DEDICATED TO MAKING A DIFFERENCE

Guide to Corporate Ecosystem Valuation

A framework for improving corporate decision-making

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The WBCSD is a CEO-led, global coalition of some 200 companies advocating for progress on sustainable development. Its mission is to be a catalyst for innovation and sustainable growth in a world where resources are increasingly limited. The Council provides a platform for companies to share experiences and best practices on sustainable development issues and advocate for their implementation, working with governments, non-governmental and intergovernmental organizations. The membership has annual revenues of USD 7 trillion, spans more than 35 countries and represents 20 major industrial sectors. The Council also benefits from a network of 60 national and regional business councils and partner organizations, a majority of which are based in developing countries.

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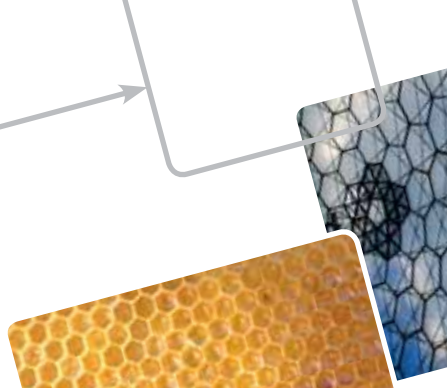

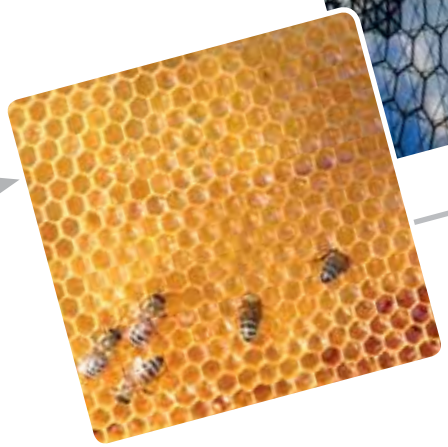

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Foreword

The World Business Council for Sustainable Development (WBCSD) recognizes the value of biodiversity, including ecosystems and the services they deliver. Our leading companies understand, for example, that freshwater is a critical input for most, if not all, major industrial process, and that pollination and pest regulation are essential for food production. Unfortunately, biodiversity loss and ecosystem degradation are continuing to escalate, thereby putting business at risk. These risks are real, but if managed properly, can be transformed into new opportunities.

The Economics of Ecosystems and Biodiversity study (TEEB) – initiated by the G8+5 environment ministers (2007-2010) – has emphasized the concept of ecosystem valuation as a practical and influential aid to decision-making. Companies must anticipate that ecosystem valuation will be more consistently incorporated into public policies, regulations, and political decisions. The UN Convention on Biological Diversity (CBD) meeting held in Nagoya, Japan in October 2010 agreed that countries should adapt their National Biodiversity Strategies and Action Plans by 2012 to support implementation of the CBD's new 2020 biodiversity targets and other commitments. This will put strong demands on business to measure and report their actions to conserve as well as sustainably use and share the benefits of ecosystems and biodiversity. Ecosystem values will be increasingly considered by the finance sector and business-to-business customers as they assess the biodiversity and ecosystem-related risks and opportunities of investments and supply chains.

In response to these challenges, WBCSD has developed this Guide to Corporate Ecosystem Valuation (CEV). I believe it will become one of WBCSD's flagship tools, along with the Global Water Tool, the GHG Protocol and the Corporate Ecosystem Services Review. I also believe it will help companies proactively respond to the changing expectations of key stakeholders – including communities, regulators, shareholders, NGOs and the media – about how business measures, values, manages and reports their ecosystem and biodiversity impacts by providing a practical approach for effective CEV application at a company level.

I encourage all businesses, large and small, to use this Guide and integrate ecosystem values in their decision-making. I encourage all NGOs, academia and experts to help companies along this road, where much complexity and jargon can present obstacles in this emerging field. Finally, I encourage governments and municipalities to include business in their discussions around ecosystem-related policy and regulation.

I would like to thank our Ecosystems Focus Area Core Team for demonstrating such leadership in this exciting field; the Road Testers and Partners, without whom the Guide would not have been so robust; and especially ERM for leading the writing of the Guide itself.

Björn Stigson
President, WBCSD

Message from Road Testers

Mainstreaming ecosystem considerations into business is becoming increasingly important in order to deal with the challenges of a resource-constrained world. This Guide to Corporate Ecosystem Valuation (CEV) is a valuable addition to the toolkit used by business today. It can be used in relation to business operations as well as to suppliers, customers and other stakeholders.

This Guide has enabled us to, for example, value the benefits of ecosystem services, choose among alternative land and water management options, and determine new sources of revenue. It will help businesses explore how to adapt their current accounting and finance systems to better reflect the full value of the ecosystems they impact and depend on.

We see that CEV can strengthen business performance by considering social benefits, sustaining revenues, reducing costs, revaluing company assets and determining levels of liability and compensation.

We see the **value** of ecosystem **valuation**.

Hans Wijers
CEO and Chairman of the Board of Management, AkzoNobel

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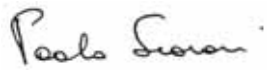
CEO, EDP - Energias de Portugal



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Executive Summary

What is Corporate Ecosystem Valuation?

Corporate Ecosystem Valuation (CEV) can be defined as a process to make better-informed **business decisions** by explicitly **valuing** both **ecosystem degradation** and the **benefits** provided by **ecosystem services**. By including ecosystem values, the company's aim is to improve corporate performance in relation to social and environmental goals and the financial bottom-line. Valuation can make decision-making around ecosystems more compelling and practical, thereby enhancing sustainable development strategies and outcomes.

Ecosystem services are the benefits people gain from the environment and biodiversity (i.e. the benefits that flow from natural capital). They include, among many others, water, crops, timber, flood protection, waste assimilation, carbon sequestration, recreation and spiritual benefits. All businesses depend and impact upon ecosystem services in some way.

The ability to factor ecosystem values into business decision-making is becoming an ever-more pressing need because:

- There is increasing evidence that ongoing **ecosystem degradation has a material impact on companies** – undermining performance, profits, their license to operate and access to new markets.[1]
- New **opportunities are emerging** that are linked in some way to restoring and managing ecosystems. For example, according to WBCSD's Vision 2050 project, sustainability-related global business opportunities in natural resources may be in the order of US$ 2-6 trillion per annum by 2050.
- Communities, NGOs, customers, consumers and **shareholders are becoming increasingly conscious** of the interrelationship between business operations and the state of ecosystems, and are demanding that these issues are addressed, reported and accounted for.
- Meanwhile, in many parts of the world, the **regulatory and legal requirements** for companies to minimize and mitigate their ecosystem impacts, and to fully compensate any damages caused, are becoming more stringent.

Understanding one's ecosystem impacts and dependencies is of key importance to companies, and CEV offers a "value-based" lens through which associated environmental, social, economic and financial issues can be quantified, and the complex trade-offs between them compared.

CEV can be applied to any aspect related to a business, such as a product, a service, a project, an asset or an incident and generally falls within one of the following four generic applications:

1. Calculate the change in value of ecosystem services associated with **trade-offs between alternative scenarios and their related impacts;**
2. Value the **total benefit of ecosystem services;**
3. Assess the **distribution of ecosystem service costs and benefits** across different stakeholder groups;
4. Determine **sources of revenues and compensation packages** relating to ecosystem service benefits and losses to stakeholders.

What is the business case for CEV?

The underlying business case for undertaking CEV is that it enables companies to improve decision-making and thereby increase revenue, save costs and boost the value of their assets and potentially share prices. As highlighted in Figure 1, this is achieved through managing a range of ecosystem risks and opportunities both internally and externally.

An underlying benefit of all CEV studies is that decision-making is improved by informing mindsets, behavior and actions among stakeholders and employees. For example, raising awareness of

The fourteen company road testers applied CEV to:

• Compare the societal costs of atmospheric emissions for three alternative chemicals used in paper production – AkzoNobel • Assess financial and societal costs and benefits of maintaining higher water levels in the canals and reservoirs associated with several hydropower facilities – EDP • Evaluate the ecosystem services impacts and dependencies relating to an existing oil operation and to a new development in a sensitive area near a national park – Eni • Evaluate the cultural services associated with tourism at a conservation area associated with a pumped storage scheme – Eskom •

ecosystem values can help when negotiating prices and costs – e.g. accounting for ecosystem values might justify price premiums on products.

This inclusion of ecosystem values can give rise to **external benefits**, which in turn helps companies comply with external requirements, demands and actions. These benefits can, for example, assess levels of **liability and compensation**; quantify environmental performance to better **measure company value**; and allow more complete disclosure of environmental issues and activities to assist with **reporting upon performance**.

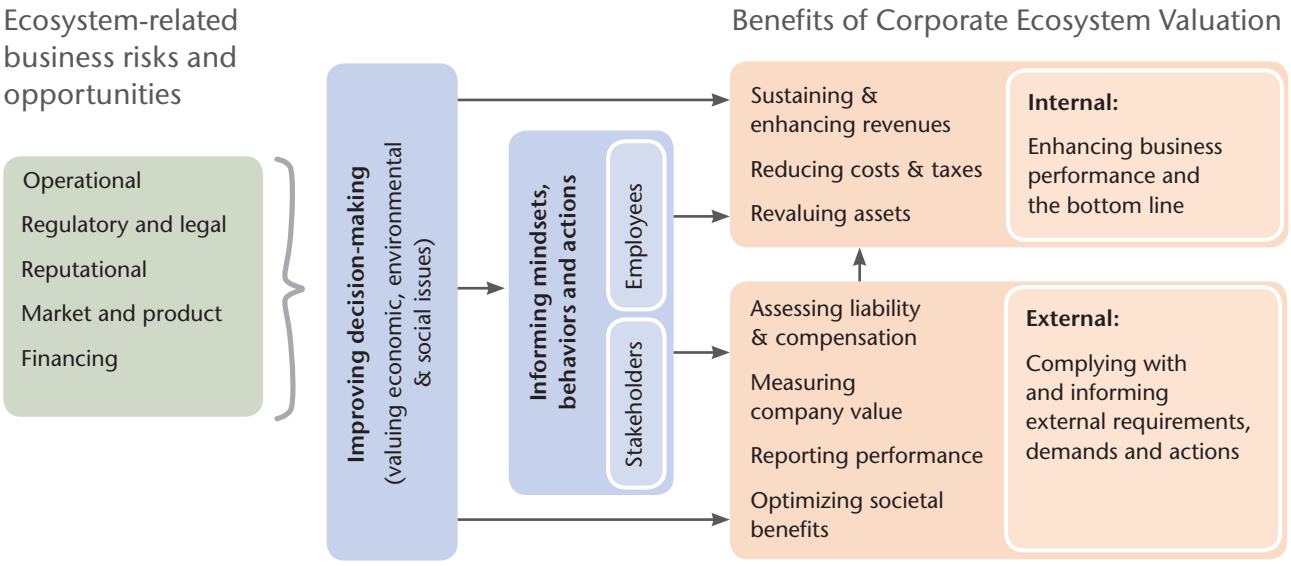
In turn these can also result in **internal benefits** which directly enhance business performance and the bottom line; for example, by helping to **sustain and enhance revenues, to reduce costs** and **revalue assets**.

The need for the Guide

The concept of ecosystem valuation is new to many businesses, even though it has developed significantly as a discipline over the past fifty or so years. It exists widely within numerous legal frameworks, including its application in the establishment of environmental liability and compensation. This is not, however, the only application of CEV, as the fourteen WBCSD member company road testers have demonstrated.

Ecosystem valuation is a complex topic with extensive jargon and rapidly evolving techniques. Although a multitude of related guidelines already exist, none cater directly for the needs of business. As companies start to show an interest in CEV, it is therefore essential to provide an approach that they can follow and rely upon, that is accepted by planners and decision-makers, and which has been developed through a process of close collaboration with businesses themselves. This is what this *Guide to Corporate Ecosystem Valuation* aims to do.

Figure 1: Business benefits of undertaking CEV



• Assess the value of ecosystem services provided under several catchment management options – GHD / SA Water • Evaluate the costs associated with carbon emissions for alternative manufacturing processes for multi-layer CCL (Copper-Clad Laminates) used in electronic products – Hitachi Chemical • Inform a rehabilitation plan for proposed extensions to a sand and gravel pit, and examine the net value of ecosystem services under several alternative scenarios – Holcim • Inform land management planning for reclamation of a quarry – Lafarge •

What is in the CEV Guide?

The Guide is divided into two parts.

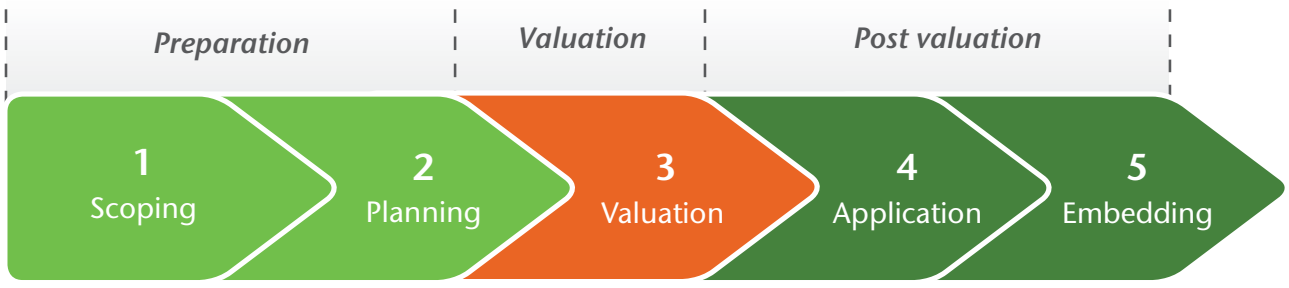
Part 1: Screening, or "Do you need to undertake a CEV?" answers some of the key questions that businesses might ask in relation to CEV: what it covers, how they might benefit from using the process, and what techniques and information are used. It also helps companies ascertain whether or not they need to conduct a CEV through a set of screening questions.

Part 2: CEV Methodology, or "How to conduct a CEV?" outlines a 5-stage process and a set of 12 principles for businesses to undertake CEV.

The CEV methodology presented in Part 2 consists of five stages, as illustrated in Figure 2 and explained below. The first two stages are necessary to prepare for the main valuation stage, and the final two stages assist in optimizing the results and embedding CEV into existing company processes.

1. **Scoping:** This stage helps companies identify specific business goals and an appropriate analytical context for CEV. This stage also facilitates the preparation of terms of reference for ecosystem valuation and helps build a strong internal case for any CEV project to be undertaken.
2. **Planning:** In this stage, the Guide explains how to elaborate a plan for the implementation of ecosystem valuation. This plan includes determining the internal and external resources required to conduct a CEV and developing a suitable timeline.
3. **Valuation:** The Guide identifies nine steps that are typically followed when undertaking ecosystem valuation, and describes each step to help companies conduct such valuations, or assess valuations they have previously commissioned.
4. **Application:** The Guide provides advice on how companies can use and communicate their ecosystem valuation results in order to influence internal and external change.
5. **Embedding:** In the final stage, the Guide gives suggestions on how to embed the CEV approach within existing company processes and procedures which address environmental issues.

Figure 2: The five stages of CEV



The fourteen company road testers applied CEV to:

• Map and value water dependencies among major water users in a South African watershed – Mondi • Assess the financial and social costs and benefits of conserving areas of rainforest as part of a policy of Net Positive Impact (NPI) on biodiversity – Rio Tinto • Assess the value of natural pollination, and the value of providing habitat buffer strips for native bees – Syngenta • Quantify physical ecosystem benefits realized through the process of matching undervalued or waste materials from one company with the needs of another – US BCSD / Houston By-Product Synergy •

The valuation stage (stage 3) has been developed in line with a typical Environmental and Social Impact Assessment (ESIA) process. However, CEV can readily link with many other existing company processes and analytical techniques. For example, CEV can easily be integrated into full cost accounting, life cycle assessments, land management plans, economic impact assessments, company reporting, and sustainability appraisals, to name just a few.

However, before embarking on CEV, companies should have a good understanding of the risks and opportunities they face in relation to their ecosystem impacts and dependencies. A reliable methodology for this is the **Corporate Ecosystem Services Review (ESR)**, developed by the World Resources Institute (WRI), the WBCSD and Meridian Institute.

It should also be noted that ecosystem valuation should be "fit for purpose" – it does not need to be highly accurate and expensive to undertake. A number of valuation tools are being developed to assist ecosystem valuation, but most are still in a development stage and require a degree of technical skill to use.

Ecosystem Valuation is coming – are you ready for it?

The Economics of Ecosystems and Biodiversity study (TEEB) – initiated by the G8+5 environment ministers (2007-2010) – has emphasized the concept of ecosystem valuation as a practical and influential aid to decision-making. Companies must anticipate that ecosystem valuation will be more consistently incorporated into public policies, regulations, and political decisions. Ecosystem values will be increasingly considered by the finance sector and business-to-business customers as they assess the biodiversity and ecosystem-related risks and opportunities of investments and supply chains.

In this respect, this *Guide to Corporate Ecosystem Valuation* "operationalizes" TEEB's key messages and recommendations by providing a practical approach for effective application at the company level. There is, however, still work to be done and areas that need improvement; for example, the availability of ecosystem service values in databases, standardization of values and valuation techniques, and the development of more robust and user-friendly valuation tools.

• Assess the financial and ecological benefits associated with replacing a storm-water management system with a constructed wetland – US BCSD / CCP • Prioritize water use and land management options relating to biofuel production in an ecologically and culturally important location – Veolia Environnement • Assess the economic value of ecosystem services produced under different management scenarios for forested land – Weyerhaeuser •

Acronyms

BAU	Business as Usual
BCR	Benefit Cost Ratio
BPS	By Product Synergy
CCP	Cook Composites and Polymers
CEV	Corporate Ecosystem Valuation
EMS	Environmental Management System
ES	Ecosystem Services
ESIA	Environmental and Social Impact Assessment
ESR	Corporate Ecosystem Services Review
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GIS	Geographic Information System
IUCN	International Union for Conservation of Nature
LCA	Life Cycle Assessment
MCA	Multi-Criteria Analysis
MA	Millennium Ecosystem Assessment
NGO	Non-Governmental Organization
NPV	Net Present Value
OEE	Other Environmental Externalities
SA Water	South Australian Water
SMART	Specific, Measurable, Attainable, Relevant and Time-bound
TEEB	The Economics of Ecosystems and Biodiversity
TEV	Total Economic Value
UNPRI	United Nations Principles for Responsible Investment
US BCSD	United States Business Council for Sustainable Development
VOC	Volatile Organic Carbons
WBCSD	World Business Council for Sustainable Development
WRI	World Resources Institute
WTP	Willingness to Pay

Key definitions

Biodiversity	The variability among living organisms within species, between species, and between ecosystems.
Business aspect	A product, service, project, asset or incident associated with a business.
Corporate Ecosystem Valuation (CEV)	A process to make better-informed business decisions by explicitly valuing both ecosystem degradation and the benefits provided by ecosystem services.
Ecosystem	A dynamic complex of plant, animal and micro-organism communities and their non living environment, interacting as a functional unit (MA, 2005). They make up the environment around us and are effectively habitats for example, coral reefs, forests, grasslands, rivers, farmland and urban parks, that support various species.
Ecosystem services	The direct and indirect contributions of ecosystems to human well-being. The concept "ecosystem goods and services" is synonymous with ecosystem services. They include provisioning services such as crops, fish, freshwater and timber; regulating services, such as climate regulation through trees sequestering carbon; and cultural services such as tourism and spiritual benefits.
Externality	A consequence of an action that affects someone other than the agent undertaking that action, and for which the agent is neither compensated nor penalized through the markets. Externalities can be either positive or negative.
Environmental externality	Environmental externalities include externalities to ecosystems and ecosystem services, but they also include impacts upon people, buildings and infrastructure and other economic activities (e.g. from air emissions).
No net loss	"No net loss" means that on balance the loss of biodiversity or ecosystem services are at least matched by the gain elsewhere.
Non-use value	The value individuals derive from knowing that environmental features are maintained (e.g. pristine habitats and iconic species) even though they do not directly or indirectly use them.
Offset (as in biodiversity offset)	Sustainable conservation actions intended to compensate for the residual, unavoidable harm to biodiversity caused by development projects, so as to aspire to no net loss in biodiversity.
Other environmental externalities (OEE)	For the purposes of this Guide, these are defined as "non-ecosystem service-related environmental externalities". They include externality values associated with carbon and other air emissions, which comprise impact upon health and buildings, etc.
Scenario	In this document, "scenario" and "option" are used interchangeably.

Introduction

What is Corporate Ecosystem Valuation?

Corporate Ecosystem Valuation (CEV) can be defined as a process to make better-informed **business decisions** by explicitly **valuing** both **ecosystem degradation** and the **benefits** provided by **ecosystem services**. By including ecosystem values, the company's aim is to improve corporate performance in relation to social and environmental goals and the financial bottom-line. Valuation can make decision-making around ecosystems more compelling and practical, thereby enhancing sustainable development strategies and outcomes.

How do businesses depend and impact on ecosystem services?

It is important to take a step back and to consider why CEV is necessary – how, exactly, are ecosystem services linked to business performance? The simple answer is that almost all businesses are directly or indirectly linked to the status and functioning of natural ecosystems. How ecosystem services are used by businesses, and how business activities affect the provision of ecosystem services, have a significant potential bearing on corporate performance, particularly if externalities are taken into account.

According to the Millennium Ecosystem Assessment (MA), there are four basic categories of ecosystem services: provisioning, regulating, cultural and supporting services – see Box 1 below. Together, these generate not only products and raw materials, but also the primary productivity and vital life-support services that are critical to human wellbeing and to the functioning of the economy.

Box 1: Categories of ecosystem services

Provisioning services

Products or goods such as water, fish & timber.

Regulating services

Ecosystem functions such as flood control & climate regulation.

Cultural services

Non-material benefits such as recreational, aesthetic & spiritual benefits.

Supporting services

Fundamental processes such as nutrient cycling & photosynthesis that support the other three categories.

Source: Based on WRI materials.

The first and most important thing to recognize is that all businesses depend upon, and in some way impact, the ecosystem services that are provided by the natural ecosystems and biodiversity that make up planet Earth.

Water, for instance, is a critical input for most, if not all, major industrial processes. The pharmaceutical industry benefits from nature's genetic resources. Agribusiness and the food sector depend on nature's pollination, pest control, water, and erosion regulation services. Forest industries – and downstream construction, communications and packaging sectors – rely on continued supplies of timber and wood fiber. All extractive industries inevitably cause some level of ecosystem disturbance, while tourism increasingly builds on nature's cultural services and aesthetic values. All building owners and plant operators benefit from the natural hazard protections that some ecosystems provide. In fact, it is hard to think of any economic activity that does not benefit from ecosystem services, or in some way impact the natural ecosystems around it.

