Release Inventory, risk of future liability, and degree to which the method of disposal is acceptable to stakeholders. Some process wastewater has traditionally been managed through deep-well injection, a practice that has come under increasing regulatory and public scrutiny in recent years. Some of this wastewater can also be treated at the shared, on-site biological treatment facility.

The environmental accounting exercise found that, for the agricultural pesticide, more than 19% of manufacturing costs are deemed "environmental". However, when comparing the relative costs associated with different waste management options, DuPont discovered that costs as given by the traditional accounting system had been misleading, pointing to sub-optimal waste management practices. Deep-water injection had previously been assumed to be the least expensive approach, a misconception stemming from the way the depreciation of the facility had been factored into the unit cost of bio-treatment. The accounting system charged each strategic business unit with the full-absorption cost of bio-treatment, based on actual use. In other words, the cost per pound of bio-treatment was calculated as the total variable and fixed costs of the bio-treatment facility, divided by the total number of pounds processed. This provided an incentive to divert waste to deep-water injection, where the full-absorption cost is lower. Unfortunately, in reducing the demand for bio-treatment, the cost per pound increases for those still relying on it. This leads to an even lower demand for bio-

Case 5: Reducing waste management expenditures (DuPont)

treatment, and so on. The apparent cost savings from using deep-well injection are thus an illusion, because the fixed costs of bio-treatment are incurred anyway – the cost of the plant has already been incurred. This illusion is further reinforced if the analysis is conducted on a cost per pound of total organic carbon (as opposed to the cost per pound of wastewater). With a reanalysis of environmental costs the corresponding values for bio-treatment and deep-water injection become US$ 2.80 and 60¢ respectively when calculated per pound of total organic content, and when focusing on variable costs bio-treatment showed a saving of 0.04¢ per pound over deep-well injection.

By focusing on incremental costs, the company was able to realize real cost savings in the transition from a deep-well injection to biological treatment of process wastes. This had a positive financial, as well as environmental, effect for DuPont.

Case 6: Securing tax deductions on unused company land (Allegheny Power)

Valuation methods:	Eco-asset model, assessment of marketable values
Business motivation:	To earn income from unused land
Outcome:	Gained deductions in Federal taxes
Case study source:	Lashley, D. undated. Market Based Case Studies Involving Eco-Asset Management on Non-Mined Lands; Bayon, R. 2002. Making Money in Environmental Derivatives. The Milken Institute Review, 1st Quarter 2002.

Allegheny Power is one of two businesses operated by Allegheny Energy, an investor-owned power utility with over US$ 3 billion in annual revenues and more than 4,000 employees. The company owns approximately 9,670 megawatts (MW) of generating capacity, with approximately 95% of the power output coming from coal. Regulated utilities doing business as Allegheny Power include West Penn Power Company (Pennsylvania), Monongahela Power Company (West Virginia), and The Potomac Edison Company (Maryland, Virginia, and West Virginia).

In addition to generating revenues through sales of power, Allegheny has recently managed to identify a new source of income and tax relief. This arises from a phenomenon know as "mitigation banking." The idea is to take living plants, animals and ecosystems and turn them into fungible assets that can be sold through newly formed markets. In the case of Allegheny Power, valuation of the marketable benefits provided by one of the pieces of land it owned identified the potential to capture this innovative source of earnings.

Allegheny had earlier made a decision to divest its 4,800-hectare Canaan Valley property in West Virginia, which it had originally purchased in 1925 in hopes of eventually using the site for a hydropower project. That project was ultimately not viable, and the company had a large land holding that was of little value to its power business. Traditional land valuation approaches appraised the real estate at US$ 16 million. Believing the property – with its pristine forests, marshes, and abundant wildlife – was worth more, the company commissioned an economic valuation of the marketable environmental benefits provided by the site, including its ability to sequester carbon and its wetlands.

Working with EPRI's STREAM (Strategic Eco-Asset Manager) model, a team of consultants established a value of US$ 336 million for the ecological services provided by the parcel. This figure was ultimately deemed too large to be credible in a business transaction (particularly a tax deduction), and so the company made a second effort at the valuation. Focusing on the potential for wetland mitigation banking and carbon sequestration, the ecological services alone were valued at US$ 17 million, in addition to the traditional land valuation.

Ultimately, the company found a willing buyer for the parcel in the US Fish and Wildlife Service (which merged it with an existing wildlife refuge) for the original appraisal price of US$ 16 million. In addition, US Tax Code permitted the company to claim a tax deduction for a "bargain sale" of the property, meaning that the company was able to claim a charitable contribution of US$ 17 million for the property's environmental value, saving the company over US$ 5 million in federal taxes.