However, very little is known about the actual value of these services for business, or the specific opportunities that they present in business terms. Such values have not, conventionally, formed a part of business planning and financial analysis.

What are the business consequences of ecosystem degradation?

Valuable services are being compromised because of the severe ecosystem degradation that has been taking place across the globe. The MA found that 60% of the world's ecosystem services have been degraded over the past 50 years.[2] Land use change, resource overexploitation, pollution, invasive species and climate change have all undermined the functioning of natural ecosystems.[3] These changes are being exacerbated further through factors such as rapid population growth and escalating consumption.

Ecosystem degradation presents a real, and increasingly pressing, risk to business operations. A number of global initiatives have highlighted these issues over recent years, and are beginning to shed light on the value of ecosystem services and the cost of their degradation and loss (Box 2). Information is starting to come to light which underlines the financial and economic consequences of ecosystem degradation and loss. This affects businesses and impacts on corporate profits, production and market opportunities. The clear message to business is that the status and functioning of ecosystems is not just a biological or ecological concern. It has major implications for economic growth, human wellbeing and business performance.

Box 2: How valuable are ecosystem services?

Through deforestation alone, the world loses ecosystem services worth between US$ 2-5 trillion each year.[4]

The global carbon market grew from virtually nothing in 2004 to over US$ 140 billion in 2009.[5]

The current global biodiversity offset market is worth a minimum US$ 3 billion and is expected to grow rapidly.[6]

Sustainability-related global business opportunities in natural resources may be in the order of US$ 2-6 trillion by 2050.[7]

The cost of global environmental externalities was nearly US$ 7 trillion (11% of the value of the global economy) in 2008, with the largest 3,000 companies causing around 35% of them.[8]

55% of corporate executives believe biodiversity should be among the top ten items on the corporate agenda, and 59% believe biodiversity is more of an opportunity than a risk for their companies.[9]

Various reports and studies – such as The Economics of Ecosystems and Biodiversity (TEEB) report – now reveal that the costs of ecosystem degradation are immense. We are, for example, losing US$ 2-5 trillion of ecosystem services each year just from deforestation, and the costs to the global economy associated with environmental externalities are estimated at nearly US$ 7 trillion per year.

Meanwhile, ecosystem services are also presenting a growing number of opportunities to build and strengthen businesses. The international market in biodiversity offsets is, for example, now worth a few billion dollars, while global trade in carbon is worth over a hundred billion dollars a year, and sustainable natural resource-based business opportunities are counted in trillions of dollars.

The overriding consensus is that an essential part of the solution for a more sustainable planet is to take better account of the true value of nature's wealth. At the same time, new market-based mechanisms that can capture these values need to be developed, as well as the smart regulation that reflects them.

Why Corporate Ecosystem Valuation?

Clearly, understanding ecosystem service dependencies and impacts is of key importance to almost all companies – if only we had the tools to measure these values and integrate them into business decision-making. CEV is targeted specifically at meeting these challenges. It provides a process to explicitly value and account for ecosystem costs and benefits in business decision-making.

The business benefit of using CEV is that it offers a "value-based" lens through which associated environmental, social, economic and financial issues can be quantified, and the complex trade-offs between them compared. It often achieves this by converting ecosystem dependencies and impacts into a single (and influential) metric – money. However, even if money is *not* always used in a CEV, the quantitative assessment a CEV study provides will be valuable input into any decision-making process. It generates information in a form that can be integrated with other aspects of business decision-making. As illustrated in Box 3, CEV can potentially assist companies address a wide range of decision-making issues and topics more effectively.

Box 3: Business decisions that CEV can help to make

- How significant are environmental risks from our operations?
- Which capital investment scheme provides the best combination of financial and societal outcome?
- What is the best mitigation measure that will avoid us incurring disproportionate costs?
- What are the best long term economic uses of our land holdings?
- How much should we pay stakeholders to change their behavior to save us incurring major capital investments?
- How can we convince regulators to change policies in order to improve management of natural resources that our business depends on?
- What potential revenues could we make from emerging environmental markets such as carbon, water and biodiversity?
- Which stakeholders should we compensate and at what price?

The ability to factor ecosystem values into business decision-making is becoming an ever-more pressing need because:

- There is increasing evidence that ongoing **ecosystem degradation has a material impact on companies** – undermining performance, profits, their license to operate and access to new markets.[10]
- New **opportunities are emerging** that are linked in some way to restoring and managing ecosystems. For example, according to WBCSD's Vision 2050 project, sustainability-related global business opportunities in natural resources may be in the order of US$ 2-6 trillion per annum by 2050.
- Communities, NGOs, customers, consumers and **shareholders are becoming increasingly conscious** of the interrelationship between business operations and the state of ecosystems, and are demanding that these issues are addressed, reported and accounted for.
- Meanwhile, in many parts of the world, **the regulatory and legal requirements** for companies to minimize and mitigate their ecosystem impacts, and to fully compensate any damages caused, are becoming more stringent.

All of these changing circumstances point to the conclusion that the time has come to find ways of integrating ecosystem values into business decision-making. CEV provides companies with a strategic advantage, because it offers a process for dealing with these external and internal demands. It allows businesses to recognize, manage and capture the value of ecosystem service risks and opportunities through understanding more fully the nature and magnitude of the values, and incorporating those values within business decisions.

Why the Guide?

The concept of ecosystem valuation is new to many businesses. With it comes a myriad of new jargon and approaches, and concerns over the implications of potential applications (and misapplications) for businesses. CEV is a process which is just emerging as a part of business planning.

As companies start to show an interest in CEV, it is essential to provide an approach that they can follow and rely upon, that is widely accepted by planners and decision-makers, and has been developed through a process of close collaboration with businesses themselves. This is what this *Guide to Corporate Ecosystem Valuation* aims to do.

Objectives of the Guide

This Guide explains how CEV can be used to improve corporate performance and decision-making. The aim is to provide a **consistent and robust ecosystem valuation framework for business managers, to link corporate ecosystem service risks and opportunities more directly to the company bottom-line**.

In addition, the Guide will:

- Explain the **basic concepts** around ecosystem valuation;
- Outline **business case arguments** to support CEV;
- Assist businesses to determine **whether or not** to undertake a CEV;
- Present a **5-stage methodology** for undertaking CEV;
- Provide a set of **valuation principles** to follow;
- Illustrate the range of potential CEV **applications** using the road testers;
- Provide useful hints drawing upon the **experience of road testers**;
- Highlight how companies can **incorporate** CEV results;
- Offer guidance on **embedding** CEV within company systems.

What the Guide covers

The Guide outlines four generic applications for CEV that can help to answer a range of business decisions:

1. Calculate the change in value of ecosystem services associated with **trade-offs between alternative scenarios and their related impacts**;
2. Value the **total benefit of ecosystem services;**
3. Assess the **distribution of ecosystem service costs and benefits** across different stakeholder groups;
4. Determine **sources of revenues and compensation packages** relating to ecosystem service benefits and losses to stakeholders.

The focus of the Guide is upon valuing ecosystem services. This includes ecosystem services which have a clear market price (such as timber, fish or crops), those for which market prices are emerging (for example, carbon) as well as those which do not currently have either a clear market or price but where this might change in the future (for example, watershed protection). In addition, the Guide provides some guidance on valuing "other environmental externalities" (OEEs) which are important to business, such as greenhouse gas (GHG) emissions and impacts of other pollutants.

The Guide has been developed to apply to the management of any business "aspect", including products, services, projects, processes, assets and incidents. It features fifteen pilot studies (by fourteen road testers, one of which carried out two studies) which report upon how businesses have actually "road tested" CEV. The Guide is relevant to all business sectors, although the "road test" examples are confined to applications from mining, oil and gas, chemicals, manufacturing, forestry, paper, energy and water sectors.

Structure of the Guide

The Guide is divided into two parts.

Part 1: Screening

or **"Do you need to undertake a CEV?"** answers some of the key questions that businesses might ask in relation to CEV: what it covers, how they might benefit from using the process, and what techniques and information are used. It also helps companies ascertain whether or not they need to conduct a CEV through a set of screening questions.

Part 1

Part 2: Methodology

or **"How to conduct a CEV?"** outlines a 5-stage process and a set of 12 principles for businesses to undertake CEV.

Part 2

Overview of CEV "Road Tests"

Helpful hint: four-page summaries of each of the road testers' experiences are available on www.wbcsd.org/web/cev.htm

Company	Sector	Country	Case Summary	CEV value added
AkzoNobel [AkzoNobel Pulp & Paper Chemicals (Eka Chemicals)]	Chemicals	*Global, head-quartered in Europe*	AkzoNobel compared the societal costs of atmospheric emissions for three alternative chemicals used in paper production. Benefit transfer was used to assess the value of externalities caused by greenhouse gases, SO_2, NO_x, VOC, dust and ammonia released in the life cycle from cradle to delivery at paper mill.	Sustaining & enhancing revenues – by assessing potential future regulatory costs, AkzoNobel can inform supply chain decisions. The results can also help manage reputational risks and opportunities so that the company can maintain and add to its current customer base, and also demonstrate company values supporting long term business.
EDP [Energias de Portugal]	Energy	*Portugal*	EDP assessed private and social costs and benefits of maintaining higher water levels in the canals and reservoirs associated with several hydropower facilities in a 7,200 ha watershed. Ecosystem services assessed include recreational uses, soil protection and water use (for consumption, irrigation, etc.) among others.	Sustaining & enhancing revenues – EDP could add customers and charge an appropriate price for energy by marketing the value of ecosystem services generated through sound management of their water network. Assessing liability and compensation – the valuation results will be useful for future renegotiation of mandatory financial liabilities as required under the EU Environmental Liability Directive.
Eni	Oil and gas	*Italy*	Eni evaluated the ecosystem services impacts and dependencies relating to an existing oil operation and to a new development in a sensitive area near a national park.	Sustaining & enhancing revenues – Eni could maintain a license to operate and identify potential new income streams from carbon sequestration and ecotourism. Avoiding costs – Eni could avoid costs associated with project delays by developing a good relationship with local authorities and stakeholders.
Eskom [Eskom Holdings Limited]	Energy	*South Africa*	Eskom evaluated the cultural services associated with tourism (specifically birding) at the conservation area associated with their Ingula pumped storage scheme.	Sustaining & enhancing revenues – Eskom could create an additional revenue stream and local jobs to manage the conservation area. Avoiding costs – costs associated with the management of a large conservation area could be avoided.
GHD / SA Water [GHD and South Australia Water Corporation]	Water	*Australia*	SA Water assessed the value of ecosystem services provided under several catchment management options. The ecosystem services evaluated included aesthetic and recreational values, erosion reduction, carbon sequestration and clean water.	Saving costs – improved management of catchment areas reduces the amount of treatment required prior to the distribution of water to customers. Optimizing societal benefits – the CEV helps make the case for investment in catchment management activities which will benefit a large and diffuse population that has been undervalued in the past.
Hitachi Chemical [Hitachi Chemical Co. Ltd]	Manufacturing	*Japan*	Hitachi Chemical evaluated the costs associated with carbon emissions for alternative manufacturing processes for multi-layer CCL (Copper-Clad Laminates) used in electronic products.	Avoiding costs – future costs could be avoided by managing CO_2 emissions and influencing internal behavior. The CEV helped to determine the "switching point" at which the company would change decisions around CO_2 management.

Overview of CEV "Road Tests"

Helpful hint: four-page summaries of each of the road testers' experiences are available on www.wbcsd.org/web/cev.htm

Company	Sector	Country	Case Summary	CEV value added
Holcim [Aggregate Industries UK, (a subsidiary of Holcim)]	Mining	*UK*	Aggregate Industries applied a CEV to better inform the rehabilitation plan for proposed extensions to a sand and gravel pit as part of the UK permitting process. The study examined the value of ecosystem services including wildlife habitat, flood control, recreation and carbon sequestration, generated for local communities and the wider region under several alternative restoration scenarios, including restoration of agricultural land and establishing a mix of wetlands, as well as an artificial lake.	Sustaining revenues – by enhancing relationships with authorities and communities, Holcim hopes the CEV process will complement national and regional biodiversity planning requirements, helping them develop a holistic plan for new extraction sites. Optimizing societal benefits – by informing stakeholder negotiations, it is hoped that the process of CEV will strengthen decision-making in the process of compensation for damage, and by rehabilitating quarry sites, particularly when there is disagreement among stakeholders.
Lafarge [Lafarge North America Inc. (LNA)]	Mining	*USA*	Lafarge assessed the value of ecosystem services to inform land management planning for reclamation of a quarry in Presque Isle, Michigan. The services evaluated included erosion regulation, water purification and recreation/ecotourism.	Saving costs and optimizing societal benefits – through better decision-making, the CEV results can be used to inform land management best practice for mining and rehabilitation plans.
Mondi	Paper	*South Africa*	The ESR identified freshwater, and the growing water stress in the Mhlatuze catchment, as a critical ecosystem service. Mondi used GIS-based analysis to map land use and value water dependencies among major water users in this South African catchment. The results form a base for predicting future water constraints and opportunities for forest plantations and mills owned by the company.	Resource efficiency – collating valuable data sets into a GIS framework for managing impacts and opportunities within constrained resources. Sustaining revenues – reducing operational risk from potential water shortages in the future. Optimizing societal benefits – improving decision-making at local and catchment level. The CEV will facilitate better coordination and planning with other resource users (municipal areas, farmers, etc.) to address efficiency of use in the context of a constrained resource.

Rio Tinto	Mining	*Madagascar*	Rio Tinto assessed the financial and social costs and benefits of conserving areas of rainforest as part of the company's policy of Net Positive Impact (NPI) on biodiversity at an operational level. Ecosystem services examined include carbon sequestration, ecotourism, habitat conservation and hydrological regulation.	Optimizing societal benefits and assessing compensation – positive outcomes are necessary for local communities affected by operations or conservation activities. Sustaining business – Rio Tinto's access to resources, capital and markets is increasingly dependent on its reputation, its biodiversity record and biodiversity policies, as well as its management practices. Enhancing revenues – Rio Tinto could explore current and potential markets for ecosystem services and biodiversity offsets to reduce costs of biodiversity programs and to generate sustainable income streams for local communities. Fuller cost accounting – the company is working towards more transparent and complete accounting of its use of, and investments in, natural capital. As a large landholder, the company is exploring how to improve information regarding the value of ecosystem services produced on its non operational and operational landholdings.
Syngenta	Agriculture	*USA*	Syngenta assessed the value of pollination services provided by wild bees to blueberry farms in Michigan USA and the value of providing habitat buffer strips for native bees.	Sustaining revenues – the results of the CEV accentuated the case for farmers to invest in native bee habitat adjacent to farmland, in order to sustain agricultural outputs.
US BCSD / BPS [US BCSD - Houston By-Product Synergy]	Manufacturing	*USA*	Houston BPS utilized Eco-LCA, an ecological life cycle assessment tool, to quantify physical ecosystem benefits realized through the process of matching undervalued or waste materials from one company with the needs of another. The value of ecosystem impacts and dependencies was assessed for tires, asphalt, acetic acid, aluminum oxide, and other materials.	Sustaining revenues – CEV enables companies participating in a BPS scheme to market the additional value of ecosystem services preserved to customers. It also presents a more complete accounting for the benefits of BPS to internal decision-makers.
US BCSD / CCP [US BCSD - Cook Composites and Polymers]	Manufacturing	*USA*	Cook Composites assessed the financial and ecological benefits associated with replacing the storm water management system for a manufacturing facility in Houston with a constructed wetland for on-site flood control and water treatment.	Sustaining revenues – CCP could maintain a social license to operate and a good reputation with consumers and regulators. Saving costs – CCP could save costs associated with updating and maintaining an aging storm water management system; potential additional supply chain cost savings due to CO_2 emission reductions.
Veolia Environnement	Water	*Germany*	Veolia used CEV to help prioritize water use and land management options for a parcel of land owned by Berlin Wasserbetriebe (BWB). Ecosystem services evaluated included recreation and non-use values, biofuel production and other crop production.	Saving costs – the CEV results help to make the case for growing biofuels on areas of the site, a scenario which would reduce the water company's tax and maintenance costs. Sustain and enhance revenues – the results demonstrate the potential for Veolia Environnement to capture additional revenue from water use and visitors at sites they manage.
Weyerhaeuser	Timber	*USA, Uruguay*	Weyerhaeuser assessed the economic value of ecosystem services produced under different management scenarios for forested land owned by the company. The scenarios included different mixes of tree species, biofuel crops, and other land uses.	Sustain and enhance revenues – the CEV results may help Weyerhaeuser capture new income streams by adjusting management regimes to take advantage of markets for ecosystem services as they emerge.

Part 1: Screening
"Do you need to undertake a CEV?"

The following pages provide clarity on what the Guide covers, and answer a number of questions which might be relevant when considering whether or not to undertake a CEV.

The main focus is valuing ecosystem services

As the name suggests, CEV is focused on valuing ecosystem services. This includes both the benefits arising from their use or enjoyment, as well as the costs and losses associated with their degradation. CEV looks at the stocks and flows of ecosystem services, as well as any changes to their quantity and/or quality.

Biodiversity is not valued separately

Biodiversity is defined by the Convention on Biological Diversity as "the variability among living organisms from all sources", including "diversity within species, between species and of ecosystems". Biodiversity is therefore not an ecosystem service, but is rather an attribute of the natural world. It underpins the supply of all ecosystem services; greater biodiversity tends to support a broader range of ecosystem services and to enhance their productivity and resilience and, in some cases, the presence of biodiversity enables or stimulates certain ecosystem services (for example, tourism and cultural values). The value associated with the conservation of biodiversity commonly goes under the title of "cultural service" through recreational use value, and non-use values whereby individuals may be willing to pay for the maintenance of biodiversity, with no intended practical use.

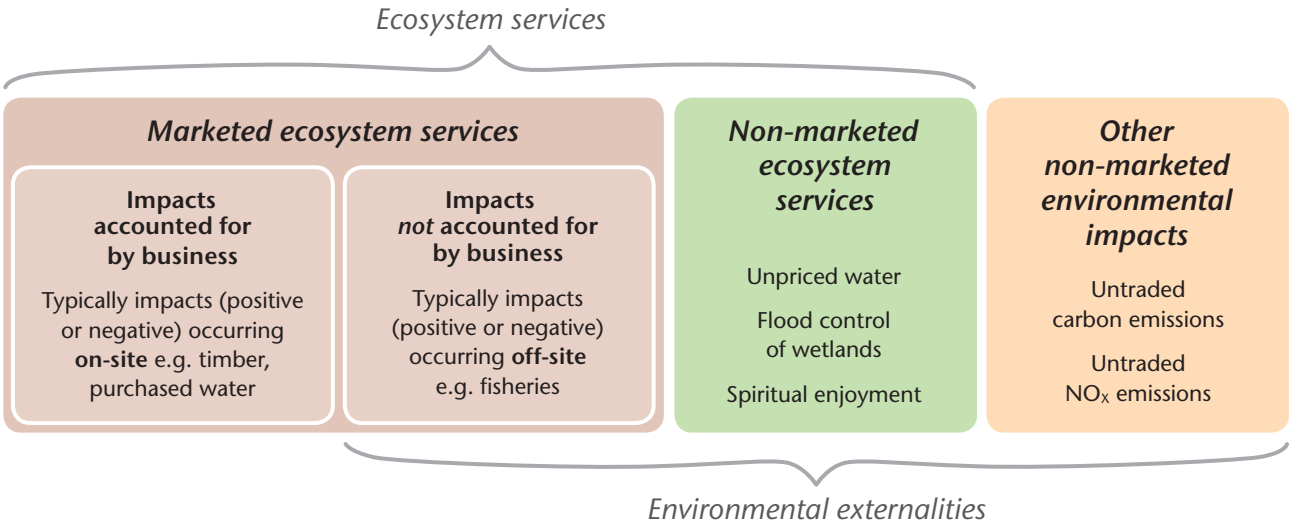
How are environmental externalities dealt with in CEV?

Environmental externalities are defined as any impact on the environment that a company's actions cause (or that impact on a company as a result of others' actions), that is not compensated (in the case of a negative externality) or rewarded (in the case of a positive externality). An example of a positive environmental externality is when one landholder's investment in upper catchment conservation benefits other downstream users. An example of a negative externality is when the abstraction of water upstream leaves insufficient flow or quality for human and natural systems downstream.

The concept of externalities can apply to ecosystem services when they do not have a market which would enable this reward or compensation to be paid. In this sense, a company's impacts and dependencies on all **non-marketed** ecosystem services are environmental externalities, and can be assessed by CEV. However, CEV also provides the means of including the externalities associated with **marketed** ecosystem services, but which would not normally be included in a financial analysis – for example, because they occur indirectly, they are felt at quite a distance off-site, or accrue to stakeholders who are excluded from a company's calculations.

In addition, a variety of **"other environmental externalities" (OEEs)** that are not *directly* related to ecosystem services, but that are relevant to businesses, might sometimes be included in CEV. These include, for example, the costs associated with emissions such as greenhouse gases, NO_X and SO_2. There are advantages in including OEEs into a CEV, as they provide a more holistic perspective of the company's impacts, potentially resulting in more sustainable decision-making.

Figure 3: The relationship between ecosystem services and environmental externalities



CEV covers both financial and societal values

Any financial values that are associated with ecosystem services (for example, the purchase of land, payments for water, sales of timber or trading in carbon credits) should already be captured in conventional business analysis techniques, in so far as they affect the company's bottom-line. The added value of CEV is that it also measures the broader economic or societal, marketed and non-marketed values that are affected by a company's dependencies and impacts on ecosystem services (for example, the loss of forest ecosystem services when timber clear-felling takes place, or the improvements in downstream water quality that result from cleaner production). In other words, CEV measures the broader positive and negative externalities associated with a company's effects on ecosystem services. The results of CEV therefore lend themselves well to feeding into both financial (from the viewpoint of the company concerned) and economic (from the viewpoint of society or the broader economy) analyses.

CEV is based on the total economic value of ecosystem services

Ecosystem services provide four categories of economic value that make up the "Total Economic Value" of an ecosystem:

- **Direct** use values (timber, recreation or food, etc.);
- **Indirect** use values (flood control, watershed protection, etc.);
- **Option** values (the "premium" placed on maintaining ecosystem services for future possible uses);
- **Non-use** values (values gained without any physical use of ecosystems).

These categories are *broadly* in line with the scheme of provisioning services (direct use values), regulating services (indirect use values) and cultural services (non-use and direct use). In addition, it must be noted that ecosystems and species have their own "intrinsic" value, irrespective of human values. For more information, please see the on-line resource notes (www.wbcsd.org/web/cev.htm).