Notably, several other companies and individuals have taken advantage of similar laws at the federal and state level. Many states allow landowners to establish conservation easements on property that limit the development on the parcel. These easements are then donated to non-profit organizations, and the value of the easement is captured as a tax deduction. Laws vary across states – in some areas the value of the easement can offset tax liability, rather than taxable income. In these areas, the private value of the ecosystem services associated with the easement is equal to the public value.

Case 7: Prolonging the lifetime and productivity of a hydropower facility (INECEL)

Valuation methods:	Damage costs avoided
Business motivation:	To prolong the lifetime and production of a hydropower facility
Outcome:	Operational cost savings and greater revenues
Case study source:	Southgate, D. and R. Macke, 1989. The downstream benefits of soil conservation in Third World hydroelectric watersheds. Land Economics 65(1): 38-48; Winpenny, J.T., 1991. Values for the Environment: A Guide to Economic Appraisal. Overseas Development Institute, HMSO Publications, London.

The Instituto Ecuatoriano de Electrificación, INECEL, was formerly the state-owned electricity monopoly in Ecuador. It has now been unbundled and its assets transferred to the new electricity authority CONELEC, and transformed into six generation companies and a transmission company. INECEL has invested significant sums of money in upstream erosion control in order to preserve the reservoir capacity of its hydropower schemes. Although the origin of watershed degradation arises outside INECEL's boundary, economic valuation was used to show that it was in the company's financial interests to internalize these costs.

At the time of the study, the Paute Hydroelectric project (1,075 MW) was being managed by INECEL. Hidropaute, which now owns Paute, is the largest company in the country, representing more than 50% of total power generation. The Paute reservoir was completed in 1983 at a cost of US$ 600 million. Located in the Andean highlands, its watershed is steeply sloping and heavily populated. It had an initial active storage capacity of 100 million cubic meters and a design lifetime of 50 years. As in many other parts of the country, soil

Case 7: Prolonging the lifetime and productivity of a hydropower facility (INECEL)

erosion in the upper watershed was affecting the viability of the Paute hydropower scheme in a number of ways, reducing the lifespan of the reservoir and impairing its thermal energy saving functions. It also requires the hydropower utility to undertake costly remediation and mitigation work to remove stones and boulders that might slough off against the dam and finer silt that might clog the intakes. Additional expenditures were also being made on more frequent replacement of turbine blades and other equipment which now worked less well because of the sediment load passing through.

In response, INECEL began a program comprising civil works for keeping eroded material from entering waterways, protection of the remaining upstream forests, and reforestation and erosion control on farmland on the upper slopes of the Paute watershed.

A simulation model was developed which quantified the effects of upper watershed degradation on the lifespan and productivity of the hydropower scheme. With upstream conservation measures, the benefits to INECEL were taken to be the increased net value of hydroelectric output from the increased reliability of energy, lower dredging costs, and an extension to the scheme's lifespan. Modeling the increased reliability of power involved distinguishing between "firm" power (which is fully substitutable for thermally produced energy) and "non-firm" power (which is too unreliable). The value of firm power was taken to be equivalent to the long-run marginal cost of a thermal plant, while the value of non-firm power was taken to be the short-run marginal cost. Furthermore, it was assumed that the useful lifespan of the reservoir would cease when its active storage fell below 20% of the initial level.

Even very modest investments in upper watershed management, and conservative estimates of downstream erosion, showed a sizeable net present value (NPV). In a minimum-case scenario, where benefits are only half those expected, the NPV is US$ 15 million. Full realization of benefits yielded NPVs of between US$ 30 million and US$ 40 million. Clearly, investing in watershed conservation was in the direct financial interests of INECEL. These benefits were realized through prolonging the reservoir's life and energy generating capacity, and thus maintaining the revenue base of the utility.

Case 8: Calculating oil spill natural resource damages (ExxonMobil and the State of Alaska)

Valuation methods:	Contingent valuation
Business motivation:	To comply with natural resource damage assessment and environmental compensation requirements
Outcome:	Monetary estimate of environmental damage costs incurred which could be used in courts of law
Case study source:	Carson, R.T., Mitchell, R. C., Hanneman, M., Kop, R., Presser, S. and P.A. Ruud. 2003. Contingent Valuation and Lost Passive Use: Damages from the Exxon Valdez Oil Spill. Environment and Resource Economics 25: 257-286; Swanson, T. and A. Kontoleon. 2003. What is the role of environmental valuation in the courtroom? The US experience and the proposed EU directive. In Vig, N. and M. Faure (eds) Green Giants? Environmental Policy of the United States and the European Union. MIT Press, Boston.