Ecosystem costs and benefits can be measured in many different ways

The Guide is concerned with measuring ecosystem dependencies and impacts in terms of economic (societal) and financial values. The broader "economic impacts" of business activities affect different groups in different ways. Examples include gains and losses in tax revenue, investment flow, jobs and foreign exchange earnings. The measurement of these economic indicators is not dealt with directly in this Guide. This is because they represent a different way of measuring the market-based values covered in CEV, and are covered by other guidelines, such as the WBCSD's Measuring Impact Framework (2008). Providing both types of information can be useful for decision-making, as long as caveats are made with respect to potential double-counting.

Which business risks and opportunities can CEV evaluate?

The ESR identified five categories of business risks and opportunities associated with the degradation and enhancement of ecosystem services. As shown in Box 4, CEV can help evaluate these risks and opportunities by quantifying ecosystem service impacts and dependencies in monetary terms. In addition, the actual process of undertaking CEV can also help to improve the degree to which these risks and opportunities are managed, in order to enhance business values.

Box 4: How CEV can be used to evaluate business risks and opportunities

Operational risks relate to a company's day-to-day activities, expenditures and processes. CEV can be used to inform operational risks along the whole value chain. Similarly, companies can use CEV to investigate the risk of paying more for ecosystem dependencies such as water, and for environmental externalities. In terms of **operational opportunities**, CEV can help improve operational efficiencies and save costs, for example, by finding lower-cost ways of securing clean water supplies and flood control through maintaining ecosystems rather than investing in expensive technological solutions.

Regulatory and legal risks include government policies, laws, and court actions. CEV is commonly applied to assess the value of environmental damage to inform compensation payments. It is also used to inform risk assessment and to prioritize when dealing with risks. In terms of **regulatory and legal opportunities**, CEV can be used to demonstrate the value of improving ecosystem management policies, regulations and incentives to stakeholders and regulators. For example, companies dependent on ecosystem services, such as water or storm protection, could benefit from more sustainable catchment management practices.

Reputational risks affect a company's brand, image, "goodwill" and relationships with their customers and other stakeholders. In some cases, CEV can help to inform the assessment of reputational risks, if perceived impacts to ecosystems are a cause of the problem.

Reputational opportunities could involve using CEV to help justify implementing and communicating sustainable purchasing, operating or investment practices in order to differentiate corporate brands.

Market and product risks relate to product and service offerings, consumer preferences, and other market factors that affect corporate performance. CEV can help to identify and evaluate products that rely on resources with high environmental costs, or give rise to pollutants with high externality costs. **Market and product opportunities** include using CEV to identify opportunities and to estimate potential new revenue streams when participating in emerging environmental markets.

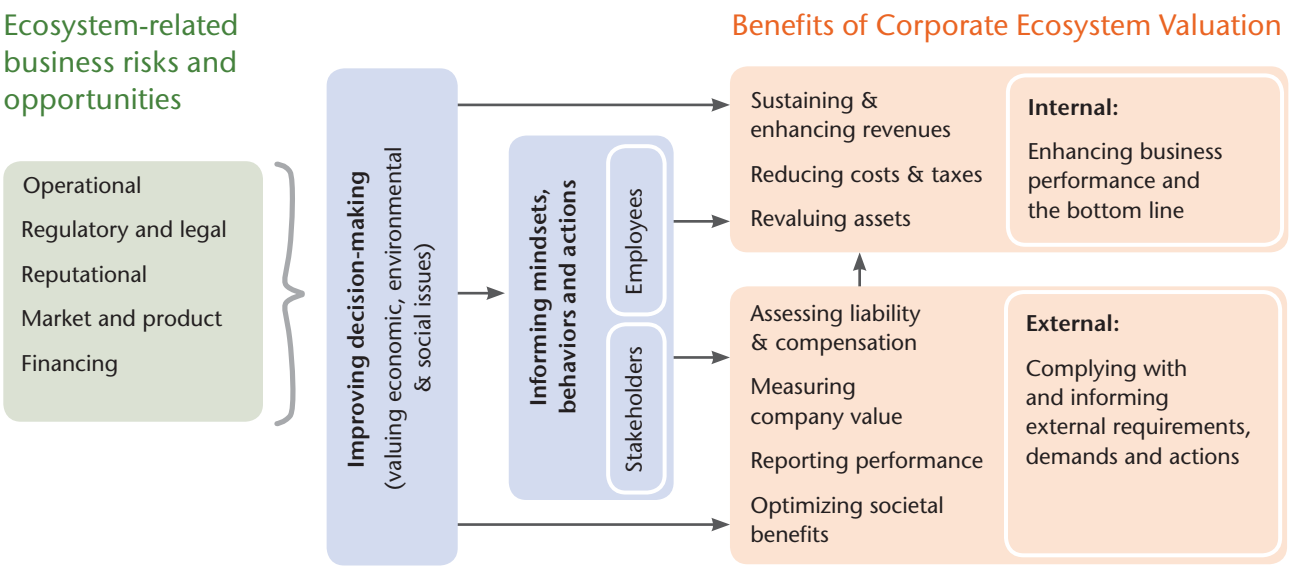
Financing risks affect the cost and availability of capital to companies. CEV can be used to identify cost-effective "no net loss" scenarios for major developments. This can help, for example, receive project finance loans for complying with the 'Equator Principles' and the underlying IFC biodiversity performance standards or a bank's own biodiversity policies. **Financing opportunities** could potentially include companies obtaining more favorable lending terms, or access to new green funds. This could be facilitated through using CEV to quantify, and systematically reduce, company impacts to ecosystems services and negative environmental externalities.

What are the business benefits of undertaking CEV?

There are many benefits to be gained from undertaking CEV. Perhaps most importantly, it enables companies to improve their decision-making by pointing to ecosystem service-related risks and opportunities that might not normally be included in conventional approaches to planning and analysis. The aim is to generate internal benefits by enhancing business performance and the bottom-line, and also help companies to comply with and inform external requirements, demands and actions (Figure 4).

In turn, a company using CEV would expect to see these benefits manifested in concrete gains in performance. As shown in Box 5, the application of CEV aims to demonstrate ways of increasing revenue, saving costs and boosting the value of assets and potentially share prices, as well as improving company reporting and accountability.

Figure 4: Business benefits of undertaking CEV



Box 5: The business benefits of undertaking CEV

Improving decision-making

A core underlying benefit of all CEV studies is that they help to strengthen decision-making around a company's environmental impacts, use of natural resources, profitability and equitability. They provide an additional "value-based" lens that allows risk and opportunities to be quantified, and complex trade-offs to be compared, often using the single metric of money. CEV thus contributes towards assessing sustainability, because it allows economic, environmental and social issues to be dealt with in terms of a common metric. In addition, CEV provides a process which helps prioritize and add urgency to important environmental issues, and can often contribute positively towards building trust with external stakeholders and regulators, as well as demonstrating leadership in corporate sustainability issues.

Informing mindsets, behaviors and actions

In many cases, CEV benefits businesses because it informs the mindsets, behavior and actions of company staff and external stakeholders. For example, CEV will often contribute towards raised awareness and increased understanding concerning environmental issues, and inform company staff, shareholders and consumers about the true value of different ecosystem impacts and options. The impact of these changes in attitude can be wide-ranging – CEV results can, for instance, influence broader company policy, and even inform government regulations and policies. In addition, CEV can directly benefit business because it provides information which can be used to better negotiate costs and prices, both internally and externally.

Sustaining and enhancing revenues

CEV can help to justify investing in natural capital as a key input to production. Using CEV can also improve a company's reputation for sustainability, and help to sustain future revenues through preferential access to new raw materials. CEV can help to scope out and plan for a company's involvement in new ecosystem markets and revenue streams (e.g. biodiversity offsets, carbon credits and watershed payments). It can assist with setting more appropriate prices (including "green premiums") that fully reflect ecosystem service values and/or reduced externalities. CEV can also determine and verify the environmental benefits associated with new products and services such as new technologies and business solutions, thereby helping to market and sell them.

Reducing costs and taxes

CEV can be used to demonstrate cost savings from maintaining or creating ecosystems, for example, to provide more cost-effective flood control and water treatment than alternative technological measures. It can be used to help to prioritize the use of limited natural resources, such as water, within a catchment area. CEV can also identify areas of focus when reducing pollutants, such as modifying manufacturing processes, to avoid increased costs from evolving environmental markets (e.g. carbon and NO_X). Companies may also be eligible for reduced taxes for managing assets to generate ecosystem services which yield broader social benefits.

Revaluing assets

CEV can allow companies to quantify the true value of the natural assets that they own or have access to, through determining the broader benefits they provide and identifying ways to capture that value.

Assessing liability and compensation

As environmental regulation becomes ever-more stringent, companies are facing an increasing array of penalties, fines and compensation claims when their operations damage ecosystems. CEV can help to inform project appraisal and risk assessment to minimize such threats, and gauge the cost of ecosystem damage if claims are made against companies.

Measuring company value

CEV provides a means to quantify environmental performance improvement and allow external sources to factor this in their evaluation of company and theoretical share values.

Reporting performance

CEV can help measure a company's environmental performance, and facilitate more complete reporting and disclosure. CEV can also be used to indicate the value of externalities or to form the basis of case studies outlining how a company may lead the way in accounting for wider environmental and social impacts.

Optimizing societal benefits

CEV can help inform stakeholder negotiations and strengthen the decision-making process by facilitating better coordination and planning with other stakeholders. CEV can be used to help select alternatives that provide a net positive or maximum benefit to society.

How relevant is CEV to my business?

CEV is relevant to almost all businesses, either directly or indirectly. It is particularly important for companies that depend or impact directly on ecosystem services – the "biodiversity dependent", "large footprint", "manufacturing" and "green enterprise" business sectors illustrated in Figure 5. Such companies face obvious risks and opportunities associated with ecosystem services. However, even companies that do not depend or impact directly on ecosystem services stand to benefit from the use of CEV. Financial service organizations, for example, may fund or insure companies with significant exposure to ecosystem service risks and opportunities – and need to be able to gauge ecosystem-related monetary impacts and the probability that these might affect the company bottom-line.

Figure 5: Links between business sectors and ecosystem service values

	Biodiversity dependent industries (e.g. fishing, agriculture, forestry)		**Large 'footprint' industries** (e.g. mining, oil and gas, construction)		**Manufacturing & processing** (e.g. chemicals, ICT, consumer products)		**'Green' enterprises** (e.g. organic farming, ecotourism)		**Financial services** (e.g. banking, insurance & other financial intermediaries)	
Key Ecosystem Services	***DEPEND***	***IMPACT***	***DEPEND***	***IMPACT***	***DEPEND***	***IMPACT***	***DEPEND***	***IMPACT***	***DEPEND***	***IMPACT***
Provisioning										
Food	●	●	○	●	●	●	●	○	●	●
Timber & fibers	●	●	●	●	●	●	●	○	●	●
Freshwater	●	●	●	●	●	●	●	○	●	●
Genetic / Pharmaceutical resources	●	●	○	○	●	●	●	○	●	●
Regulating										
Climate & air quality regulation	●	●	●	●	●	●	●	○	●	●
Water regulation & purification	●	●	●	●	●	●	●	○	●	●
Pollination	●	●	-	○	○	○	●	●	●	●
Natural hazard regulation	●	●	●	○	●	○	●	○	●	●
Cultural										
Recreation & tourism	○	●	-	●	-	○	●	●	●	●
Aesthetic / non-use values	○	●	-	●	-	○	●	●	○	●
Spiritual values	○	●	-	●	-	○	●	●	○	●

● *Moderate to Major relevance* ○ *Minor relevance* - *Not relevant (typically)*

Note: "Supporting services" are not included in this table as they are already captured within provisioning, regulating and cultural services.

What can CEV be used for?

There are four generic applications of CEV in business decision-making (summarized in Table 1) which have, in turn, been used in different ways by the CEV road testers. They can also be used in combination.

Table 1: Generic applications of CEV in business decision-making[11]

What business decision is needed?	How can CEV help?
What is the best option from a range of alternatives? What is the full company and societal cost/benefit from a particular company aspect?	Trade-off analysis can assess the net financial and economic costs and benefits associated with different impacts to ecosystems caused by an intervention. This application is useful for impact assessments, option appraisals, pricing products, etc.
What is the true total value of a landholding or natural asset?	Total valuation can determine the total value in terms of the flow of financial and economic benefits that ecosystems contribute to a business and society. This application is useful for asset revaluations, land management and risk assessments.
Which stakeholders are affected by different company impacts, and by how much? Which stakeholders depend and impact upon ecosystem services, and by how much?	Distributional analysis can identify the extent to which stakeholders depend and impact upon ecosystem services. This application is useful for determining winners and losers from any intervention, and for equitability, liability/compensation, practical and incentive-related reasons.
Which stakeholders could contribute to the ecosystem services they benefit from, and how much? Which stakeholders deserve compensation and how much?	Sustainable financing and compensation analysis can help identify ways a business can develop new or enhanced revenue streams and best compensate stakeholders in relation to ecosystem service dependencies and impacts. This application is useful for enhancing revenues and evaluating compensation claims.

The most common application is known as **trade-off analysis**. This can be used to value ecosystem changes associated with single company aspects (such as a project or an oil spill) or to compare outcomes from alternative options (for example, in capital expenditure investment analyses). CEV is used to value and compare the trade-offs between different impacts (e.g. relating to carbon, water, food, biodiversity, landscape, etc.). All road testers drew upon this application.

An alternative application, known as **total valuation**, uses CEV to estimate the full range of values associated with an ecosystem. This can be used to determine the total value of natural assets and land owned by a company or others. In this case, CEV involves measuring the annual flow of different ecosystem services, and converting them into an aggregated monetary value.

The two remaining applications are often undertaken in conjunction with one of the applications described above, and are commonly applied together.

Distributional analysis identifies the winners and losers from a particular course of action that results in a change in the supply of ecosystem services. It can be applied to a specific company aspect, or more generally to land and activities over a wider area.

The fourth application is referred to as **sustainable financing and compensation analysis**. It identifies the sources of revenue that can potentially be captured from the people who gain from a positive change in ecosystem services, or the potential compensation packages that might be offered to those who lose out. The third and fourth applications are ideal for dealing with equity issues, and were commonly applied by the road testers.

Can CEV support existing company analytical approaches?

CEV aims to generate information that can be integrated into existing corporate planning and analysis processes. It essentially provides businesses with a more complete set of information (on ecosystem costs and benefits).

Financial methods (for example, management accounting analyses) can draw on CEV results, especially when evaluating cost savings and revenue-generation schemes. Some companies are beginning to undertake **full-cost accounting** exercises, **economic impact assessments** and **extended cost-benefit analyses** which have the explicit aim of incorporating environmental costs and benefits; CEV is an ideal way of generating information to feed into these analyses.

Liability and compensation claims, and the **environmental and natural resource damage assessment** procedures that guide them, lend themselves naturally to the use of CEV. These are often backed-up by specific regulations and guidelines that require, or are compatible with, CEV. Along the same lines, some heavily-regulated industries and public companies (for example, water utilities and oil companies) are increasingly expected to demonstrate that they are **generating public benefits**. CEV provides valuable information to demonstrate that this is the case.

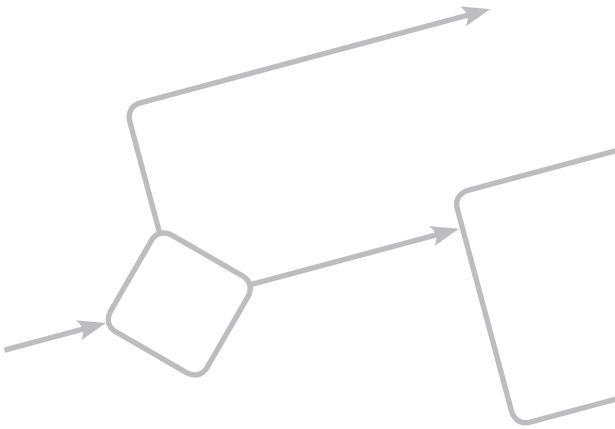
In addition, CEV can support **many other analytic approaches** that are routinely used by companies, and which can benefit from information on ecosystem costs and benefits. Examples include Environmental and Social Impact Assessments (ESIAs), risk assessments, life cycle assessments (LCAs), environmental management systems (EMS), and land management plans.

Should CEV involve qualitative, quantitative or monetary valuation?

In principle, it is possible to value ecosystems in qualitative, quantitative or monetary terms (Box 6), each involving a different level of detail. It is desirable, however, to use a combination of these approaches in CEV.

Monetary valuation provides a particularly important means of aggregating, comparing and communicating different ecosystem service values. Nevertheless, to limit CEV to monetary indicators alone would run the risk of excluding important ecosystem benefits and costs as it is rarely possible to quantify or monetize each and every ecosystem value. Incorporating some level of qualitative analysis ensures that even when key ecosystem costs and benefits cannot be expressed in numerical or monetary terms, they are given some weight in analysis.

As suggested in the methodology, CEV should generally begin with a *qualitative* assessment to identify priority ecosystem services. Based on this information, a *quantitative* assessment can be undertaken, and finally a *monetary* valuation may be carried out for some or all of the ecosystem costs and benefits identified. There will, however, sometimes be situations where qualitative or quantitative assessments will suffice to inform the business decision to be made.



Box 6: Hierarchy of valuation approaches

Qualitative review:

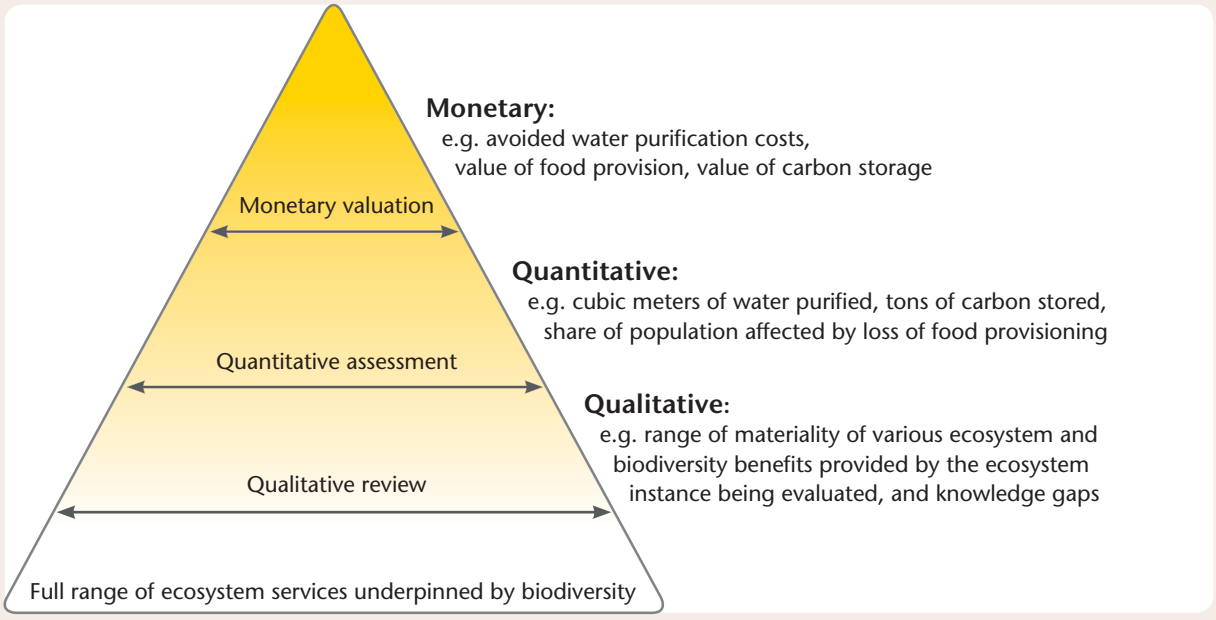
This approach involves describing the value and ideally indicating the relative scale of value, for example, in terms of high, medium or low.
The scaling needs to be relative in terms of all the ecosystem services being assessed at a specified geographical level (e.g. site or global level etc.). Thus a business impact may reduce the productivity of a lake fishery affecting the revenues (and livelihoods) of a number of local people from several villages, representing a "medium" loss of value.

Quantitative assessment:

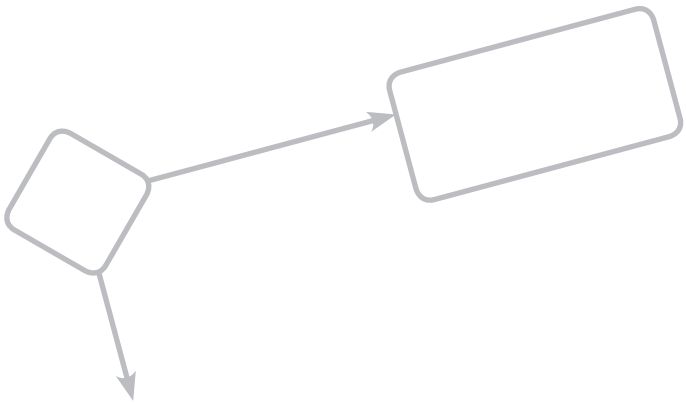
This approach involves describing the nature of the value in terms of relevant quantitative information. For example, the above mentioned fishery impact may cause an estimated 25% decline in fish caught by 40 fishermen from 4 villages who catch an average of 2 tons of fish per year.

Monetary valuation:

This approach involves placing a "monetary" value on the impact. It translates quantitative valuation into a single common currency, so as to enable aggregation and comparison. For example, the fishery impact in this case may result in a loss in net profits of US$ 50,000/ year, with two villages losing US$ 20,000 each and the other two losing US$ 5,000 each.



Source: P. ten Brink as cited in TEEB – an interim report (2008)



How accurate do CEVs need to be?

There is, to some extent, a trade-off between conducting a very detailed and time-consuming exercise and the need for rapidly generated decision-support information based on available data and knowledge. As with any research or analytical work, CEVs can range from rapid "back of the envelope" calculations to complex scientific studies. In practical terms, most CEV exercises lie somewhere in the middle of this spectrum. A company must balance the time, money and expertise they have available to spend on a CEV against the complexity of the issue with which they are dealing, and the need to generate timely decision-support information.

It is, however, important to emphasize that undertaking a CEV is not the same as commissioning academic research, and that rapid studies do not automatically translate into a compromise on quality or detail. In most cases, ecosystem service valuation does not need to be lengthy or expensive. While a CEV should always generate credible information, the key point is that it should be fit for purpose. In other words, the techniques used, and level of detail provided, should be commensurate with the purpose for which the CEV is being used. For example, when CEV is being used for initial screening or feasibility assessment, broad ballpark values will generally suffice. When justifying major investments, assessing significant compensation claims or reporting to the general public, more accurate and robust valuations are usually required.

The credibility of a CEV is also highly dependent on the basic scientific parameters and assumptions that are used in the analysis. Accurate ecosystem valuation always requires a good understanding of the relationship between ecosystem change, ecosystem service provision, and economic or human wellbeing indicators. This almost always requires input from scientists and technical specialists. Valuation of the downstream impacts of afforestation, for example, must be based on sound data concerning the link between land cover and hydrology, and economic quantification of the externalities arising from the release of SO_2 and NO_X relies upon good information on the resulting human health impacts.

This is a key point, as many ecosystem valuation exercises do not pay sufficient attention to establishing credible or well-informed biophysical and dose-response relationships before imputing benefits or costs. It is also important because scientific uncertainty or lack of knowledge concerning the links between cause and effect is a common limitation. Lack of full information should not, however, prevent a CEV exercise from taking place. Best practice in CEV involves setting out the assumptions that have been used to ascertain a particular figure, making it explicit when background information is lacking, and justifying why the resulting estimates are reasonable and realistic.

Which techniques does CEV use to value ecosystem services?

CEV uses a standard suite of valuation techniques to put a monetary value on ecosystem services. These go beyond the use of market prices (the conventional way economists measure the value of goods and services), and include a range of methods that enable the valuation on non-market benefits and costs. Although not without limitations, some are already commonly used and widely accepted in environmental economics.

When undertaking a CEV, it is necessary to decide which method to use to value a given ecosystem benefit or cost. While some of the techniques in the standard environmental valuation toolbox lend themselves more readily to certain types of ecosystem service (Box 7), the selection of valuation methods is typically also determined by the data, time and resources available to carry out the CEV. Further guidance is provided at www.wbcsd.org/web/cev.htm on selecting and applying ecosystem valuation techniques.

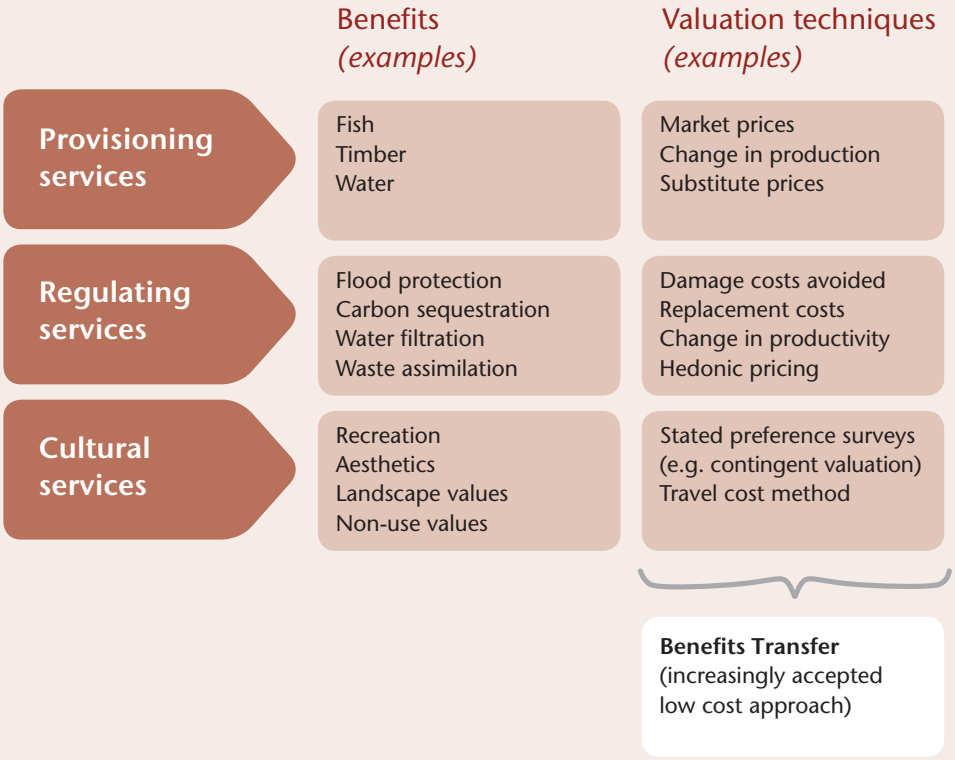
Box 7: Commonly-used ecosystem valuation techniques

Revealed preference techniques: These techniques rely on people's behavior to reveal their preferences. This includes using market prices where they exist and estimating changes in yield associated with altered ecosystems (change in productivity). Other examples include inferring the value of visitor trips based on time and costs incurred getting to a site (travel cost method), and establishing a price premium associated with environmental attributes, such as the fact that houses near clean rivers are worth 10% more (hedonic pricing).

Cost-based approaches: These rely on market costs to provide a proxy for the true value. For example, the value of wetland flood control can be estimated based on the cost of building a man-made equivalent (replacement cost). Alternatively, its value can be estimated based on predicted flood damage it prevents (damage costs avoided). These approaches are well suited for valuing regulating services, and the costs are readily determined.

Stated preference approaches: These involve questionnaire surveys that ask individuals about their preferences. For example, "contingent valuation" asks an individual their "willingness to pay" (WTP) to secure their preferred environmental option, while "choice experiments" ask people to select their preferred option from a set of costed alternatives. These techniques are good for valuing recreational visits and are the only primary techniques available to estimate non-use values. Detailed stated preference surveys can be expensive and time consuming to undertake, but low cost versions can still provide valuable information if conducted carefully. Due to the many potential biases involved, expert involvement in their design and analysis is essential.

Value (or benefit) transfer: This involves applying values estimated from studies elsewhere to the study site in question, with appropriate adjustments. This can be relatively inexpensive and quick to implement, and databases of values are becoming freely available. However, it must be applied carefully and transparently to avoid significant errors.



What tools are available to help undertake a CEV?

The majority of ecosystem valuation studies use simple, tailor-made spreadsheet models. By their very nature, such tools are highly flexible, readily aligning with business objectives and processes. They can draw upon valuation databases and can link to other tools such as Geographic Information System (GIS). The latter is particularly useful for ecosystem service mapping and calculations.

Various web-based tools, data models and GIS based approaches used to value ecosystem services have recently begun to be developed.[12] Most involve input of user key data on the specific site, ecosystem service or sector that they are concerned with, and combine this information to generate valuation results. Many use aggregated or averaged information on ecosystem values taken from other sites and contexts, or are based on the application of national, regional or global estimates concerning the value of key ecosystem services. As such, they should be treated with great caution. Most are still in a developmental stage, dependent on doubtful data, and are often cumbersome and inflexible to use.

How to carry out screening

Before initiating CEV, it is usual to carry out a screening exercise to establish whether, and in what way, it would be useful for a particular company, in a given situation. An ideal methodology to assist this screening process is the **Corporate Ecosystem Services Review**, or **ESR** (WRI, WBCSD and Meridian Institute, 2008). A decision tree is provided in Figure 6.

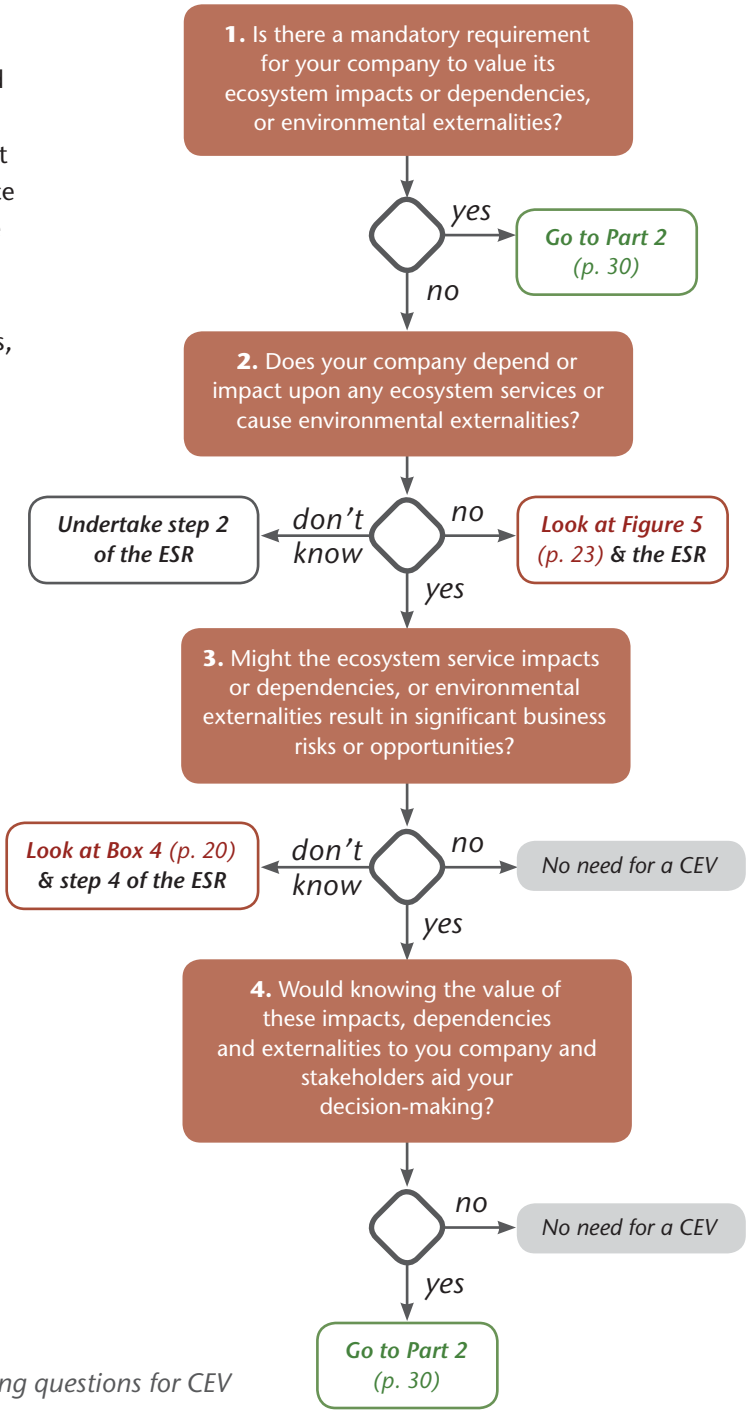


Figure 6: Screening questions for CEV

Part 2:
Methodology "How to conduct a CEV"

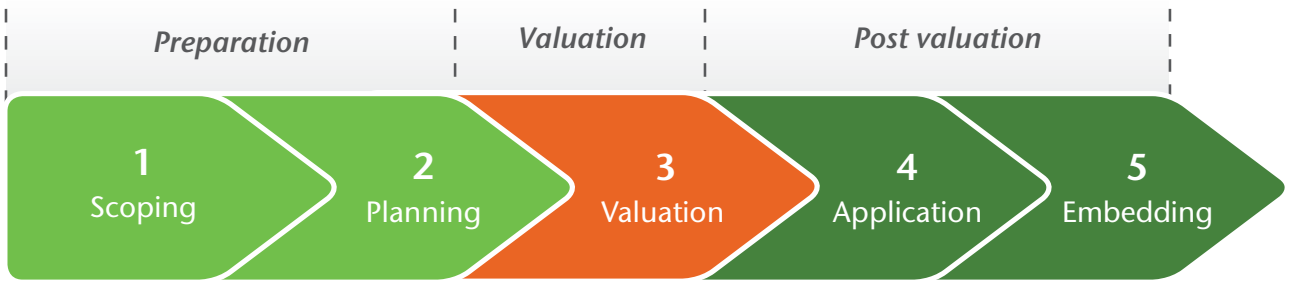
Summary of the methodology

CEV comprises a five-stage process of scoping, planning, valuation, application and embedding. In addition, 12 principles are proposed to enhance credibility of results. As CEV is a new methodology, it is continuously evolving. There is great flexibility in how the approach can be applied. It can be modified and adapted according to the needs of the company that is using it. What ultimately matters is that it is applied in a way that generates useful and credible results. In time, further guidance and standardization of approaches are likely.

Stages in the CEV process

CEV follows a logical five-stage process (Figure 7, Box 8). First of all, it is necessary to prepare for the CEV through scoping and planning. This is followed by the actual valuation exercise. Post-valuation involves applying the results of the CEV in decision-making and, for some companies, embedding the CEV approach in its business practices.

Figure 7: The five stages of CEV



Box 8: Stages of the CEV process

Stage 1 – Scoping:

This stage helps a company define the scope for the valuation exercise, using a checklist of questions. Only brief responses are required, and the process may involve numerous iterations.

Stage 2 – Planning:

This stage develops a suitable plan to undertake the valuation effectively. The plan should be more specific in terms of detail as compared to stage 1.

Stage 3 – Valuation:

This stage involves the actual valuation, which may be qualitative, quantitative and/or monetary. It begins by fully defining the company aspect to be valued, and ends by subjecting the results to a sensitivity analysis.

Stage 4 – Application:

This stage involves companies using and communicating the valuation results to influence internal and external decision-making.

Stage 5 – Embedding:

The final stage is to embed the CEV approach within company processes and procedures.

Overview of the CEV stages

Helpful hint: four-page summaries of each of the road testers' experiences are available on www.wbcsd.org/web/cev.htm

Stage		1. Scoping	2. Planning	3. Valuation	4. Application	5. Embedding
Activity		Use 10 guiding questions to define the scope	Plan the valuation	Follow a 9-step valuation process	Communicate and apply the results	Embed CEV within company processes
Key components		Ecosystem services	Context	Business aspect	Internal uses	Company buy-in
		Business case	Methodology	Environmental baseline	External uses	Link to processes
		Business aspect	Reporting outputs	Physico-chemical changes	Communication	Build capacity
		Objective	Team details	Environmental changes	Confidentiality	
		Study boundaries	Detailed timeline	Qualitative assessment	Verification	
		Conformance	Detailed budget	Monetize selected ecosystem services		
		Information available		Identify benefits & costs		
		Stakeholders		Compare benefits & costs		
		Valuation techniques		Sensitivity analysis		
		Implementation constraints				
Who is involved?	Environmental manager	✔	✔		✔	✔
	Executive managers	✔			✔	✔
	Operational staff	✔	✔	✔	✔	
	Environmental staff	✔	✔	✔	✔	✔
	Environmental economist	✔	✔	✔	✔	✔
	Finance department	(✔)		✔	✔	✔
	Stakeholders	(✔)		✔		
Sources of input and data	In-house business managers	✔		✔		
	Existing internal analyses	✔		✔		
	Local stakeholders	(✔)		✔		
	Operational staff	✔	✔	✔		
	Expert stakeholders	(✔)	✔	✔		
	Published research		✔	✔		
	Other resources & tools			(✔)		
End product		Defined scope for CEV analysis	Detailed plan for undertaking valuation	Comparison of benefits and costs	Various reports and outputs	Integrated operational approach
Estimated time		1 to 4+ weeks	1 to 4+ weeks	2 to 20+ weeks	1 to 10+ weeks	5 to 100+ weeks
For details see:		p. 34	p. 43	p. 46	p. 59	p. 66

Key principles

There are twelve key principles that should underpin all CEV studies (see Box 9), regardless of their nature and size. These draw upon accepted financial and environmental accounting and reporting principles, as well as best practice in ecosystem valuation. Adhering to them will improve the credibility and consistency of CEV results. They should also guide decisions where ambiguity exists over a particular methodological approach or issue. Box 9 describes the key principles in brief.

Box 9: Key principles for CEV

1. **Relevance:**
   Use data, methods, criteria and assumptions appropriate for the intended valuation and that meet the expectations and requirements of its intended users.
2. **Completeness:**
   Consider all potential ecosystem services affected in terms of both dependencies and impacts. The CEV should focus on the most significant and readily monetized values, and highlight other ecosystem services not monetized.
3. **Consistency:**
   Use data, methods, criteria and assumptions that allow for meaningful and valid comparisons. If monetary values are drawn from previous studies, they should be updated to current values using appropriate conversion factors.
4. **Transparency:**
   Provide clear and sufficient information for reviewers to assess the credibility and reliability of the valuations, particularly in relation to values and assumptions used.
5. **Accuracy:**
   Identify and reduce potential biases wherever possible. Do not give a false impression of accuracy by stating values at an unwarranted level of precision. Apply sensitivity analysis to illustrate residual uncertainty in values, and ensure that data and assumptions (especially bio-physical relationships) are "fit for purpose".
6. **Conservativeness:**
   Use conservative assumptions, values, and methodologies when uncertainty is high and the cost of overcoming the uncertainty is disproportionately high.
7. **Compliance:**
   Ensure, where appropriate, that relevant national and international legislation and guidelines are adhered to.
8. **Verification:**
   Where possible, use participatory processes to elicit stakeholder values and preferences. If the results are to be relied upon externally, formal independent external verification of the process and values is advisable.
9. **Avoid double-counting:**
   Ensure that no values are included more than once, for example, as a result of applying multiple valuation techniques.
10. **Assess distributional aspects:**
    Identify who the winners and losers are in terms of different stakeholders affected. Where appropriate, highlight where the values arise on a spatial and temporal basis.
11. **Landscape-level assessment:**
    CEV should be conducted at a "landscape level". This means issues of "connectivity" (i.e. interactions) between surrounding ecosystems, habitats and species, as well as landscape level impacts, should be taken into account.
12. **Engage with stakeholders:**
    Some degree of stakeholder engagement should ideally be undertaken throughout the CEV process, especially where external buy-in is essential for the intended outcome. Where the CEV may be sensitive, for internal purposes only or just used at a high level, stakeholder engagement may be more limited.

Getting started

Thinking through the business case

It is a good idea to think through the business case for applying CEV even before starting to embark on the CEV process itself. This, after all, is the basic aim of CEV – to improve corporate decision-making. This rationale should be articulated to company leadership as early as possible, so as to establish buy-in from senior management.

Unless somebody in your company already has sound knowledge and experience in environmental economics, it is recommended that external advice is sought to help with developing the business case for a CEV. Potential sources of technical expertise include universities, research institutions, governments, non-governmental organizations and consultants. Advisors should be experienced in applying ecosystem valuation, and ideally understand business issues too.

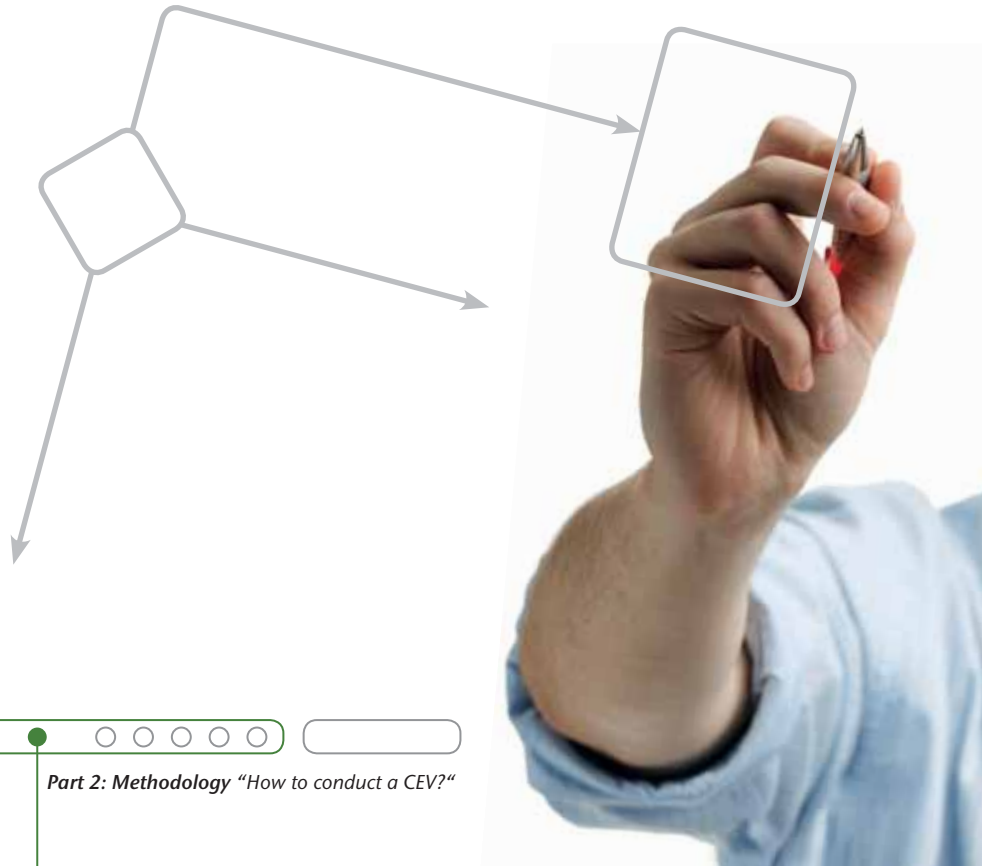
Who should be involved?

An early step is to decide who will participate in the study. While different people will be involved at different stages, some kind of core team should be formed that will be responsible for overseeing the CEV process from start to finish.

The overview of the CEV process highlights key participants in the CEV process. It is, for example, desirable to find an influential senior manager who can "champion" CEV, to ensure that the finance department is supportive of the process from its early stages, and to include people with knowledge in the following areas:

- Details of the company aspect from a technical perspective;
- Details of the environment and key stakeholders;
- Relevant company analytical approaches, procedures and policies;
- How to assess ecosystem and environmental impacts;
- Applied environmental economics (both valuation and markets).

These participants may come from within the company or from outside. Depending on the issues and complexity of the CEV that is being undertaken, further specialist expertise might be needed – for example scientists (such as those specialized in hydrology, air quality, water quality or biology), engineers, GIS and remote sensing specialists.



STAGE 1
Scoping

The aim of the scoping stage is to determine the objective and scope of the CEV study, using a checklist of key questions. It involves developing a reasonably well-defined context, business case and scope for the valuation. This stage is equivalent to – or could be used for – preparing project documents such as concept notes, terms of reference or requests for proposals. If required, it could also be used to develop a strong business case to secure internal support and funding to conduct the CEV.

Helpful hints:

- The scoping stage is often an iterative process which involves several meetings and brainstorming sessions among a group of people.
- Involve someone with experience undertaking similar applied ecosystem valuation studies to help with the scoping, otherwise it could take a great deal of time and might fail to be accomplished.
- Where existing data availability for the site is uncertain, it may be advisable to undertake or commission a scoping study to help answer the scoping questions (and possibly complete stage 2 as well).
- Don't be too ambitious with the overall scope. Focus on one product or project to begin with, and use the questions to refine the scope to something achievable.
- An alternative approach is to do a high-level review of values (probably qualitatively) for a portfolio of products or projects to help prioritize actions, or to target more detailed valuation studies.

The scoping checklist

The scoping checklist is comprised of ten main questions (Table 2). There is no right or wrong way to complete this. None of the questions are mandatory, and only brief responses are required at this stage. Greater detail will, however, be needed on all these issues at the subsequent planning and valuation stages.