ExxonMobil is the world's largest publicly traded international oil and gas company, and the world's largest refiner and marketer of petroleum products. The company operates facilities or market products in most of the world's countries, and explores for oil and natural gas on six continents.

In 1989, the Exxon Valdez oil tanker struck submerged rocks in Prince William Sound, Alaska, spilling about 40 million liters of Prudhoe Bay crude oil into the sea. The oil eventually covered 28,000 km^2 of ocean, and more than 1,300 kilometers of coastline were affected. Prince William Sound is an important habitat for salmon, sea otters, seals, and seabirds.

After the oil spill, the State of Alaska commissioned various studies to identify the physical damage to the environment, including economic damage assessments. An interdisciplinary group of researchers was appointed to design and implement a national contingent valuation study to measure the loss of non-use values to US citizens as a result of the oil spill. Up to this time, the estimation of non-use or existence value was an area of economic research which was not well known to many economists working outside the environmental field, and was not a method that had been used before in the context of natural resource damage assessment.

The environmental damages caused by the oil spill were subsequently estimated to lie between US$ 3 and US$ 15 billion, including non-use values worth around US$ 2.8 billion. The use of contingent valuation, and inclusion of non-use values, in relation to natural resource damage assessment, sparked something of a controversy among both academics and the industry. Exxon commissioned a group of researchers to verify whether non-use values could be accurately measured by means of contingent valuation. In order to address this critique, the National Oceanic and Atmospheric Administration (NOAA) set up a panel to evaluate contingent valuation. The panel eventually concluded that "well conducted CVM studies can produce estimates reliable enough to be the starting point of a judicial process of damage assessment, including lost passive values". From this point forward non-use values and contingent valuation techniques have been allowed in US court proceedings relating to the remediation or compensation of environmental damages.

The Exxon Valdez experience set a precedent for the use of ecosystem valuation in natural resource damage assessment and compensation liability claims. In the 1989 case of Ohio vs. US Department of Interior, the court granted equal weight to use and non-use values in damage assessment. In the Montrose damage assessment, trustees used a contingent valuation to assess the value of impacts due to DDT contamination off the coast of California, and recovered the value of interim losses. Other examples of the successful use of contingent valuation techniques for the estimation of environmental damages include the State of Colorado's case quantifying the damage caused to watersheds by the Eagle Mine, and the State of Washington's case quantifying the damages from an oil spill that soiled the coastline of the State of Washington.

Case 9: Articulating environmental performance and costing environmental impacts (Ontario Hydro)

Valuation methods:	Full cost accounting
Business motivation:	To generate information as an input into decision-making and change management behavior
Outcome:	Recommendations leading to cost savings, cost avoidance, revenue generation, waste reduction and improved image

Case 9: Articulating environmental performance and costing environmental impacts (Ontario Hydro)

Case study source:	Bailey, P. 1996. "Full Cost Accounting" for decision making at Ontario Hydro: A Case Study. ICF Incorporated, Fairfax VA.

At the time of the case study, Ontario Hydro was the largest utility in North America in terms of installed generating capacity, and had an estimated 92% market share. Ontario Hydro was a self-sustaining, government-owned utility without share capital whose bonds and notes were guaranteed by the Province of Ontario.

An important reason for Ontario Hydro's adoption of full cost accounting was to generate information as an input into decision-making, particularly to change management behavior. The anticipation of future policy and enhancement of future competitiveness drove the exercise. Other important motivations included cost avoidance, revenue enhancement and environmental quality improvement.

In 1993, Ontario Hydro underwent major restructuring, to better meet the competitive challenges of the times. Much of the restructuring was designed to contain costs, stabilize electricity rates and gain greater efficiency. The changes also involved dividing the company into separate business units, each with clear accountability for its activities, costs and environmental performance.

The company had already been considering environmental costs and impacts for some time: for example, it was the first Canadian company to publish an environmental performance report. In 1993, a Sustainable Energy Development Task Force was appointed, which formed ten teams, including a Full Cost Accounting Team. "Full Cost Accounting" is how Ontario Hydro terms environmental accounting, which it defines to include both internal and external environmental and health impacts of the company's activities.