It may be preferable to first focus on answering the "primary" questions – these help to define the overall objective of the CEV. Typically, Question 1 or 3 will be the best starting point. Then the "secondary" questions can be addressed – which are intended to assist in further refining the scope. Note that many scoping questions overlap or feed into each other, so scoping is likely to be an iterative process, revisiting the questions a number of times before reaching an agreed final objective.

Table 2: The scoping checklist - Primary Questions

Primary Questions – Establishing the CEV Objective	
1. What are likely to be the main ecosystem service dependencies, impacts, and other environmental externalities?	• What are the main ecosystem service dependencies and impacts likely to be? • What other environmental externalities are relevant, and should these be valued too?
2. What is the business case for doing a CEV?	• What are the associated potential business opportunities and risks? • What are the business benefits for undertaking a CEV? • How significant might the benefits be? • What wider benefits may be gained from doing a CEV?
3. What is the business "aspect" to be assessed?	• What aspect of the business is going to be assessed? • Are there alternatives of the same aspect to be considered? • What is the "business as usual" scenario likely to entail? • What part of the value chain is it?
4. What is the overall objective of the CEV?	• The responses to the above questions should provide a primary objective for the CEV.

Table 2: The scoping checklist - Secondary Questions

Secondary Questions – Refining the Scope	
5. What geographic and temporal boundaries should be used?	• Where are the relevant ecosystem services located? • Which specific locations or countries are relevant? • What timeframe is appropriate for the valuation?
6. What standards or processes should the CEV conform to?	• Should the valuation link to an existing company analytical approach? • To what other internal policies or procedures should the CEV conform? • What external industry, national or international guidelines or regulations should be followed?
7. What relevant information is available?	• What data and information is available within the company? • What data and information is available externally? • Are there any language issues? • What further data requirements may be needed?
8. Who are the key stakeholders and how should they be engaged?	• Who is the intended audience for the CEV study? • Who are the key internal and external stakeholders? • What consultation is required, how, and with whom? • What reporting output is needed for different stakeholders?
9. What ecosystem valuation techniques are likely to be necessary?	• What application is required: trade-off analysis, total valuation, distributional analysis or sustainable financing and compensation analysis? • What level of valuation is required? • How accurate do the values need to be? • What types of valuation technique are likely to be needed? • Should a particular valuation tool be used?
10. What might the key study implementation constraints be?	• What is the likely scale of the budget? • Who should be involved in the study? • When does the CEV need to be completed by?

Answering the scoping questions

1. What are likely to be the main ecosystem service dependencies, impacts and other environmental externalities?

If starting with this question (as opposed to starting with Question 3 and then moving back to Question 1, which is also an option), it should initially be addressed at a high level and then narrowed down to focus on a particular "aspect" of the business, in what will be an iterative process. If uncertain as to the key dependencies and impacts, consider undertaking or reviewing Step 2 of the ESR. Also consider the potential significance of other environmental externalities, such as air emissions, that may be a concern.

Road Tester Example 1: Scoping Question 1 (dependencies and impacts)

Mondi	Mondi identified water as a key ecosystem service dependency for its tree plantations in South Africa. Furthermore, this was a resource under considerable pressure from other users in the area. Water scarcity due to poor catchment management would lead to rising costs for the company in the future, so this service became the focus of their study.
AkzoNobel	AkzoNobel examined the impacts of three alternative products on air quality, a traditional "other" externality. The company focused specifically on emissions such as dust, GHG, NO_X and SO_2 released from cradle to delivery of paper chemicals at a paper mill. For a raw material to one of the paper chemicals, a qualitative water footprint risk assessment was carried out.

2. What is the business case for doing a CEV?

Begin by identifying what risks and opportunities are associated with the ecosystem services and OEEs identified in Question 1. Next, frame a business case by determining how these risks and opportunities can be translated into business benefits by undertaking a CEV.

Where possible, indicate the relative significance of the benefits (their materiality); is it potentially thousands or millions of dollars? Also consider any wider benefits to the company, such as internal capacity building or linking with partner organizations.

Road Tester Example 2: Scoping Question 2 (business case)

GHD / SA Water	GHD / SA Water recognized that land management practices had a major influence on water quality in several catchments from which they produce drinking water. The company realized that they could achieve significant savings in water treatment costs and reduced customer health risks if they invested in influencing land use activities to reduce contamination and reinstate instream wetland functions in order to enhance nutrient recycling in the water catchment. Ecosystem service benefits of cleaner waterways would also accrue to other users, potentially improving coordination and relationships among water users across the watershed.
Eni	Eni applied CEV to assess ecosystem service impacts and dependencies at one of their oil installations near a sensitive ecological area in Italy. At a corporate level, undertaking a CEV was seen to be of strategic significance; at the Exploration and Production (E&P) Headquarter level, the study was important for integrating ecosystem services issues into global decision-making and to differentiate the impact of E&P from those of other actors. At an operational level, the assessment helped improve environmental performance at the site and enhanced the company's reputation. The benefits from undertaking a CEV at the site included cost savings from avoiding delays arising from stakeholder and regulator issues; sustaining and enhancing revenues through maintaining a license to operate and gaining access to new resources; increased revenues through possible energy crops and carbon credits from forest management; and reduced costs of mitigation measures through cooperating with the nearby National Park.

3. What is the business "aspect" to be assessed?

This may be the starting point if there is an obvious business aspect to assess. The business aspect could be a:

- **product** (e.g. wheat, paint or a car);
- **service** (e.g. financing package);
- **project** (e.g. an infrastructure project);
- **process** (e.g. alternative ways of manufacturing a product);
- **asset** (e.g. an operating facility or landholding);
- **incident** (e.g. oil spill).

Other questions to consider include; is this aspect of the business part of the upstream (extraction), mid-stream (manufacturing and transport) or downstream (sales and product disposal) process, or a mix? Does the CEV relate directly to the business itself, the supply chain, or its customers? Risks and opportunities for businesses are increasingly associated with supply chain dependencies and impacts on ecosystem services. Are there alternative scenarios (e.g. options, locations or designs) that should be considered for the assessment?

The business aspect will be used as the basis for the scenarios developed in the valuation stage, beginning with how the aspect is managed or produced at the current time (in other words, the business as usual scenario).

Road Tester Example 3: Scoping Question 3 (business aspect)

Syngenta

Syngenta assessed the "process" of commercial blueberry production in Michigan, USA. The study focused in particular on the impact on production costs and yields of investing in habitat for wild pollinators (native bees) on sections of farmland. The "business as usual" (BAU) scenario entailed current land management practices and current availability of pollinator habitat. The BAU was then compared to two scenarios involving increasing levels of investment in habitat restoration and management to support native pollinators.

4. What is the overall objective of the CEV?

The responses to Questions 1-3 should help to refine the focus of the CEV. Arriving at a final objective is likely to be an iterative process. Ideally, it should ultimately become SMART (specific, measurable, attainable, relevant and time-bound).

Road Tester Example 4: Scoping Question 4 (CEV objective)

US BCSD / CCP

The objective was to: "investigate the financial and ecological benefits generated over a 20-year period by the replacement of the storm water management system for a manufacturing facility in Houston, with a constructed wetland for on-site flood control and water treatment".

5. What geographic and temporal boundaries should be used?

It is important to narrow down the countries and locations that the CEV will cover, as this will have implications for the resources and information required, as well as the scale of the exercise. This typically requires asking several questions; if it is a product, where are the inputs sourced from, and where are the customers located? If it is a feasibility study for an infrastructure project, which locations and sites are being assessed? Which indirect and secondary impacts and dependencies should be covered? (Note that some impacts may be homogenous and global, e.g. GHG emissions, whereas others may be heterogeneous or local, e.g. water, waste, SO_2 emissions). In terms of establishing a timeframe, is there a typical project or product design life (for example 25 or 50 years for a development project)? When comparing different product emissions with constant impacts over time, a one-year assessment period may be adequate to inform decision-making.

Road Tester Example 5: Scoping Question 5 (boundaries)

GHD / SA Water	GHD / SA Water used CEV to assess the value of ecosystem services, including avoided treatment costs, under several management scenarios for a catchment in which they provide drinking water services. The geographic boundary for the study began as the catchment area (the Mount Lofty Ranges Watershed), and was further narrowed down to specific "sub-catchments" where the direct effects of land management could be connected to nutrient loads in a downstream reservoir.
Holcim	Holcim applied a CEV to inform the rehabilitation plan for proposed extensions to a sand and gravel pit, as part of the UK permitting process. The planning requirement was for a 50-year aftercare program, therefore the study selected 50 years as the timeframe to examine ecosystem services generated by their proposed wetland restoration scheme.

6. To what standards or processes should the CEV conform?

The timing and required outputs of the CEV may be influenced by, or need to sequence with, existing company policies, reporting processes or analytical approaches (such as ESIAs or LCAs). The CEV might also have to comply with national guidelines on ecosystem valuation, or with particular regulations (such as compensation claims). Alternatively, companies may wish to tailor the CEV to fit into permit applications or approval processes, or to meet relevant international standards, such as the International Finance Corporation (IFC) Environmental and Social Performance Standards.

Road Tester Example 6: Scoping Question 6 (standards and processes)

GHD / SA Water	GHD / SA Water has their own well-defined capital and operational funding investment process set out in internal corporate policy documents, which the CEV outputs informed. In addition, SA Water recognized the need to follow the South Australia Department of Treasury and Finance guidelines on evaluating public sector initiatives. Although these do not refer to ecosystem services, they provide a suitable framework for integration within the specified approach for evaluating project scenarios.

7. What relevant information is available?

Valuation studies often demand a considerable amount of data, especially relating to the environmental baseline and impacts/changes. Finding and accessing this information may require thorough and prior planning. In some cases, the relevant data may already exist within the company (for example from ESIAs or baseline surveys), or it may be available externally (such as from government departments or NGOs). If an ESIA has yet to be undertaken, this could provide an opportunity to target data collection to better feed into the CEV.

In many cases, not all of the information necessary to carry out the CEV will be readily available. Expert consultation or further research may be needed, including targeted surveys to cover key biological, ecological, physico-chemical or socio-economic issues.

Road Tester Example 7: Scoping Question 7 (information needs)

Veolia Environnement	Veolia Environnement used CEV to help prioritize land management options for a parcel of land owned by their subsidiary Berlin Wasserbetriebe (BWB). Data for the study was gathered from a wide range of sources. This included estimates of input, costs and yields of energy crops from the energy company partnering with BWB and details on the capital and operational water management costs for several scenarios from BWB. Information on the existing environmental conditions was found in a report conducted by the local wildlife authority, and an ecologist was used to advise on predicted environmental changes under the different scenarios. Because value transfer data available was not considered adequate to value the scenario changes, Veolia chose to implement a limited (quasi) contingent valuation survey. This was targeted at visitors and Berlin residents to estimate local willingness to pay for changes in recreation and non-use value associated with the scenarios.
Eni	For their assessment of ecosystem service impacts and dependencies at one of their operating Exploration and Production sites, Eni could draw upon a good set of historical GIS data available from the Biodiversity Survey and Impact Assessment conducted at the site. This information could be matched with current GIS snapshots of the area of interest (including species and habitat distribution data) available from the IUCN.
Eskom	Eskom used information obtained through the Environmental Impact Assessment (EIA) carried out to obtain the required environmental authorization for the Ingula pumped storage scheme. However, this data still fell short in terms of certain avian species and the associated value that these species could obtain from a birding and tourism perspective. Therefore a targeted questionnaire was developed, which also sourced values related to the willingness to pay from other birding and conservation areas in the wider region.

8. Who are the key stakeholders and how should they be engaged?

It is wise to engage in broad-based consultation from an early stage of the CEV process. This not only ensures buy-in from stakeholders, but can also considerably improve the design and content of the CEV that is eventually carried out. Key groups include both individuals from within the company (for example, senior management and finance) as well as external stakeholders (such as regulators, government agencies, NGOs and affected populations). As a general principle, the broader the consultation the better, as long as it is well targeted.

Face-to-face consultations at meetings and workshops are an effective means of obtaining information, eliciting people's views and seeking their buy-in. Questionnaires and other forms of survey can also be used. It may also be helpful to consider what kinds of information and awareness materials (for example, detailed and summary reports, maps, glossy brochures and presentations) need to be provided to stakeholders, both at this stage and at later stages of the CEV process. This can have implications for the cost of the CEV.

Road Tester Example 8: Scoping Question 8 (stakeholders)

EDP	EDP assessed the costs and benefits of maintaining higher water levels in the canals and reservoirs associated with several hydropower facilities in a 7,200 ha watershed. Some of the findings will be useful for marketing materials, as they demonstrate to potential European Renewable Energy Certificate System (RECS) buyers the overall benefits of EDP's watershed management approach. The CEV approach and methodology are also being converted into a training kit for internal use, so that it can be used to help the company scale up the ecosystem services approach for wider use.
Eskom	The valuation study had a core focus on possible avian tourism in the conservation area associated with the Ingula pumped storage scheme. It was critical that the target audience responding to the questionnaires should be approached through existing channels, as far as practically possible, as this improves responsiveness, buy-in and credibility to the data that is being sourced.

9. What ecosystem valuation techniques are likely to be necessary?

Even at this early stage, it is necessary to start to form an idea as to how the ecosystem valuation will ultimately be undertaken. This requires making decisions about the generic application (for instance, assessing trade-offs or total values), type of valuation (qualitative, quantitative or monetary), and level of accuracy. The answers to these questions will, of course, depend on the business case and objectives that have been determined for the CEV (Questions 2 and 4).

Based on these parameters, it should be possible to decide whether a simple value transfer approach will suffice, if a survey or other data collection method will be required, and whether some additional tool (such as GIS or valuation software) will be used. Usually, a simple spreadsheet model will be the most cost-effective tool to undertake a CEV. However, over time, off-the-shelf tools may become sufficiently developed to be used more effectively and reliably.

Road Tester Example 9: Scoping Question 9 (valuation techniques)

Lafarge	Lafarge assessed the value of ecosystem services impacted by reclamation planning for a quarry in Presque Isle, Michigan. The value estimates did not need to be precise, but would be used internally to develop land management strategies. The study used the value transfer method to estimate the potential value of recreational and educational uses, and avoided costs to estimate the value of erosion regulation and water purification provided by restored habitat. Two off-the-shelf tools were used: InVEST, a GIS-based tool, was used to estimate the erosion and water purification values, and the Wildlife Habitat Benefits Estimation Toolkit was used for the value transfer. However, some significant limitations were recognized in the tools.

10. What might the key study implementation constraints be?

In addition, it is important to reflect at this stage as to whether there are any major study planning constraints that may affect the scope. As available funds, resources, expertise and time are typically limited in supply, this is an important reality check, and it may be necessary to revisit some of the earlier questions on the scope and approach of the CEV. Consideration of such constraints at this stage will help pre-empt major issues arising over the scope at the planning stage.

Useful questions include: what ballpark level of budget and resources are likely to be available or justifiable, based on the business case? What economic and technical skills are likely to be needed and available internally? How much external support is required? Are there any key internal (such as project cycle or reporting) or external (such as permitting) deadlines to be taken into account?

STAGE 2
Planning

This stage involves developing a plan for undertaking ecosystem valuation. It elaborates how the valuation will be carried out, and specifies the time-frame, staff responsibilities and other planning parameters. Investing time in planning and anticipating how the valuation will actually be implemented should ensure a more timely and cost-effective outcome. The plan may be formulated internally. However, requesting an external organization (e.g. consultant, academic or NGO) to submit a plan or proposal can be effective, especially when done in conjunction with the company.

Helpful hints:

- If the scope of the valuation exercise is still a little uncertain, a flexible plan may be best. A provisional plan may be developed and modified as the study progresses.
- Alternatively, a scoping study could be undertaken. This could investigate the data available, prioritize the ecosystem services affected, assess alternative valuation methodologies and costs, and propose a way forward (this was, for example, the approach taken by Veolia Environnement).

Contents of the plan

Table 3: Contents of the plan

Contents	Key elements to address
Context	This information should have been established in the scoping stage, but may need elaborating.
Methodology	Describe the proposed methodologies for undertaking the valuation in some detail.
Planned reporting outputs	Indicate the nature of the reporting outputs to be produced.
Team details	Identify key team members, setting out their roles. Also describe project management and quality control issues.
Detailed timeline	Set out a timeline and identify dates for key milestones, site visits and deliverables.
Detailed budget	Indicate the total expected cost and a reasonable breakdown of planned labor and expenses.

Context

The context for the study should include, most importantly, the overall objective of the CEV (as defined in Scoping Question 4). Other elements defined in the scoping stage can also be referenced here, including the business aspect and location of the study, as well as any internal or external processes or policies that the results will be fed into.

Methodology

This section should provide details of the proposed valuation methodology. For example, it should describe how and by whom consultation and data collection will be undertaken, identify site visits and surveys that will be required, outline which valuation techniques will be used, and lay out how results will be analyzed.

For valuation studies which will include primary data collection, additional details on methodology should be provided. For example, CEVs that utilize stated preference studies should provide details on the proposed approach for questionnaire design, focus groups, piloting, sample sizes, interviewers, data analysis etc.

Planned reporting outputs

While identifying the types of outputs to be produced, it may be helpful to reflect upon responses to Scoping Questions 6 and 8. Scoping Question 6 identifies internal or external reporting processes that the results should be aligned with, while Scoping Question 8 focuses on identifying the stakeholders and audience for the analysis. Additional deliverable output, such as maps and GIS, should also be identified.

Team details

The plan should provide details of the valuation team, clearly specifying their roles and responsibilities in relation to managing, carrying out, reporting on and responding to the CEV. Where external experts or organizations are involved, it may be necessary to develop a plan for cooperation and interaction. It is advisable to prepare brief Terms of Reference for key team members and, if required, contracts or agreements with external participants.

Possible questions to consider include:

- Who is the environmental economist involved? An experienced one will certainly be needed.
- Who will provide other technical skills? This could include scientific input to assess cause-effect relationships, as well as GIS and remote sensing inputs.
- What opportunities are there for training and capacity building? Internal experience and knowledge can be increased by involving a mix of staff from different levels and departments.

Detailed timeline

It is useful to set out a reasonably detailed timeline for the CEV, by using, for example, a Gantt chart. This should specify key milestones in data collection, analysis, reporting and communication. The timeline helps to clarify which deliverables are required, and when. Refer back to the deadlines identified in Scoping Question 10.

Detailed budget

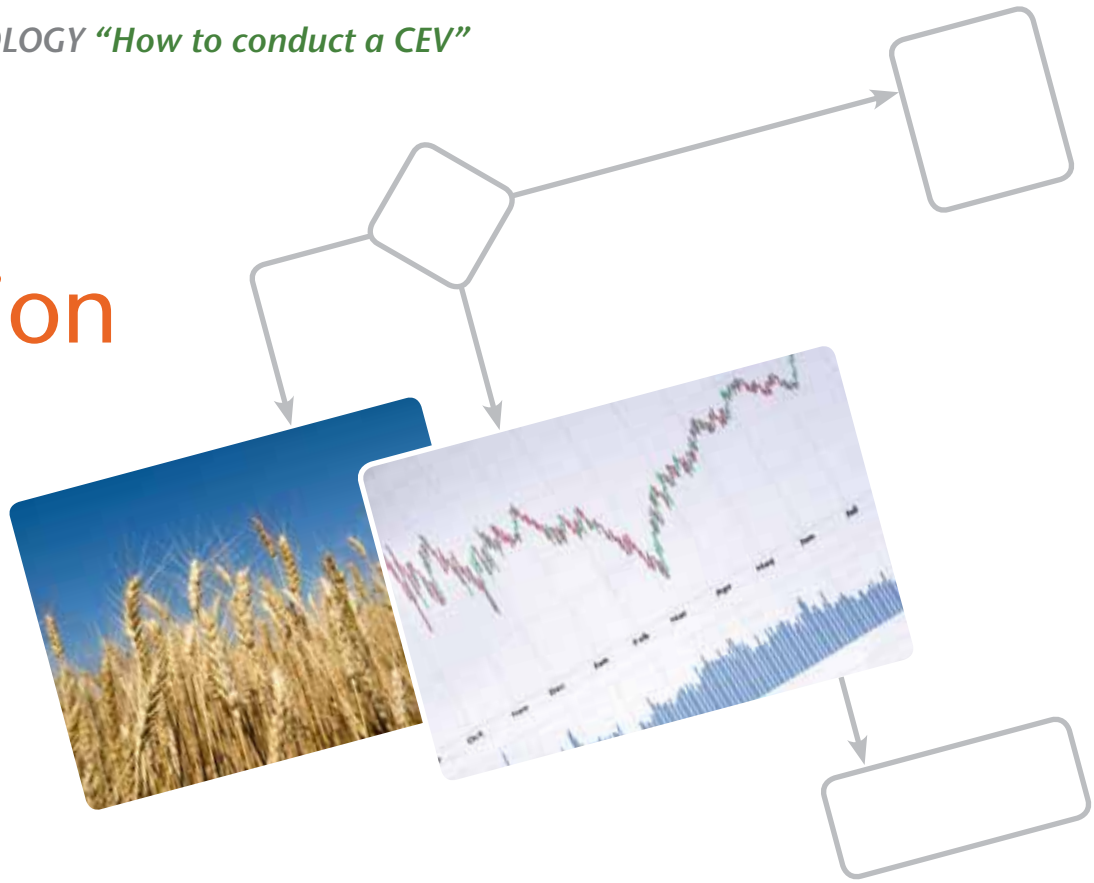
The budget for the CEV study should include all the basic input and cost elements that are required to carry it out, such as staff-time, external consultants, meetings, travel, publications and other items.

Road Tester Example 10: Planning

Lafarge

Lafarge used CEV to help evaluate alternative land use management options at a 5,000 acre quarry. They decided to develop their CEV project in three phases. Based on an initial outline scope, the project held a kickoff meeting to establish the work plan, budget and responsibilities for conducting the three phases. The first phase was to conduct an ESR at the site, to identify key ecosystem services and associated risks, opportunities and strategies. This highlighted three key areas relating to sedimentation/erosion, nutrient retention/water purification and recreation/education. The second phase was to apply various ecosystem service valuation models. The third phase involved i) conducting an internal feedback workshop; ii) developing an assessment on the reliability, reproducibility, and business applicability of ESR and CEV; and iii) presenting the project's results and recommendations for internal and external communication.

STAGE 3
Valuation



This stage involves undertaking the valuation itself, via a nine-step process. The steps adhere to best practice in ecosystem valuation, and also align with the ESIA process. The guidance provided focuses mainly on the "process" required for ensuring an appropriate and valid CEV. Additional material on valuation techniques is provided at www.wbcsd.org/web/cev.htm

Helpful hints:

- Due to the complexities of environmental valuation, CEV should be undertaken or supervised by an experienced environmental economist.
- Don't think you necessarily need detailed and accurate valuation studies. Ballpark values can still provide important information for decision-making.
- Be wary of "black box" models or toolkits that produce seemingly accurate values. These should be reality-checked, and their key assumptions should be made visible.
- Although benefit (value) transfer can provide useful indications of value, make sure that the context and ecosystem changes are sufficiently similar to be of use.
- Value transfers are most useful when comparing significantly different options and ascertaining relative values. Be wary of using them to value subtle differences and absolute values.
- If using stated preference and travel cost valuation questionnaires, it is essential to involve someone who is experienced in their design, implementation and analysis. It is very easy to design a questionnaire that elicits useless values.

Overview of the steps

The nine steps involved in ecosystem valuation are summarized below in Table 4. Although companies are encouraged to work through the complete nine-step process, this may not be necessary in all cases, given the broad range of potential CEV applications and ways of undertaking ecosystem valuation.

Table 4: Valuation steps

Valuation steps	Brief description
1. Define the business "aspect"	Describe the key features of the company aspect to be valued. This is effectively the "with" scenario being valued. Also identify any other "alternative" scenarios (i.e. options) to be valued.
2. Establish the environmental baseline	Establish the environmental baseline conditions under the "without" or "do nothing" scenario. Identify the relevant ecosystems and determine the status of habitats, species, ecosystem services and associated stakeholders. For carbon and OEEs, give details of existing baseline emissions.
3. Determine the physico-chemical changes	Identify and quantify the relevant physico-chemical changes resulting from the company aspect (e.g. emissions, discharges and land-take). For carbon and OEEs, state the changes in emission levels between the scenarios.
4. Determine the environmental changes	Detail the changes in conditions in terms of quantity and quality of the relevant ecosystems (i.e. habitats and species). For carbon and OEEs, refer to the value transfers being used.
5. Assess the relative significance of ecosystem services affected	Undertake a qualitative assessment of ecosystem service changes to determine which are likely to be of high, medium or low significance. Where relevant, support the assessment with quantitative information. This step helps screen priority ecosystem service changes to value in step 6. For carbon and OEEs, state the relative significance of the changes.
6. Monetize selected changes to ecosystem services	Identify the ecosystem service changes for which monetary valuation is possible and relevant (e.g. the high and medium value ecosystem services in step 5 above). Select the most appropriate valuation technique(s) and determine the monetary values.
7. Identify internal and external benefits and costs	Identify which values are internal and external to the company. Determine which external values could become internalized either through company or external actions.
8. Compare benefits and/or costs	Aggregate the stream of benefits and/or costs and convert them into "present day values" using an appropriate discount rate.
9. Apply sensitivity analysis	Determine the sensitivity of the outcome to a few key variables whose values are uncertain, providing a high and low range of values.

The specific requirements for, and focus of, each step may also differ, depending on the objectives and scope of the CEV, and on the application with which it is associated. Table 5 highlights key differences in emphasis, depending on the generic application of the valuation.

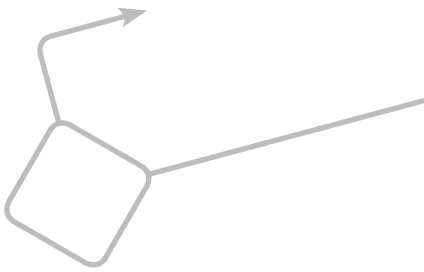


Table 5: Emphasis of steps depending on generic application of valuation

Application	How do you do it?	Difference in emphasis
1. Trade-offs	Measure the marginal change in quantity/ quality of ecosystem services due to the company aspect (compared to without); multiply by the "marginal" value of each service.	Steps 2 – 6 require care to ensure it is the "marginal" changes associated with each alternative scenario that is assessed. It is not necessary to value the total ecosystem service benefits for each option.
2. Total valuation	Identify all mutually-compatible ecosystem services provided; measure the quantity of each service provided; multiply by the value of each ecosystem service.	In step 1, the aspect to be valued is likely to be a landholding. In step 2, the "without scenario" should assume a situation without any ecosystems on the landholding (i.e. zero ecosystem services). Steps 5 and 6 should assess all ecosystem services that maintenance of the landholding generates over time.
3. Distributional analysis	Determine the nature and size of costs and benefits accruing to different stakeholders.	The step 2 and 5 stakeholder analysis components are critical.
4. Sustainable financing / compensation	Identify stakeholders that receive or cause significant benefits or losses, and identify appropriate means of generating revenues or compensating them.	The step 2 and 5 stakeholder analysis components are critical. Step 7 (analysis of internal and external costs and benefits) is critical.

The Nine Steps

The nine steps are explained below using selected examples. For continuity, two road testers are referred to in each step:

- The **Veolia Environnement** case assesses ecosystem service trade-offs associated with land use management.
- The **Hitachi Chemical** case is an example of valuing carbon emissions (an OEE) associated with alternative production processes.

An assortment of case studies from other road testers is also used.

Road Tester Example 11: CEV Objectives

Veolia Environnement	Veolia Environnement is part of a public-private partnership with Berliner Wasserbetriebe (BWB), the water and wastewater service provider for Berlin. BWB owns and manages the 290 ha Karolinenhöhe land fields in west Berlin, Germany, as an area for nature conservation, agriculture and recreation. BWB has been discharging treated wastewater here for two decades, but must stop after 2010, due to the threat of legacy contaminants at the site potentially affecting a nearby groundwater supply of drinking water to Berlin. The CEV objective is to evaluate alternative water use and land management options for the site, focusing on short rotation energy crops (biofuels), to determine the optimum solution from a financial and societal perspective. It will achieve this through a CEV trade-off analysis between different associated agricultural, biodiversity, recreational and landscape impacts. The findings will aid discussions with the energy crop provider, local stakeholders and local water and nature conservation authorities, and will inform the potential application of payments for ecosystem services at this and other sites owned by Veolia Environnement.
Hitachi Chemical	Hitachi Chemical produces a variety of base materials and components for manufacturers producing electronic equipment such as computers, digital cameras and cell phones (i.e. it is a mid-stream manufacturing company). The CEV objective is to incorporate a cost for carbon emitted during the manufacturing process for producing multi-layer CCL (Copper-Clad Laminates). It is envisaged that the outcome will help identify products to select where there is a choice (i.e. those which are more sustainable) and those investments worth making in order to reduce carbon emissions. The valuation will link to an LCA, with a view to potentially expand the monetized results of LCA outputs, in the hope of ultimately saving costs, enhancing revenue and being more sustainable.

1. Define the business aspect

This step involves describing in detail the company aspect to be valued. It characterizes key features such as its nature, extent, components, location and lifespan. The company aspect is the "with" scenario, against which a "without" scenario will be compared during the valuation. If several scenarios exist (for instance, alternative locations, design specifications or options), these should be identified. It may also be useful to consider and clarify what part of the value chain is being assessed.

Road Tester Example 12: Valuation Step 1 (business aspect)

Veolia Environnement	The company aspect is several alternative projects (scenarios) involving energy crops and targeted irrigation at the Karolinenhöhe land fields. The "without" situation is a "do minimum" scenario (scenario 1) representing the least cost option for BWB where the treated water is all discharged into a nearby river, with minimal interventions by BWB at the site. Scenario 2 is growing 100 ha of a single energy crop species with targeted irrigation, using a new groundwater pump, scenario 3 is the same but with two energy crop species, and scenario 4 is growing 100 ha of two energy crop species irrigated with treated water for only three years, using BWB's existing irrigation infrastructure.
Hitachi Chemical	The company aspect was the production process for multi-layered CCL (for printed circuit boards). The production process takes place in a factory in Japan using varnish, epoxy resin, methyl ethyl ketone, glass cloth and copper foil. Hitachi Chemical assessed carbon emissions from CCL production on an annual basis.
Holcim	The company aspect assessed by Holcim was the rehabilitation process for a specific mining project site. Rehabilitation options for the site included restoring the area to agricultural land, its former use, and alternatives including construction of artificial lakes and wetland restoration.
EDP	The company aspect was the provision of electricity using a hydropower system, comprising 6 dams linked by open air canals, situated on land of high conservation value. The case study compared the total services provided by the entire watershed with the hydropower system operating, compared to a scenario of its dismantlement.
Eni	The company aspects assessed by Eni were: (a) the main economic, social and environmental changes occurring in the area under study and their interactions with the company's activities and with other human activities; and (b) the increase of ecosystem service value related to mitigation and restoration activities that have been carried out.

2. Establish the environmental baseline

This step involves identifying and describing the environmental baseline for the "without" scenario. The preferred "without" scenario to examine is "business as usual". Business as usual should either be the current environmental status (if that is reasonably stable), or a prediction as to the status of the environment over time, given recent and future likely trends due to other influences. This may be the equivalent of a "do nothing" or "do minimum" scenario. It should consider today's existing baseline, and take into account future trends that will occur regardless of company intervention, such as an increase in human population, a decrease in water availability or growth in per capita GDP.

Given the uncertainty, and the difficulty of predicting environmental change, it is important to be very careful when establishing the baseline. At a minimum, it should include details on:

- The main **ecosystems** in terms of the quality and quantity of habitats and species, and their protection status;
- The main associated **ecosystem services**; and
- The different **stakeholders** that benefit from the main ecosystem services, as well as those that bear opportunity costs from any changes in land and resource use and associated production and consumption possibilities.

If dealing with a large site and many ecosystems, only those ecosystems and ecosystem services likely to change need to be described in any detail. If assessing the total value associated with creating a new habitat such as a wetland, the nature of the existing environment at that site will still need to be considered (e.g. agricultural land or scrubland). For carbon and OEE assessment, details should be given of the existing quantities of the "without" scenario baseline emissions.

Road Tester Example 13: Valuation Step 2 (environmental baseline)

Veolia Environnement	The existing environmental baseline was first assessed to provide a reliable starting point for the analysis. This included describing the current condition and protection status of the different ecosystems (e.g. farmland, grasslands, wetlands and groves) and associated flora and fauna on the Karolinenhöhe site. It also involved identifying the main ecosystem services and associated stakeholder beneficiaries, the most important being local farmers and recreational visitors. In this case, the biodiversity and landscape values associated with wetlands at the site were considered very high, but so was the risk of contaminating Berlin's water supply through continued discharge of treated wastewater due to the legacy contamination.
Hitachi Chemical	Hitachi Chemical used "business as usual" production methods, materials and life cycle for CCL products as the baseline. They explored emission rates of CO_2 per kg produced of CCL, under two alternative scenarios as compared to the baseline.
Rio Tinto	Rio Tinto established the environmental baseline by projecting how local forests would be converted or degraded without conservation action. They looked at historical rates and drivers of deforestation such as "slash and burn" agriculture and the unsustainable harvest of forest products. Only the incremental benefits of conservation, i.e. avoided deforestation, were included in the cost benefit analysis.
GHD / SA Water	GHD / SA Water used current land use practices in the Upper Cox Creek catchment as the baseline or "business as usual" scenario (scenario 1). They compared the baseline to five alternative scenarios, each successive scenario adding an additional management action. For example, scenario 2 introduces on-farm management actions such as sediment traps, improved cover crops and buffer strips. Scenario 3 adds construction of a sedimentation pond and a wetland to this, and so on.

3. Determine the physico-chemical changes

This step involves identifying and quantifying the physico-chemical changes associated with company impacts and dependencies under different scenarios:

- For company **impacts**, this could, for example, include land-take (m^2 of habitat destroyed or improved), emissions (kg or tons emitted of specific pollutants), discharges (m^3 of specified chemicals discharged or accidentally spilt) and waste (m^3 of specified solid waste). For carbon and OEE assessments, state the change in emission levels between the scenarios.
- For company **dependencies** this could, for example, include consumption of provisioning services (m^3 of water and kg or tons of natural materials) by a company process.

Road Tester Example 14: Valuation Step 3 (physico-chemical changes)

Veolia Environnement	Physico-chemical changes were assessed for all four scenarios, which in particular included determining changes in agricultural activity (e.g. the number of hectares of fodder and energy crops) as well as changes in volumes of water flowing to the site.
Hitachi Chemical	The change in carbon emissions relative to the business as usual scenario represented a decrease of 5% and 7.5% for the two alternative production processes analyzed.
GHD / SA Water	The GHD / SA Water case examined physico-chemical changes associated with different land use management efforts in a watershed supplying water to reservoirs used for drinking water. Land management changes, such as on-farm management actions, construction of artificial wetlands, providing sewerage to a township, and riparian re-vegetation were examined. Chemico-physical modeling was undertaken to determine the reduction in nutrients and suspended sediments entering the system as a result of these changes.
US BCSD / BPS	US BCSD identified synergy opportunities between companies in terms of alternative uses for waste materials. The materials identified included vehicle tires, waste asphalt, acetic acid, off-specification polymers and diesel, spent tungsten catalysts, kiln dust and aluminum oxide. These potentially provide fuel, raw materials for construction and manufacturing as well as secondary chemical resources. The Ecologically-Based Life Cycle Assessment (Eco-LCA) method – developed by the Centre for Resilience – was used to calculate physical quantities of resources saved through identified project opportunities. The results are potential annual resource savings of: 250 million gallons of water; 4.4 million barrels of oil-equivalent of energy; 3,000 acres of land; 13,000 metric tons of CO_2 equivalents; and 29,000 metric tons of non-renewable resources. Associated monetary values were then determined in step 6.

4. Determine the environmental changes

This requires identifying and quantifying the "net" changes in ecosystems (such as habitat and species) and environmental conditions resulting from the "with" scenarios, as compared to the "without". It is usually necessary to predict the modified ecosystem and environmental characteristics under the alternative scenarios. Complications often arise, such as predicting how different stakeholders might react to different scenarios, thereby influencing the ecosystem outcomes and subsequent values. These should be assessed to the best extent possible, given the constraints of the study, with all assumptions made clear, for example, using an "expected values" approach based on the probability of alternative events occurring.

This step can be very complex. It usually requires good, credible scientific information about the relationships, linkages and predicted environmental changes between the alternative scenarios. In turn, this often necessitates specialist expertise and bio-physical modeling.

If the assessment is for an event that has already occurred, such as a pollution incident, a "pre-event" environmental baseline will be needed. Where such data is not available, either a model or similar nearby "reference" site can be used to inform the baseline characterization.

For carbon and OEE assessments, this step may simply require describing the "net" differences in environmental parameters, without having to establish and compare their actual impact on the environment. This will be the case where standard values for emissions are available. If more accurate valuations of emissions with heterogeneous impacts (for example NO_X and VOCs) are required, then regional values or a more detailed cause-effect (dose-response) assessment will be needed.

Road Tester Example 15: Valuation Step 4 (environmental changes)

Veolia Environnement	The environmental changes considered under each of the scenarios included increases or decreases in: crop productivity (hay and wheat fodder production and energy crops); ground water quality (heavy metals leaching); groundwater moisture affecting grassland productivity; habitat quality (diversity of plant, insect and bird species); and landscape aesthetics changing due to plantation of energy crops or to increasingly dry conditions under the "do minimum" scenario.
Hitachi Chemical	Because the Hitachi case assessed carbon emissions rather than an ecosystem service, a direct measurement of environmental change was not needed. Instead, the valuation relied upon current market prices for carbon which are related to an extent to associated environmental changes caused by green house gas emissions (see Step 6).
Weyerhaeuser	Weyerhaeuser owns several hundred thousand hectares of land in its two case study areas, North Carolina and Uruguay. The different land use options being considered by the company could result in different habitat types and hence different mixes of ecosystem services. Weyerhaeuser examined the differences in yield of wood between solid wood forests (eucalyptus in Uruguay and southern yellow pine in North Carolina), a mix of hardwood and energy crops, a dedicated energy crop regime, and native pastureland (in Uruguay only).

5. Assess the relative significance of ecosystem services affected

This step involves a qualitative assessment of the relative significance of changes to ecosystem services. Significance is often best assessed as to whether ecosystem service changes are likely to be manifested as high, medium or low values (or absent), and whether they constitute costs (negative impacts) or benefits (positive impacts). These ratings can be based either on professional judgment, or informed through a basic quantitative assessment. The latter involves indicating what items or groups are affected (such as volume of produce or number of people).

Distributional aspects are typically key to this assessment – in other words, which stakeholder populations are affected by ecosystem service changes, and by how much. The type of stakeholder group affected may influence the values, as is often the case with foreign tourists' willingness to pay values compared to those of locals or nationals. This evaluation can also help identify potential winners and losers, and can identify needs and options when considering payment for ecosystem service schemes.

Road Tester Example 16: Valuation Step 5 (significance of ecosystem service effects)

Veolia Environnement

The site was split into four core ecosystem types, and the relative value of the main ecosystem services were assessed qualitatively for the current baseline and for the predicted conditions under the four scenarios. Ecosystem services particularly impacted include: agricultural output (fodder crops), energy crop (biofuel) output, carbon sequestration, recreation and non-use values and drinking water supply (quality).

Ecosystems	Ecosystem services		Existing baseline	Scenario 1 - 'Do Minimum'	Scenario 2 - Single Energy Crop	Scenario 3 - Mixed Energy Crop	Scenario 4 - Low Irrigation Energy Crop
Crops / fallow land	P	Hay / crops for fodder	+ + +	+	+ + +	+ + +	+
	P	Energy crops	*n/a*	*n/a*	+ + + + +	+ + +	+ +
Woodlands / trees	P	Fruit crops	+ +	+	+ +	+ +	+
Above two ecosystems plus natural grassland and wetlands	R	Carbon sequestration & avoided emissions	-	+	+ + +	+ + +	+ +
	R	Local climate regulations	+	+	+ +	+ +	+ +
	R	Assimilation of waste by vegetation	+	+	+ +	+ +	+ +
	C	Informal recreation (landscape / biodiversity)	+ + +	+	+ +	+ + +	+
	C	Non-use values (landscape / biodiversity)	+ + + + +	+ +	+ +	+ + + + +	+ + +
Groundwater	P	Quality of drinking water supply	- - - - -	-	+ + +	+ + +	+ + +

Note: P = provisioning, R = regulating and C =cultural services.
The pluses and minuses represent the level of ecosystem services provided under each scenario over a 25 year period.
(-) = minor negative value; (- - -) = moderate negative value; (- - - - -) = major negative value.
Similarly (+) = minor positive value; (+ + +) = moderate positive value; (+ + + + +) = major positive value.

Road Tester Example 16: Valuation Step 5 (significance of ecosystem service effects)

Hitachi Chemical	Because the Hitachi case assessed carbon emissions, the CEV did not assess changes in ecosystem services.
Holcim	To maximize its chances of receiving approval to extend a quarry, the company proposed wetland restoration to follow extraction on flood-prone land previously used for agriculture. Due to constraints on bringing in soil for restoration, the company proposed a mixture of wetlands and an artificial lake. The main benefits identified were based on managing the wetlands for biodiversity and the lake for recreation. Both areas would provide flood control benefits, but to avoid double-counting in relation to the biodiversity benefit transfer values for reedbeds, specific flood control benefits were included for the lake only. Water filtration benefits were not considered as there is no local water extraction for human consumption.
Lafarge	Lafarge assessed changes in ecosystem services that could result from alternative approaches to land management during reclamation of a mining area. Changes in land use were expected to impact a number of bio-physical and environmental aspects of the local watershed, and hence a number of ecosystem services. Lafarge applied the InVEST model to quantify, map and value changes in erosion regulation and water regulation resulting from land use changes. They also estimated changes in fishing, hunting, and wildlife viewing (recreation services) that could result from habitat changes in wetland and terrestrial habitats.
EDP	At the initial stage of the valuation process, the provisioning service of wild food was not considered to be of high or even medium significance. However, during a local stakeholder workshop, it was clear that the perceived importance of this service by stakeholders was high, and therefore important for EDP to evaluate in their CEV.

6. Monetize selected changes to ecosystem services

This step first of all involves identifying which ecosystem service values will be monetized. As already mentioned above, in few cases it is possible to value each and every change in ecosystem services that occur as a result of a given course of action. The ecosystem services that are selected for monetary valuation will usually be the most significant ones (as identified in Step 5), and the ones for which sufficient data is available.

Having identified the ecosystem services to be monetized, it is then necessary to select and apply appropriate valuation techniques. Detailed guidance on valuation techniques is not included in this Guide, but can be found on www.wbcsd.org/web/cev.htm.

Road Tester Example 17: Valuation Step 6 (monetizing changes)

Veolia Environnement	Veolia Environnement used the "change in production" approach to assess the value of agricultural and energy crop outputs. Value transfer was applied to estimate benefits and costs from reduced CO_2 emissions through use of energy crop biomass instead of fossil fuels, and increased emissions from pumping water to irrigate the energy crops respectively. French government values, based on the marginal abatement cost of carbon, were used (starting at € 32 per ton of CO_2 and increasing over time). To estimate recreation and non-use values, the available resources allowed for a small-scale contingent valuation survey. Local stakeholder engagement as part of this exercise was also welcomed by BWB, with 124 visitor and 83 general public interviews conducted. Average visitor willingness to pay values for scenario 3 were between € 1.9 to € 7.8 per person per year, while average general public non-use values for scenario 3 ranged from € 0.05 to € 7.2 per adult per year.

Road Tester Example 17: Valuation Step 6 (monetizing changes)

Hitachi Chemical

After carefully considering a range of potential carbon costs to use, Hitachi Chemical decided to use a proxy market price of US$ 20 per ton based on the EU ETS Mid Price: EUA Spot Vintage (for 3 months between March and June 2010). The price was accessed from www.ecosystemmarketplace.com.