In 1995, the company issued *Corporate Guidelines for Full Cost Accounting*. Their adoption represented a fundamental change in the way the company expected to do business. At a higher level, Ontario Hydro took the concrete step of adding environmental considerations into investment decision-making by requiring that when investments were evaluated, they would where possible quantify and monetize potential environmental impacts and resource/energy use efficiencies.

Full Cost Analysis was also integrated into existing planning activities, namely the Corporate and Local Integrated Resource Plans (strategic exercises to evaluate different supply generation and demand management plans for the future). One of the criteria used to assess the plans became environmental impact, which was assessed on an environmental damage basis (using the damage function approach). Environmental impacts were quantified and valued in monetary terms where feasible.

Because Ontario Hydro had not yet developed monetized environmental impact estimates for all available supply, demand side management and transmission options, they realized that an evaluation method was s required to facilitate the comparison of environmental impact information expressed in different units (qualitative, quantitative, and where available, monetized) and to integrate such data into their decision-making and planning processes. For these purposes, they adopted multi-criteria analysis: an analytic tool that integrates different types of monetary and non-monetary decision criteria, based on ecological, economic and social criteria.

The company also took steps to reform its cost and expenditure allocations, as expressed in environmental expenditures and overhead accounts. In order to implement full cost accounting, it is necessary to be able to isolate environmental expenditures from other types of expenditures, particularly from overhead accounts. Ontario Hydro began to minimize the practice of charging expenses to overhead accounts by implementing procedures to ensure that each business unit is accountable for its own costs: all costs are incurred by or allocated to business units, and overhead charges for corporate services are limited only to those costs for which fees cannot be reasonably charged.

In order to investigate methods to obtain more precise information on its internal environmental expenditures at the project/process level, to track and allocate these expenses on a life-cycle basis, and to accomplish this more explicitly than in the past, an internal environmental cost pilot project was initiated at Southwest Hydro, one of the thirteen retail utilities owned and operated by Ontario Hydro. The Southwest Hydro Utility territory includes approximately 75,000 customers, and had a net income of US$ 19 million in 1995. The goal of the pilot project was to identify and collect all internal environmental costs associated with Southwest Hydro's activities, identify and prioritize processes or products having higher environmental costs and liabilities, and develop recommendations leading to cost savings, cost avoidance, revenue generation, waste reduction and improved image in the community for the Utility.

There are a handful of other similar, innovative efforts by firms to account for environmental costs. One much-cited example is by BSO/Origin (now Atos Origin), a Dutch computer software consultancy, which recorded a monetized imputation reflecting its external impact in an "environmental value added statement". Both AT&T and Dow Chemical have been considering a similar approach to the costing of externalities.

Case 10: Reassessing company and share value on the basis of sustainable development metrics (Inco)

Valuation methods:	Discounted Cashflow, Price to Cash Flow Per Share Ratio, Option Pricing Valuation
Business motivation:	To reflect company's sustainable development metrics in financial valuation measures
Outcome:	Reassessed estimates of company and share value
Case study source:	Yachnin & Associates, Sustainable Investment Group Ltd. and Corporate Knights Inc. 2006. The sdEffect™: Translating Sustainable Development Into Financial Valuation Measures: A Pilot Analytical Framework. Yachnin & Associates and Sustainable Investment Group Ltd, Ottawa.

Canadian metals and mining company Vale Inco is a leading producer of nickel, copper, cobalt and precious metals. It is a wholly-owned subsidiary of Companhia Vale do Rio Doce, the world's second-largest mining company by market capitalization. Inco was one of only 12 Canadian mining companies who produced sustainability reports in 2003.

Based on a review of Inco's 2003 Environmental, Health and Safety Report, the potential influence of sustainable development metrics on the financial variables typically considered important by analysts were identified and quantified. Key environmental metrics considered were non-hazardous solid waste diversion, land reclamation, recycling, and environment, health and safety audits. Inco diverts non-hazardous solid waste (e.g., wood, concrete, building demolition material) to a disposal site in the midst of the tailings disposal area in Sudbury, reducing pressure on local municipal landfills. By the end of 2003 a total of 2,550 hectares of land had been revegetated in Ontario. Also by 2003, Inco had completed nine Environmental, Health and Safety audits at locations in Canada, United

Case 10: Reassessing company and share value on the basis of sustainable development metrics (Inco)

Kingdom, United States and Asia. In addition, Inco has received a number of awards for its environmental work, including the Gold Level Reporter status (for the 5th consecutive year) from Canada's Climate Change Voluntary Challenge and Registry, and in 2004 received a "best in class" ranking from Storebrand Social Responsibility Index, and was included in FTSE4Good Index.