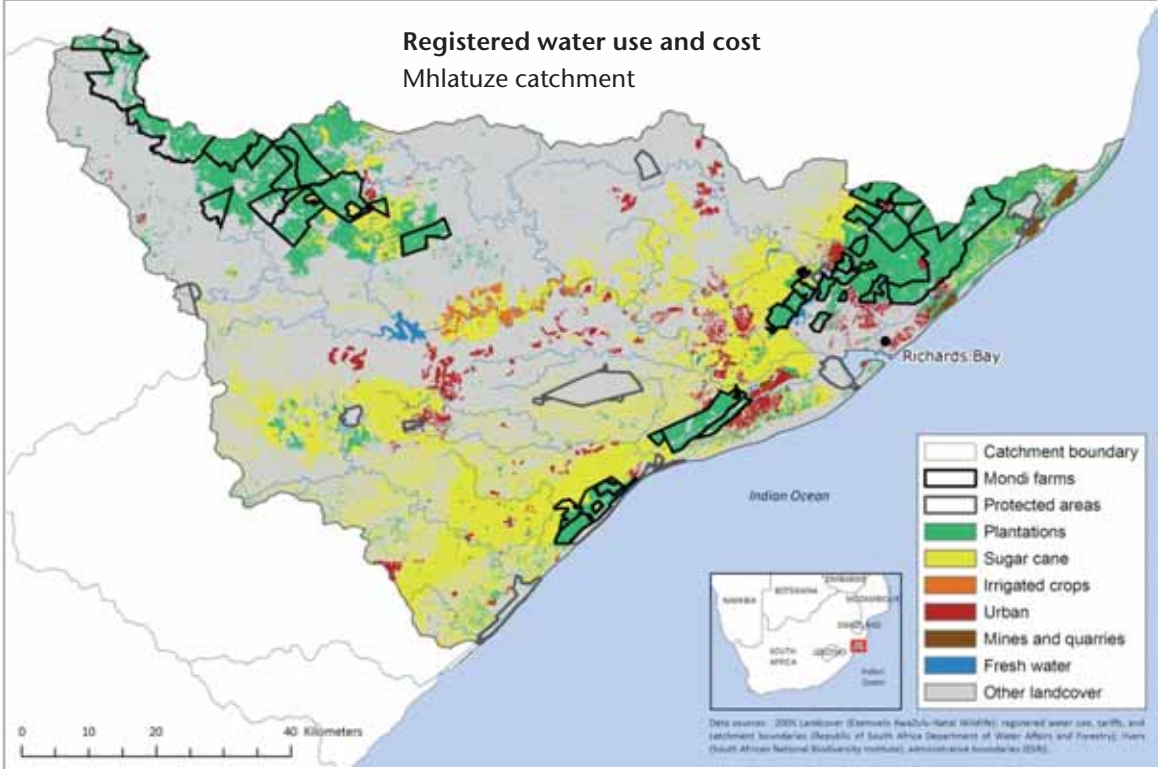
EDP

EDP assessed a large variety of ecosystem services associated with the system of reservoirs and canals making up a section of the company's hydropower network in Portugal. Market-based estimates were available for some services, including water consumption, electricity generation and soil protection (dredging costs). Recreational services such as fishing and boating were measured using the travel cost method. Benefits transfer was used to estimate non-use values. Results were still preliminary at the time of this publication, but ranged from € 4,167 per year in recreational fishing value to € 13,157 per year in fire risk avoidance, to € 7.5 m per year in electricity generation.

Mondi

Mondi used a GIS-based analysis to assess the value and distribution of water use in the Mhlatuze catchment (see figure below). The analysis reclassified 2005 land use and land cover data from Ezemvelo KwaZulu-Natal Wildlife into categories of major water use by sector (forest plantations, irrigated crops, sugar cane, urban and mines). Next, the land use class and total annual registered water use was calculated using data from the South African Department of Water Affairs and Forestry. Annual volumes from 2008 were multiplied by 2009-2010 water use tariffs, which vary by sector, to estimate the cost of water use by sector in the catchment. Although there is still some way to go in refining the map and data, the figures provide a good estimation of the annual value of the freshwater system in this heavily allocated catchment.

Sector	Estimated area (ha)	Registered area (ha)	2008 water use mill (m^3)	2010 tariff (Rand/m^3)	Current value (Rand)
Forestry plantations	67,200	43,570	68.7	0.38	R 26.1m
Irrigation (mostly sugar cane)	107,929	150,000	58.5	0.70	R 40.9m
Urban / industrial	18,412	_____	85.7	0.81	R 69.4m



7. Identify internal and external benefits and costs

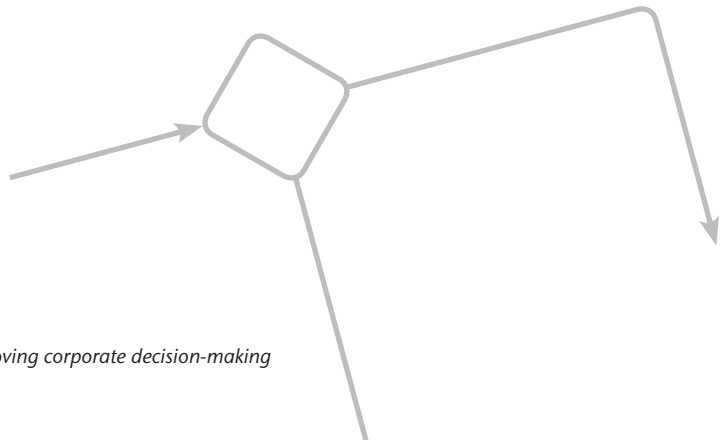
In most cases it is necessary to distinguish between costs and benefits that are internal to the company and which directly affect the bottom-line (financial costs and benefits), and those that are external (societal and non-financial, i.e. externalities). Some external costs and benefits may potentially be internalized by the company. This could be achieved, for example:

- Directly by **company actions** (e.g. charging visitors for access to their land or resources);
- Directly by **external bodies** (e.g. regulators establishing new market mechanisms to capture the costs of externalities, such as water pricing, biodiversity offsets or NO_X trading);
- Indirectly by **stakeholder actions**, and impacts to corporate reputation.

From a business perspective, it is worth identifying which costs and benefits might or could be internalized at some point in the future. These can be investigated further in Stage 4 (Application) of the CEV process.

Road Tester Example 18: Valuation Step 7 (identifying benefits and costs)

Veolia Environnement	Veolia Environnement undertook financial analyses to assess direct bottom-line implications for BWB and financial viability of the energy crop scenarios. These analyses included asset depreciation, taxes, capital and operating costs and market prices for the energy crops. Separate economic analyses estimated net agricultural benefits accruing to local farmers, the cost of carbon affecting global populations, recreation values of site visitors and non-use values for the general public in Berlin. The analyses were used to inform BWB's discussions with the energy crop provider, and encouraged local authorities to seek appropriate authorizations. They were also used in decisions over future water bills and possible payment for environmental services.
Hitachi Chemical	The cost of carbon is currently an external cost to the company as Japan is not yet involved in any carbon trading schemes, and because there is no carbon tax. However, this could well change in the near future. Hitachi Chemical also believes they may gain indirect reputational benefits from improved sustainability due to reduced carbon emissions.
Rio Tinto	The results of the Rio Tinto case suggest that the financial costs of conserving rainforest, borne by the company, are relatively small. However, the societal costs of conservation were very large, particularly the opportunity costs borne by local communities whose access to forests to supplement their incomes was restricted. Moreover, the benefits with the highest economic value (carbon storage and biodiversity) accrued to global populations, with fewer benefits accruing locally. By looking at the distribution of costs and benefits, the company is better able to determine appropriate compensation and benefit-sharing regimes that protect local communities and identify potential income streams associated with benefits accruing to rich country populations.



8. Compare the benefits and/or costs

This step involves aggregating and comparing all the benefits and costs associated with the "with" scenario(s). Costs should include capital, operating, decommissioning and externality costs, as appropriate for each assessment. All potentially significant benefits (and costs) should be identified, even if they are not valued monetarily.

It is also necessary to account for the time factor. Streams of benefits and/or costs will accumulate over time. However, economic theory suggests that the further into the future costs and benefits accrue, the less value they have in today's terms – due to people's time preferences and the opportunity cost of capital. This requires the use of a "discount rate" (essentially the inverse of a compound interest rate), to bring future values to their present-day value. Further guidance on the use of discount rates can be found at www.wbcsd.org/web/cev.htm.

Two common techniques for comparing (discounted) costs and benefits are worthy of notice. Firstly, the difference between total costs and benefits provides the **"net present value" (NPV)**, which is preferably positive. Secondly, the ratio of benefits to costs gives the **"benefit cost ratio" (BCR)**, which should be greater than one. Finally, some means of comparing costs and benefits, together with a range of other non-monetized impacts and broader sustainability metrics (such as multi-criteria analysis), should be considered. Further guidance can be found at www.wbcsd.org/web/cev.htm.

Road Tester Example 19: Valuation Step 8 (comparing benefits and costs)

Veolia Environnement	The costs and benefits were compared over a 25 year period for each scenario, using a financial discount rate of 5.5% and an economic discount rate of 3.5%. The financial analysis revealed scenario 2 (planting a single species of energy crop) as the only financially viable energy crop scenario, with a benefit cost ratio (BCR) of 1.03. However, when economic (societal) costs and benefits were included, scenario 3 (the two crop species) emerged as the most favorable option with a BCR of 17.4. This was due to the value of recreation and cultural benefits which included increased biodiversity and visual variety provided by the mix of crops on the site.
Hitachi Chemical	Hitachi Chemical calculated the additional annual costs it might incur based on the various scenarios examined, which assumed different costs of carbon and different emission levels of production. Internal benefits could potentially accrue in future scenarios where the cost of investment in alternative production processes is lower than the possible carbon cost.
Weyerhaeuser	Weyerhaeuser found that the relative value of different land management scenarios varied depending upon the time-frame considered. For example, for land holdings in Uruguay, management for hardwood production would generate the highest annual cash flow. However, taking potential changes in carbon prices into account, a mixed-use regime of trees for carbon sequestration, including dedicated energy crops and hardwood production, would generate the highest net benefits for the company over a longer term.
Holcim	The scale of economic benefits associated with wetland restoration was assessed using a value transfer approach. The study showed that the value of biodiversity benefits that would be generated by the proposed wetlands (£ 1.4 million), the recreational benefits of the lake (£ 350,000) and increased flood storage capacity (£ 224,000) would, after deducting restoration and opportunity costs, deliver net benefits to the local community of about £ 1.1 million, in present value terms. The value of carbon sequestration in these wetlands was found to be relatively small, while the marginal benefits associated with wetland restoration far exceeded the current benefits derived from agricultural production.

9. Apply sensitivity analysis

This last step involves investigating how sensitive the valuation results are to changes in key assumptions, where uncertainty exists. Typical assumptions to test for sensitivity include the number of people affected, the magnitude of change in ecosystem service, and real changes in price levels (for example, the amount people are willing to pay for key goods and services, the price of energy over time and the cost of carbon). If value transfer techniques have been used, it is particularly important to conduct a sensitivity analysis which assesses the impacts of changes in key values, as they typically represent imprecise estimates.

Sensitivity analysis usually involves determining high, medium and low values for key parameters, thus giving a range of possible results, depending on future circumstances and conditions. Risk assessments and calculations of statistical levels of significance can be useful measures for these calculations. Another approach to sensitivity analysis is to determine "switching values". These are the values that a parameter needs to reach in order to change a decision, or to alter the ranking of options from one option in favor of another.

Road Tester Example 20: Valuation Step 9 (sensitivity analysis)

Veolia Environnement	High, medium and low estimates were determined for a number of values assessed. However, three core areas of uncertainty were tested through sensitivity analysis. In the financial analysis, an increase in assumed market value of energy crops by 33%, would mean that scenario 3 becomes financially viable as well as scenario 2. When non-use values are excluded from the economic analysis, the overall BCRs for all three scenarios were less than 0.5, with scenario 2 having the highest at 0.43. This highlights the considerable significance of the non-use values. Finally, doubling the estimated number of site visitors, and taking a high estimate of their willingness to pay, has little impact on the BCRs, highlighting their relative insignificance in relation to the scenarios assessed.
Hitachi Chemical	Sensitivity analysis was a central part of the whole valuation process in that the scenarios assumed different carbon prices (ranging from half to double the assumed mid-value) and emission factors (varying by 5% and 7.5%). The outcome showed how sensitive the assessment and possible strategic investment responses may be to potential market price fluctuations.
Rio Tinto	Due to uncertainty regarding certain parameters, extensive sensitivity analysis was undertaken. Changes were made to discount rates (2%, 5% and 10%), the time horizon (10, 30, 60 years), the willingness to pay (US$/person/year) of OECD populations for rainforest conservation, carbon prices (US$ 4-20/ton CO_2e), and the success of developing ecotourism in the area. A form of sensitivity analysis was used to identify a suitable level of compensation for local communities. It was estimated that if local communities received roughly one third of revenue associated with Reduced Emissions from Deforestation and Forest Degradation (REDD) at modest carbon prices (US$ 4/ton CO_2e), they would not be worse off, and if they received roughly half of REDD revenues, they would be significantly better off, compared to the "business as usual" scenario.

STAGE 4
Application

Thinking about how the CEV results might be applied is a fundamental issue both at the beginning of the process (i.e. at the scoping stage) and after ecosystem valuation has been carried out. The intention of Stage 4 is to outline different strategies which can be used to help target the application of credible results. It focuses on five key areas: internal applications, external applications, communicating the results, dealing with confidentiality issues, and verification of the results.

Helpful hints:

- Engage with experts with extensive experience in CEV to consider the broad range of potential applications within your business.
- Using maps, graphics and simple summary tables can significantly enhance the communication of the message and results.
- If, at the outset, it is not clear what the results may show, consider adopting a flexible approach to targeting external stakeholders.

Overview of strategic application of results

Table 6: Overview of strategic elements to consider

Strategic elements	Description
Internal application	Highlights use of the generic applications of CEV and links to existing business analytical approaches to secure internal business benefits.
External application	Covers the same strategy as above, but with more focus on securing external business benefits.
Communicating the results	Provides advice on how best to communicate the results.
Confidentiality	Outlines how to deal with confidentiality issues.
Verification	Stresses the importance of verification of the results.

Applying the results internally

As already mentioned in earlier chapters, companies can gain substantial internal benefits from conducting a CEV – for example, sustaining and enhancing revenues, saving costs and revaluing assets, together with informing staff mindsets, behavior and actions.

To maximize the likelihood of achieving these benefits, it is useful to think how the four generic applications of CEV can be applied (trade-off analysis, total valuation, distributional analysis, sustainable financing and compensation analysis), and to consider how the results can feed into existing company analytical approaches. Both trade-off analysis and total economic valuation can be readily applied. For example, trade-off analysis can be used for option appraisal to save costs and to inform the pricing of products to enhance revenues. Total economic valuation can be used to revalue landholdings and inform risk assessments, thereby reducing operational costs. In addition, sustainable financing analysis can help identify and enhance revenue streams (such as carbon and biodiversity credits).

In order to increase the likelihood of CEV results being adopted internally, it is important to link the process directly to existing company processes and analytical approaches. There is considerable scope to incorporate or add CEV values to most existing approaches, and even to align them over time (see Stage 5 – Embedding). Table 7 highlights the ways in which linkages can be made between CEV and corporate analytical approaches that are commonly used for internal decision-making.

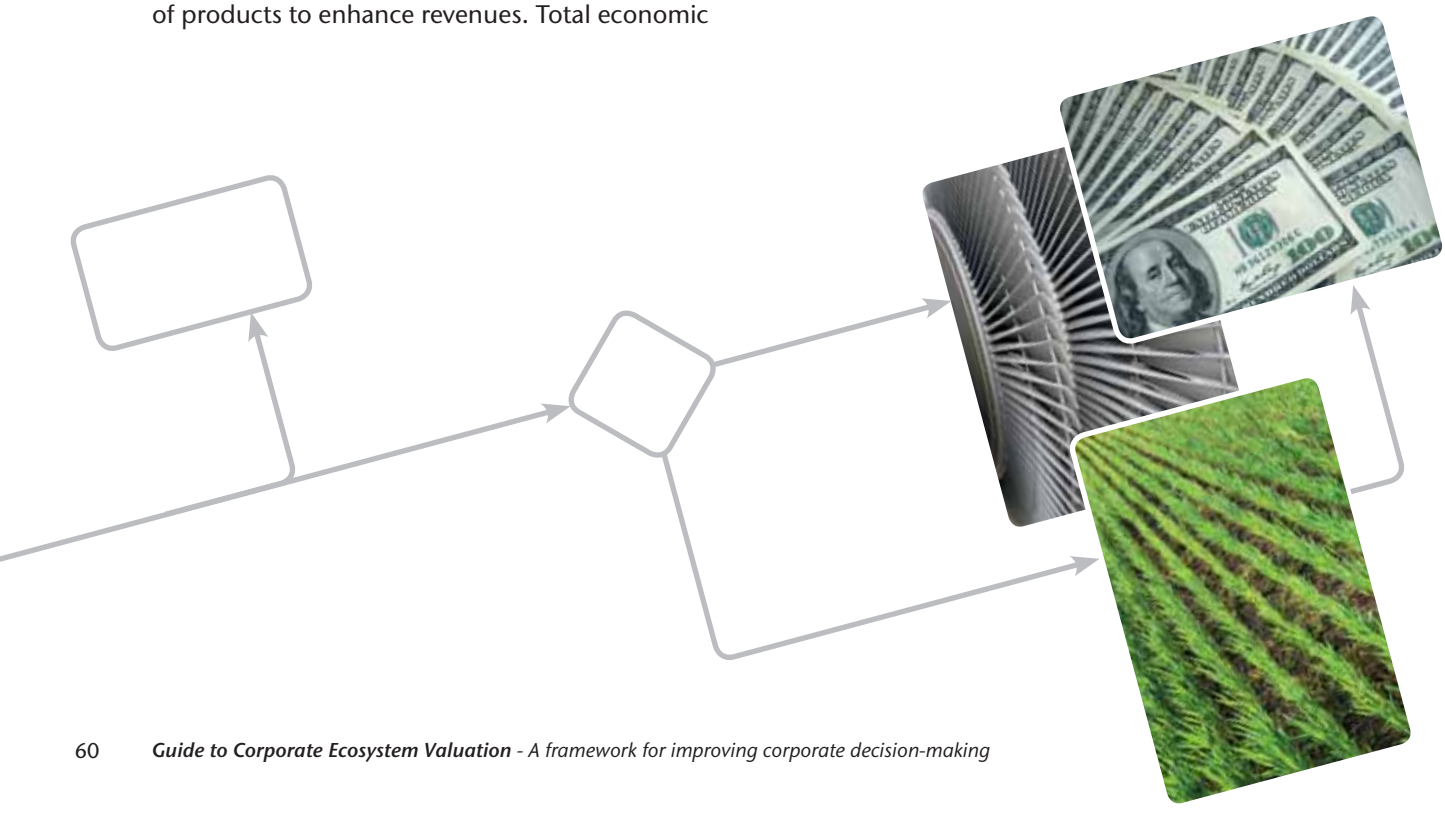


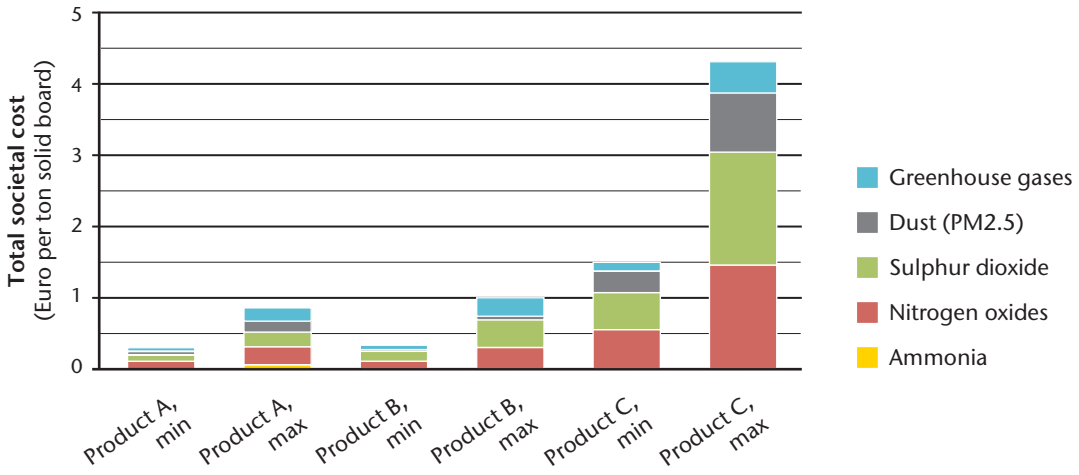
Table 7: Linking CEV results with company analytic approaches – internal focus

	Corporate analytical approach	Linkages with CEV
Monetary	Management accounting	CEV can inform management accounting techniques for assessing pricing decisions on products, new revenue streams and cost savings etc, which are relevant to budgeting and pricing decisions.
	Full (environmental) cost accounting	CEV can supplement full cost accounting approaches by putting monetary values on social and environmental parameters.
Non-monetary	Environmental management systems	CEV outputs can supplement the assessment of environmental opportunities and risks thereby saving costs, enhancing revenues and justifying and prioritizing environmental management actions.
	Ecosystem Services Review	CEV can help evaluate and prioritize potential strategic outcomes from an ESR to help manage ecosystem service risk and opportunities, delivering a range of business benefits.
	Multi-criteria analysis (MCA)	CEV outputs are often included in MCAs to assist in company option appraisals where monetary and non-monetary criteria can be evaluated together.
	Risk assessments	CEV outputs can be readily included in risk assessment when the probability of their occurrence is determined, thereby saving costs and reducing liability.
	Life cycle assessment (LCA)	CEV derived monetary values can be directly linked to quantitative LCA outputs, to inform sustainability assessments, reduce risks and costs, and justify product premiums that enhance revenue.
	Land management plans	CEV is ideal to help identify and value the full range of true values associated with different land uses, and to explore the costs and benefits of alternative land management options.

Road Tester Example 21: Internal benefits

AkzoNobel

AkzoNobel applied a trade-off analysis CEV to help inform the societal costs of three alternative paper chemicals. The study compared the societal costs of negative environmental externalities relating to GHG, dust, SO_2, NO_x and ammonia. The Figure below summarizes one set of results that came out of the analysis, which were linked to a life cycle assessment, to help to inform internal decisions on how to manage supply chain risks and optimize the sustainability of the company's supply chain. In addition, use of CEV in this way will hopefully provide internal benefits relating to sustained or enhanced profitability through enhanced product positioning, and improved sustainability decisions for capital investment.



The results show minimum and maximum total societal costs (expressed as Euro per ton solid board) for alternative sizing chemicals used in solid board production.

Applying the results externally

Companies can also generate important external benefit from conducting a CEV – for example, assessing liability and compensation, measuring share value, reporting company performance and optimizing societal benefit, together with informing stakeholder mindsets, behavior and actions.

As with internal business benefits, the four generic CEV applications can be used to maximize the likelihood of securing these benefits. Trade-off analysis is particularly useful for identifying the ways in which societal benefits can be optimized, when choosing between alternative options for informing stakeholders and regulators about actions and policies aimed to enhance sustainable natural resource use and management. Total valuation of landholdings and natural assets can inform company share valuations. In addition, distributional analysis, sustainable financing and compensation analysis can all help in assessing how much various stakeholders should contribute, or receive as compensation, when company actions enhance or decrease the supply of ecosystem services.