Two valuation methods were used to translate two of these sustainable development metrics into financial valuation measures. Inco's solid waste diversion was translated into Discounted Cash Flow (DCF) and Price to Cash Flow Per Share Ratio (P/CFPS), and the company's environmental awards were translated into Option Pricing Valuation.

The assessment of sustainable development performance revealed that Inco had diverted substantial amounts of solid waste from away from the municipal landfill. This diversion represents an annual savings of approximately US$ 2.4 million. This provides a suitable metric for illustrating translation using DCF and P/CFPS. For the DCF analysis, for example, at an estimated weighted average cost of capital of 12.7%, and an estimated value of cash flow assuming 5% annual growth in usage or avoided fees, this represents a present value of savings of approximately US$ 31 million. With 189 million shares outstanding, this converts to per share incremental value (potential share price appreciation) of US$ 0.16 per share. With respect to P/CFPS valuation and with a peer group multiple of 5-6 times, it can be discerned that cash flow per share/annual savings per share is equal to US$ 0.013. The overall valuation result for INCO solid waste diversion is therefore: the US$ 2.4 million in savings associated with waste diversion is equivalent to just over 1 cent earnings per share. These savings are worth US$ 31 million in total shareholder value (using DCF) or between US$ 0.06 and US$ 0.16 per share in total value (using P/CFPS and DCF).

Receiving environmental awards can contribute to a company being identified as a partner of choice, which may mean better access to markets and the fast tracking of project expansions. This provides a suitable metric for translation using Option Pricing valuation. A hypothetical extension of this example is given, which assumes that Inco is considering opening a new mine in Voisey's Bay. In order to approve the project, the provincial government of Newfoundland and Labrador require that Inco develop a smelter to process ore on site rather than trucking the ore to another location for processing, in order to provide jobs and economic development in the local community. The mine on its own has a net present value (NPV) to the company of US$ 2 billion and is economically viable, the mine with the smelter has a NPV of (-US$ 400 million) and is not economically viable. However, because of Inco's good environmental reputation, the provincial government gives the company an "option" to expand the mine anytime in the next five years without any of the additional approval or permitting requirements that would normally be required for such an expansion. The overall valuation result is that Inco's track record makes it possible for the company to open a new operation in Voisey's Bay, because of the expansion option it is given. This option, worth US$ 712 million to the company, changes the economics of the project from a negative NPV of -US$ 400 million to a positive NPV of US$ 312 million (mine, smelter and pre-approved option to expand) thereby making the operation at Voisey's Bay attractive and viable.

7. Ways forward: Needs, gaps and opportunities in corporate ecosystem valuation

Needs – What are the elements of a business-oriented approach to ecosystem valuation?

One of the main conclusions of this scoping exercise is that ecosystem valuation has evolved largely in response to public interest goals and economy-wide concerns. Given that this is the case, an initial – and very important – question to ask is: If solely public interest concerns are not considered to cover the full range of concerns of the corporate sector, why would a business care about ecosystem values? It is, after all, the wish to solve real-world problems and address on-the-ground needs that drives the use of ecosystem valuation in the first place, and then shapes how it is subsequently applied.

To answer this question it is necessary to look at the key management goals and decision-making priorities facing business. For simplicity's sake, we can base these on the ecosystem dependencies and impacts identified in the 2008 *Corporate Ecosystems Review* and the 2006 WBCSD issue brief *Business and Ecosystems*. Here, risks are defined as: operational, regulatory and legal, reputational, market and product, and financing. Opportunities are defined as: new technologies and products, new markets, new businesses, and new revenue streams.

Drawing also on the issues highlighted in the tools and case studies reviewed in Chapters 5 and 6, and linking these risks and opportunities to companies' bottom-line goals, gives us six core elements of a business-oriented approach to ecosystem valuation. These elements are listed in Figure 6. Of course they are of necessity fairly broad. The relative priority accorded to each, and the ways in which they are interpreted, will differ between companies and will also vary according to the specific circumstances, management issue or decision-making choice that a business is facing when they choose to use ecosystem valuation. The point made in the first chapter of the report should also be re-emphasized: this document is concerned primarily with the use of ecosystem valuation to meet financial bottom line goals, and so the elements listed below are targeted towards such concerns.

Figure 6: Elements of a business-oriented approach to ecosystem valuation

End uses of corporate ecosystem valuation	
Identifying new investments, markets, prices and products	Includes improving existing prices and production as well as identifying additional or alternative revenue streams based on ecosystem service markets
Managing risk	Includes managing both environmental and economic risk in relation to ecosystem issues
Highlighting opportunities for saving costs, reducing taxes and sustaining revenues	Includes avoiding unnecessary expenditures, as well as investing in ecosystem measures that will enhance production potential and efficiency
Assessing environmental liability and compliance	Includes factoring environmental damage and remediation costs into investment appraisal and project planning, as well as dealing with liability and compensation claims levied either by or against the company
Articulating environmental performance and costing environmental impacts	Includes internal management information needs as well as requirements for external and mandatory reporting, and public disclosure
Reassessing company and share value	Includes calculations made to inform companies themselves, as well as to generate information for their shareholders and for market and investment analysts

Gaps – How far do existing initiatives address these needs?

We can now review existing ecosystem valuation initiatives in the light of these six elements. For the case of the mainstream approaches reviewed in Chapter 3, a tool-by-tool or initiative-by-initiative review will not be very useful – as, quite simply, ecosystem valuation has not for the most part been geared towards business interests or the financial bottom line. Rather, it has long been driven by a quite different set of goals and interests (on which, it should be emphasized, it has for the most part usefully and credibly delivered). These goals and interests are certainly not irrelevant to the socially and environmentally minded businesses, but it is of concern that they continue to exclude the financial bottom line.

Of the initiatives reviewed, just one is explicitly targeted at the business community (The Economics of Ecosystems and Biodiversity). Here, however, the corporate sector forms just one target group among several intended audiences, including policy-makers, administrators, consumers and citizens. It is not as yet clear whether the focus will be merely on reiterating conventional "mainstream" ecosystem valuation tools and trying to retrofit these to private sector concerns, or on developing new and more focused ecosystem valuation tools, which are designed specifically with corporate interests in mind. Of the mainstream tools and

models identified, only ARIES specifically incorporates the use of ecosystem valuation to identify and optimize business opportunities. Even these two initiatives, however, are concerned primarily with public interest goals and with transposing the ecosystem valuation tools that have been used to serve them to a business context.

One important finding of the scoping study is therefore that mainstream ecosystem valuation, as it has been practiced, does not address in any depth the complete gamut of corporate sector goals and needs. Few attempts have as yet been made to engage business except, as explained in Chapter 4, as a passive player liable and accountable to remediate and compensate environmental damage.

For the case of the commonly used ecosystem methods described in Chapter 2 and summarized in Figure 3 and Figure 8, conclusions on business applicability are a little different. Most of the techniques and methods that have evolved to value ecosystems (such as effect on production, travel costs, hedonic pricing, cost-based approaches, contingent valuation, choice experiments and conjoint analysis) are certainly applicable in a business context – in fact, several of them were first developed (for non-environmental purposes) by the private sector, and only later were they applied to ecosystems. These methods are geared towards placing a monetary value on ecosystem impacts and dependencies, which is of as much concern to business as it is to public interest goals. As we will describe below, these tools have been applied by businesses, in the context of specific real-world decisions, but usually within a very different conceptual framework than that suggested by “mainstream” ecosystem valuation.

An important conclusion is therefore that the basic tools and approaches used for ecosystem valuation do, indeed, have relevance for the corporate sector. It is only when they are actually applied that particular interests and intended outcomes are superimposed – and, to date, the mainstream applications of ecosystem valuation have proven to be lacking as regards business goals.

The scoping study shows clearly that most of the tools and models that have recently been designed by and for the corporate sector, and are described in Chapter 5, do not in fact make use of conventional ecosystem valuation methods. They mainly apply the techniques that are already commonly used by business for financial analysis, across a range of green, brown and blue sector issues. Although together the emerging business-led tools for ecosystem valuation cover the main elements of corporate decision-making in relation to ecosystem services and the financial bottom-line (Figure 7), they remain very limited in scope and number. Businesses currently have very few methodological and technical resources available to them with which to carry out ecosystem valuation. This is another important conclusion: although dynamic and innovative, and a rapidly-emerging field, corporate ecosystem valuation is very much at an embryonic stage – it is clear that additional work needs to be carried out to advance its reach and hone its focus.

Figure 7: Coverage of reviewed corporate ecosystem valuation tools

	Corporate Environmental Accounting	Biodiversity Accountability Framework	Trucost	sdEffect™	Ecosystem Services Benchmark	ENVEST
Identifying new investments, markets, prices and products	✓				✓	
Managing risk					✓	✓
Highlighting opportunities for saving costs, reducing taxes, sustaining revenues	✓				✓	
Assessing environmental liability and compliance					✓	
Articulating environmental performance and costing environmental impacts	✓	✓	✓			✓
Reassessing company and share value			✓	✓		

Figure 8: Focus of reviewed corporate ecosystem valuation case studies

	Company	Motivation	Outcome	Valuation tools used
Identifying new investments, markets, prices and products	Potlatch Corporation	To reimburse land management costs and turn a profit for shareholders	Implementation of a fee-to-access program for recreational users of company lands	Market valuation of fee and income potential
	TXU Energy	To earn revenue from reclaimed mine lands	Identification of eco-assets that could generate income via mitigation credits that would be equal or greater to alternative uses or sale values	Eco-asset model
Managing risk	US pulp & paper	To improve the ability of investors to make sound choices	Identified the financial implications of future environmental risks to companies	Financial analysis
	Coca-Cola	To minimize costs and maximize cost effectiveness of production by reducing ecosystem water service risks	Highlighted the financial, social and environmental rationale for investing in source protection	Cost effectiveness analysis
Highlighting opportunities for:				
saving costs	DuPont	To enhance regulatory compliance, profitability and shareholder returns	Highlighted cheaper and more effective waste management options	Environmental cost accounting
reducing taxes	Allegheny	To earn income from unused land	Gained deductions in Federal taxes	Eco-asset model, assessment of marketable values
sustaining revenues	INECEL	To prolong the lifetime and production of a hydropower facility	Operational cost savings and greater revenues	Damage costs avoided
Assessing environmental liability and compliance	ExxonMobil & State of Alaska	To comply with natural resource damage assessment and environmental compensation requirements	Monetary estimate of environmental damage costs incurred which could be used in courts of law	Contingent valuation
Articulating environmental performance and costing environmental impacts	Ontario Hydro	To generate information as an input into decision-making and change management behavior	Recommendations leading to cost savings, cost avoidance, revenue generation, waste reduction and improved image	Full cost accounting
Reassessing company value and share value	Inco	To reflect company's sustainable development metrics in financial valuation measures	Reassessed estimates of company and share value	Discounted Cash Flow, Price to Cash Flow Per Share Ratio, Option Pricing Valuation

It is notable that in practice, the case studies described in Chapter 6 have tended to use a combination of conventional ecosystem valuation tools and corporate financial analysis tools, depending on their intended outcome and area of focus (Figure 8). A third conclusion is therefore that neither conventional ecosystem valuation methods nor conventional financial valuation methods are by themselves sufficient (even though each may be necessary) to address the six elements of a business-oriented approach that we have identified. It would seem that there is a need to find ways of merging the best and most useful of each set of tools, and embedding them in a framework which is relevant and useful for corporate planning, analysis and decision-making.

Opportunities – Where is the potential to advance ecosystem valuation for business?

The scoping study shows that both gaps and opportunities exist as regards the current status of corporate ecosystem valuation. One important conclusion that can be made is that ecosystem valuation clearly does offer a useful set of tools for business – as evidenced by its growing use by the corporate sector. However, mainstream ecosystem valuation as commonly applied remains severely lacking with respect to business. This is the case even though many of the basic valuation techniques themselves could potentially be applied to business, and in some cases are starting to be so. As a result, we have seen the evolution of two fairly distinct branches of ecosystem valuation: the mainstream approach, which is concerned with public values and the social and environmental bottom lines, and business applications, which are primarily (although, it is important to note, not exclusively) engaged in looking at private values and the financial bottom-line.

In reality, business is concerned with all three elements: financial, environmental and social. The greatest opportunity to advance the development of corporate ecosystem valuation would therefore seem to lie in making efforts to promote a greater coherence between the two approaches. In effect, this would entail "borrowing" the most relevant tools and experiences from mainstream ecosystem valuation, and merging them with the innovations in financial analysis that businesses themselves have been developing to deal with ecosystem issues. The six elements of a business-oriented approach to ecosystem valuation that have been identified by this study provide a starting point for testing such tools.

A strong conclusion of the scoping study is, however, that any attempt to advance corporate ecosystem valuation should not focus on trying to shift mainstream ecosystem valuation models and initiatives towards a "forced" business perspective. They are inherently unsuited to this, as they have evolved based on a quite different set of goals and approaches. Rather, there is a need to look to new ways of valuing ecosystem dependencies and impacts within the realm of existing financial and business planning tools, drawing where relevant on the methods that have been developed specifically to value ecosystem services. Unless ecosystem valuation issues are dealt with inside companies in similar ways to other management decisions, they are likely to remain things that are largely imposed from outside rather than being a core (and useful) part of the process of maximizing company and shareholder value.

Next steps – What the WBCSD Ecosystem Valuation Initiative might look like

It is now time to finish addressing the third, and final, question posed to the scoping study: What are the ways forward in developing a WBCSD Ecosystem Valuation Initiative?

Clearly there is a substantial, and as-yet unfilled, niche for the WBCSD to carry out an initiative such as this. There is also apparently demand for it. The niche lies in the fact that other organizations working in the field of ecosystem valuation have largely failed to rise to the challenge of working with and for the corporate sector. The demand is evidenced by the stated interest of WBCSD members themselves, and also by the recent emergence of business-led efforts to adapt and modify ecosystem valuation approaches to their own ends. Underpinning this is the clear potential of ecosystem valuation to provide a suite of tools that can help businesses to manage their ecosystem dependencies and impacts, and improve their financial, social and environmental bottom lines.

The WBCSD has recently completed the *Corporate Ecosystem Services Review*, which has been received extremely well by both conservation and business communities. The review provides a tool to help managers develop strategies to manage ecosystem-related business risks and opportunities, but stops short of considering ecosystem valuation. It would therefore seem to present a useful springboard from which the WBCSD could launch its Ecosystem Valuation Initiative as an additional step in ecosystem services review – the step of quantifying ecosystem dependencies and impacts in monetary terms, and capturing the potential they offer for companies to strengthen their business performance, management decision-making, and

financial (or triple) bottom line. The six elements of a business-oriented approach to ecosystem valuation identified earlier in this document present themselves as an obvious focus for taking the *Corporate Ecosystem Services Review* a step forwards.

The goal of the WBCSD's Ecosystem Valuation Initiative would thus be to use ecosystem valuation to strengthen the business license of WBCSD member companies to operate, innovate and grow by managing ecosystem risks and seizing ecosystem opportunities. Its modus operandi would be to work within the framework of existing business accounting and financial analysis tools to incorporate ecosystem valuation.

The WBCSD is a membership organization. This is its main strength and comparative advantage. Further input from members will be critical if significant advances are to be made in pushing forward the boundaries of corporate ecosystem valuation in a manner that is both relevant and applicable to business goals. These dialogues and contributions would form an essential first step in the initiative, and in shaping how it is subsequently designed and rolled out.

A second-phase guide to corporate ecosystem valuation, as a companion volume to the *Corporate Ecosystem Services Review* would fill a significant gap left by mainstream ecosystem valuation. While this activity would deliver a concrete product that would benefit businesses that are currently endeavoring to internalize ecosystem valuation into their own planning and decision-making, it could also – and equally importantly – serve to foster a more participatory process of determining just where the priorities in corporate ecosystem valuation lie and what are the best tools to address them. In particular, the six elements of a business-oriented approach to ecosystem valuation that have been identified in this document provide a useful framework that can be tested against different valuation tools.

To achieve this latter aim, substantial efforts would need to be made to road-test the guide among WBCSD members and other companies. It is only through this type of on-the-ground endeavor that any attempt to advance corporate ecosystem valuation will remain relevant for, useful to, and used by, business.

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[25] Ontario Hydro.

[26] Beth Israel Medical Center/Continuum Health Partners, Catholic Healthcare West/Dominican Santa Cruz Hospital, Contra Costa Regional Medical Center, Dartmouth Hitchcock Medical Center, Dana Farber Cancer Institute, Halifax Medical Center, Kaiser Permanente, New England Medical Center, St. Vincent’s Hospital, Mary Hitchcock Memorial Hospital and Dartmouth Hitchcock Medical Center.

[27] Repetto, Magrath, Wells, Beer and Rossini op. cit.

[28] Including Amoco Oil, Cascade Cabinet, Ciba-Geigy, Dow Chemical, Du Pont, Heath Tecna and S.C. Johnson.

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[31] Described in Repetto and Austin op. cit.

[32] Banco Real, F&C Asset Management, Insight Investment, Aviva Investors, PaxWorld, and VicSuper.

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