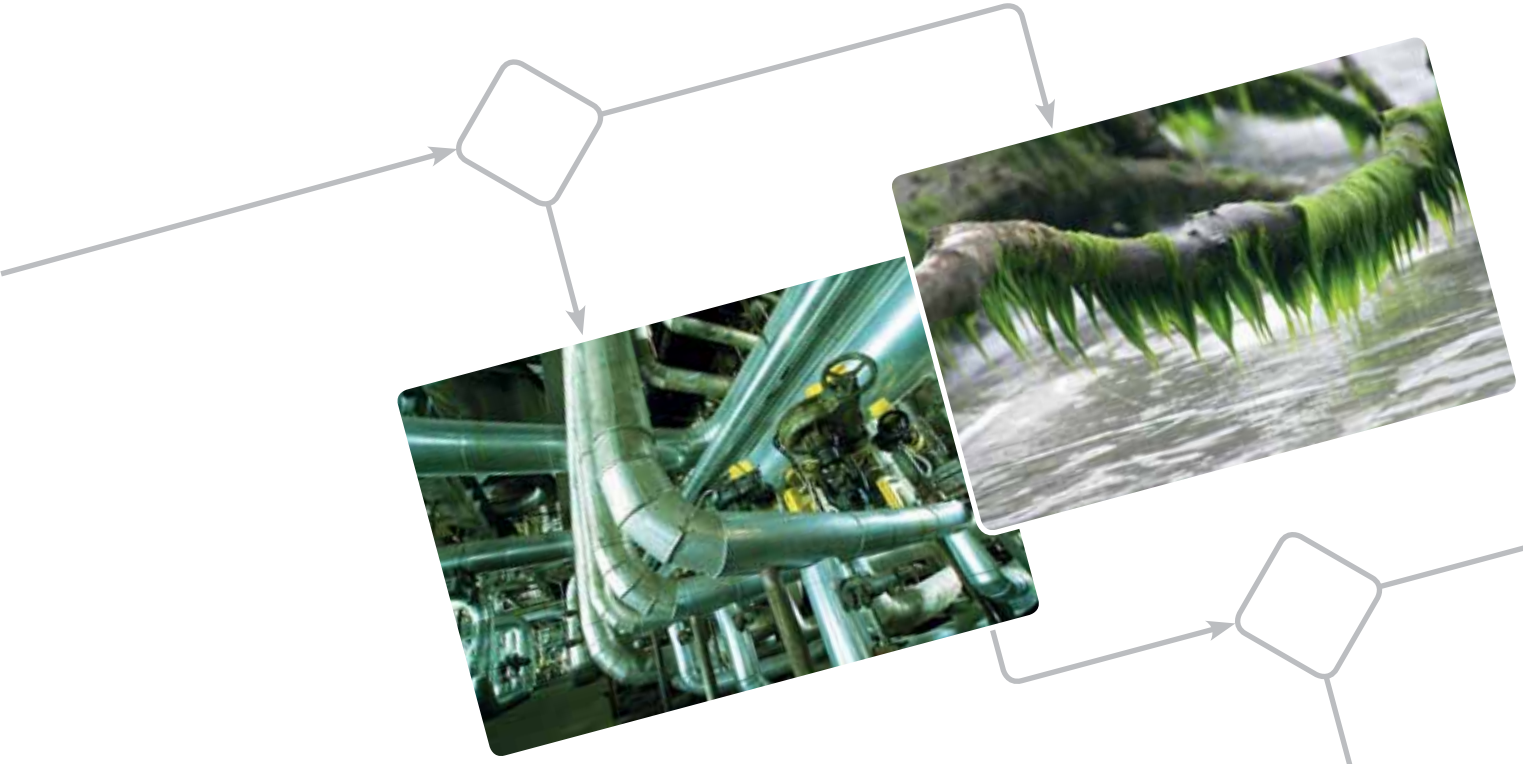
As with internal applications, it is important to link CEV output and approach with existing company processes and analytical approaches to enhance the acceptance of external uses. Again there is scope to both integrate values and align approaches (see Stage 5 – Embedding), as summarized in Table 8.

Table 8: Linking CEV results with company analytic approaches – external focus

	Analytical approach	Linkages with CEV
Monetary	Financial accounting	CEV can inform the valuation of fines, liabilities, new revenue streams and the value of landholdings which can all feed into profit and loss accounts and balance sheets used for external reporting purposes.
	Economic cost-benefit analysis	CEV results are ideal for assessing and potentially optimizing overall net benefits to society of alternative options, as well as identifying winners and losers.
	Economic (socio-economic) impact assessment	This assessment requires different information (e.g. expenditure, income and jobs etc.), but CEV output can supplement and inform socio-economic data.
	Natural resource damage assessment	CEV studies are commonly used to inform valuation of impact to natural resources for compensation claims following incidents such as oil spills, coral damages etc.
	Share price valuation	CEV output can inform theoretical share price valuations, particularly if it identifies and quantifies major new revenue, cost savings, liabilities and reputational impact.
Non-monetary approaches	Company reporting	CEV study output can currently add value as case studies in annual company reports, and in the future, the monetary values could be routinely included.
	Environmental & social impact assessments (ESIA)	CEV can readily be used to supplement evaluation of baselines, impacts; mitigation and enhancement measures; and compensation/offsetting packages. It is particularly useful to assess cost and benefits of alternative options.
	Strategic environmental assessments	The CEV results can be used in the same way as for ESIAs, but the application would be a more strategic, high-level perspective, covering a broader assessment.
	Sustainability appraisals	CEV results can represent or feed into one or more of the sustainability parameters used in such appraisals to demonstrate the degree of sustainability.
	Ecosystem Services Review	CEV can help evaluate and prioritize potential strategic outcomes from an ESR to help manage ecosystem service risk and opportunities with various external applications.

Road Tester Example 22: External benefits

Rio Tinto	Rio Tinto has found that application of CEV has presented new opportunities to identify ecosystem values and potential income streams that can be used to: • provide long-term sustainable income streams for conservation programs associated with large scale mining operations; • provide long-term sustainable income streams for local communities that live and work in and around protected areas, who may be disadvantaged by conservation programs; • demonstrate that Rio Tinto's investment in conservation programs is transparent, equitable across stakeholders, and commensurate with the value of the biodiversity impacts that are being offset.
GHD / SA Water	GHD / SA Water intends to use the CEV method in future catchment management planning within SA Water. The CEV provides a process for placing value on the services that the catchment provides to SA Water in terms of natural water filtration and nutrient assimilation and the value of reinstating these services through improved catchment management. The process also enables a more holistic view of catchment management and enables valuation of broader benefits such as recreational and aesthetic values and carbon sequestration.



Communicating the results

However interesting, relevant or useful the results of a CEV are, their ultimate impact on decision-making (both internal and external) depends largely on how well they are communicated. As a general principle, the more open, inclusive, simple and transparent the communication process and results, the more likely the results will be accepted and used.
A fundamental requirement is to make the results as clear and relevant as possible to the target stakeholder audience, using language they understand and can relate to.

A variety of options and tools exist for communicating the results to a broad range of stakeholders (see Table 9). Typically, a combination of approaches should be adopted to get the message across to those stakeholders deemed most appropriate to be targeted. Considerable care and effort should be expended in communicating the results to maximize the impact. Key aspects to communicate include the context, objective, methodology, stakeholder engagement, results, verification and implications.

Table 9: Communicating results – how and to whom

	Internal staff	Business community	Suppliers, customers & sector	Local communities, land-owners & general public	Shareholders	Regulators & policymakers
Internal report	✔					
Technical report	✔	✔		✔		✔
Annual report	✔	✔	✔	✔	✔	
Meetings	✔	✔	✔	✔		✔
Presentations / articles	✔	✔	✔	✔		✔
Website	✔	✔	✔	✔		
News stories, media campaigns and advertizing	✔	✔	✔	✔	✔	✔

Road Tester Example 23: Communicating the results

Syngenta

The output from the CEV is critical to assess the economic threshold (tipping point) in order to facilitate grower decision-making on field margin enhancement for native pollinators, and ultimately to promote broader adoption. The information may also serve to educate consumers, university researchers, policy makers and other governmental agencies to strengthen policy development relating to the provision of conservation buffers for pollinators on agricultural lands. Syngenta understands that the future of agriculture ultimately depends on protecting the environment and enhancing the livelihood of growers. They see CEV as a means to enhance long-term agricultural productivity for themselves and the growers they serve, and also to provide society with wider benefits.

Addressing confidentiality concerns

The amount of CEV information that is revealed to external audiences depends both on legislative requirements as well as the discretion and policies of the company concerned and should seek to balance the interests of commercial confidentiality and public disclosure. Transparency is, however, a key CEV principle to be followed where possible. When disclosing results and values, one way of maintaining a degree of confidentiality is to use indices and percentages rather than absolute values.

Road Tester Example 24: Addressing confidentiality concerns

Weyerhaeuser

Weyerhaeuser wanted to develop a standardized methodology to compare different forest management options and understand trade-offs between different ecosystem services. They applied the CEV to two sites using the "change in productivity" approach with quantities, market prices and costs. A cash flow index was produced, wherein the base case is 100 and others are indexed relative to the base case. This approach enabled them to compare the alternative options and share their output with stakeholders, without being concerned over any sensitive or confidential information.

Management Regimes	Cash Flow Index
Southeastern U.S.	
Non-industrial private forest owners	
Solid wood regime (southern yellow pine)	100
Industry standard	
Solid wood (southern yellow pine) + biomass + hunting	170
Weyerhaeuser - USA	
Solid wood (southern yellow pine) + biomass + hunting	226
Solid wood (southern yellow pine) + intercropping + biomass + hunting	274
Solid wood (southern yellow pine) + carbon sequestration + biomass + hunting (low CO_2e price - \$5/Mt CO_2e)	219
Solid wood (southern yellow pine) + carbon sequestration + biomass + hunting (high CO_2e price - \$20/Mt CO_2e)	237

Verification of the values

The extent to which CEV values should be verified depends largely upon their proposed use and dissemination. If the CEV is solely to be used internally, verification is usually less of an issue. However, if it is to be disseminated externally, some form of verification is usually advisable. This will need to be undertaken by a suitably-qualified individual or organization, and should involve reviewing the methodology, results and assumptions. In time, specific verification guidelines will need to be developed.

In the absence of formal verification procedures, the credibility and reliability of CEV output will be enhanced by:

- Involvement of appropriate stakeholders during the scoping, valuation and application stages;
- Using an independent environmental economics expert or organization to conduct or advise on undertaking the CEV.

STAGE 5

Embedding

This stage provides suggestions on the actions that companies can take to help ensure that CEV, if proven to be of value, is embedded within company processes and procedures.

Helpful hints:

- Use company networking and newsletter opportunities to communicate broadly within the company, informing others on the value of the approach.
- Having completed a CEV, develop a strong business case for further applications for example incorporating aspects of CEV where appropriate into (i) executive performance and review and (ii) financial and management accounts.
- Consider adapting the CEV approach so that it links more closely with one or more of your existing processes.
- Identify external organizations or individuals with whom your company can interact, to further develop CEV topics internally.

Overview of strategies for embedding

Table 10: Overview of strategies for embedding CEV

Strategies	Description
Getting internal buy-in	It is vital to develop a strong business case, and to identify champions at all levels within the company who are willing to promote CEV.
Linking CEV to existing processes	It is important to find ways to link CEV to existing processes, analytical approaches and tools within the company.
Capacity building	In order to stimulate the take-up of CEV it is essential to build capacity and awareness across the company.

Getting internal buy-in

If CEV is to be successfully embedded into company practice, the company must see that it has a clear use and relevance. There needs to be buy-in from the high-level managers who are responsible for making decisions on company policy and practice, as well as from the staff in specific technical, research and operational units. Communicating the business case for CEV to these groups, identifying "champions" who will advocate for its use, and finding concrete areas for the further application of CEV approaches can all help in securing this buy-in.

A first step is to use this Guide to **complete a successful pilot study** – a robust and relevant application of CEV that delivers value to the company. It will be important to critically appraise and articulate the business benefits the CEV provides, or could yield. A strong pilot study will need to be complemented by a number of other elements in order to build a foundation for embedding CEV. For instance, it is likely to be necessary to **develop a business case for further applications.**

Future applications of CEV in the company may or may not be similar to the pilot study – either in their scope and approach, or in the technical issue or geographical area to which they are applied. Another key step is therefore to **identify CEV champions** within the company – ideally within senior management (to facilitate uptake) as well as within other teams and business units, to help escalate the embedding process. Finally, it will be important to **build awareness** about the functions of CEV and what types of benefits it could bring to the company. This could involve writing articles in newsletters and for company internet sites, running workshops, etc.

Road Tester Example 25: Getting internal buy-in

Holcim

Aggregate Industries UK, the subsidiary of Holcim that undertook the road test, is planning to write a business case report both for themselves and for Holcim, making the case for potential future applications. They consider it necessary to understand emerging tools such as ecosystem valuation in order to: anticipate and save costs in relation to potential future mineral planning requirements; streamline decision-making; and inform negotiations for rehabilitation and aftercare requirements. Eventually, Holcim may use CEV routinely as a process to identify restoration options with the greatest biodiversity and local livelihood benefits, forming part of their ESIA toolkit.

Linking CEV to existing processes

If CEV is to be assimilated by a company, it is advisable to link it with existing company processes and systems. In most cases this should be straight-forward; for example, where an ESIA is being carried out, when the company must respond to a particular regulatory demand or request for information from shareholders, or in cases where new market research is being initiated. Other situations may be more challenging.

It may be desirable to **develop CEV-based performance indicators** that align with other company approaches (for example with EMS and company sustainability reports). Some companies may wish to develop an **internal company version** of the guidelines – either a streamlined guide or a related framework, tailored specifically to the company context.

Road Tester Example 26: Linking to existing processes

Rio Tinto	Rio Tinto plans to integrate the CEV approach with their existing biodiversity offset and Net Positive Impact (NPI) planning toolbox to improve the rigor of their existing methodology. The existing approach currently calculates biodiversity losses and gains generated by development projects based on habitat quantity and quality indicators.
EDP	EDP plans to link CEV with their European Eco Management Audit Scheme (EMAS), its environmental management system. EMAS requires a communication plan with the public which the CEV has helped reinforce and inform. As part of the CEV process, stakeholder engagement was conducted to collect local perception regarding the hydro-system operation, impact on their use of the watershed, and to identify an optimum level of social benefits through appropriate site management.
Others	Holcim hopes to link CEV more closely with their ESIAs. AkzoNobel and Hitachi Chemical plan to further explore how to utilize the CEV thinking with current LCA methodologies. Lafarge and Holcim plan to use CEV for land use planning and mine rehabilitation. Mondi plans to expand CEV to the Usutu catchment and extend the valuation to include grasslands and wider biodiversity issues.

Capacity building

Embedding CEV into company practice over the longer term will require educating staff and cultivating experts, to ensure that use of CEV as a process continues to grow along with the company.

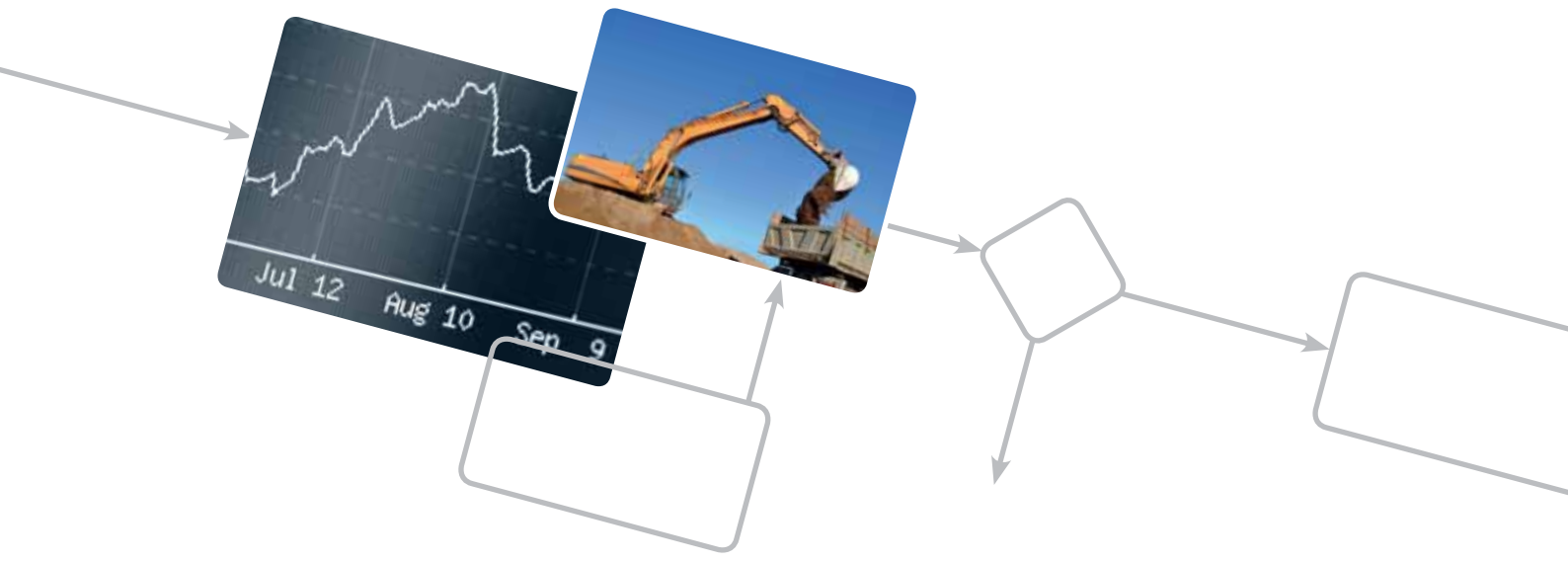
A first step will be to **identify staff with appropriate skills**. There may already be qualified and experienced environmental economists within the company working on other matters.

Capacity building more broadly will be likely to require **internal training**. Broad-based awareness activities are advisable in order to promote the approach to a wide audience within the company, while specific training may be required for those staff likely to be more closely involved in undertaking or supervising CEVs.

Fully embedding the approach across a company may require **developing a resource team**. This team could either be located at the corporate level, or within a specialized business unit. In some cases, team skills can be developed through hiring new staff with the right background, or through training of existing staff. A "virtual network" of skilled staff across different business units may be effective in some situations. In others, it may be decided that the detailed skill set required is best outsourced, for example, through partnering with a consultant, NGO or university, or even a combination of all of these.

Road Tester Example 27: Capacity building

EDP	EDP has decided to convert the approach and framework into a training kit for internal use, so it can help the company to scale up its applications of CEV. Although road testing this Guide allowed EDP to gain a deep understanding of the process, they recognize that external expertise and partnerships are still needed for future projects.
Rio Tinto	Rio Tinto has committed to a partnership with IUCN to provide a range of ecosystem and biodiversity-related skills, including in ecosystem service valuation.



Next Steps

The Economics of Ecosystems and Biodiversity study (TEEB) – initiated by the G8+5 environment ministers (2007-2010) – has emphasized the concept of ecosystem valuation as a practical and influential aid to decision-making. Companies must anticipate that ecosystem valuation will be more consistently incorporated into public policies, regulations, and political decisions. Ecosystem values will be increasingly considered by the finance sector and business-to-business customers as they assess the biodiversity and ecosystem- related risks and opportunities of investments and supply chains.

In this respect, this Guide to Corporate Ecosystem Valuation "operationalizes" TEEB's key messages and recommendations by providing a practical approach for effective application at company level. There is, however, still work to be done and areas that need improvement, for example, the availability of values in databases, standardization of values and valuation techniques, and the development of more robust and user-friendly valuation tools.

In a world that is increasingly carbon- and natural resource-constrained, global companies with strong brand positions face material risk as a direct result of biodiversity loss and ecosystem degradation. By the same token, these risks provide many new business opportunities.

WBCSD encourages the business community to proactively manage these risks and opportunities by:

1. Measuring, valuing, managing and reporting biodiversity and ecosystem impacts and dependence, i.e. know, understand and manage their "footprint".
2. Innovating and leading the development of new (i) markets for ecosystem services and (ii) eco-efficient goods, services & technologies.
3. Encouraging suppliers & purchasers – including SMEs – to adopt "best" biodiversity and ecosystem practices throughout their supply chain.
4. Entering into creative partnerships with municipalities, governments, NGOs and the science community for on-the-ground solutions.
5. When appropriate, advocating for and supporting "smart" ecosystem regulation that reverses degradation, leverages market forces, "levels the playing field" for all and supports social and livelihood benefits.

Corporate Ecosystem Valuation – and the use of this CEV Guide – can support companies with all these strategies and actions by better integrating biodiversity and ecosystem considerations into core corporate operations.

Resources

A list of key literature, toolkits and case studies which relate to CEV are available on the WBCSD website (see www.wbcsd.org/web/cev.htm). These include briefing papers on CEV concepts and valuation techniques, as well as a full set of summaries of the CEV "road tests". Such additional resources and guidance aim to assist business managers, analysts, and consultants conduct a CEV, for example, how they can select and apply different valuation techniques.

The ESR website (www.wri.org/ecosystems/esr) also provides a wealth of additional resources covering ecosystem services and associated tools.

While by no means exhaustive, Box 10 lists a few useful supporting documents, valuation guidelines and benefit transfer databases. These and many others can be accessed from the WBCSD website.

Box 10: Key supporting documents, guidelines and databases

Companion WBCSD documents:

- WBCSD and IUCN (2007): "Markets for Ecosystem Services – New Challenges and Opportunities for Business and the Environment: A Perspective". This highlights new markets being developed for ecosystem services and implications for business.
- WRI, WBCSD and Meridian Institute (2008): "The Corporate Ecosystem Services Review" (ESR). The ESR is a structured method that helps managers develop strategies related to the risks and opportunities arising from their company's dependence and impacts on ecosystems.
- WBCSD (2009a): "Corporate Ecosystem Valuation: A Scoping Report". This provides an introduction to ecosystem service valuation and examples of past CEV applications.
- WBCSD (2009b): "Corporate Ecosystem Valuation: Issue Brief". This explores the broader context and concepts underlying CEV.
- WBCSD (2009c): "Corporate Ecosystem Valuation: Building the Business Case". This identifies ten reasons why companies should undertake CEV.
- WBCSD (2007, revised in 2009 and 2010): "Global Water Tool". This tool maps a company's water-related risks and provides an inventory for reporting on GRI's water indicators.
- WBCSD and WRI (2001, revised in 2004): "Greenhouse Gas Protocol (GHG Protocol)". This is the most widely used international accounting tool for government and business leaders to understand, quantify, and manage greenhouse gas emissions.
- WBCSD (2008): "Measuring Impact Framework". This tool helps companies understand their contribution to society, inform their operational and long-term investment decisions, and have better-informed conversations with stakeholders.
- WBCSD and WRI (2008, revised in 2009): "Sustainable Procurement of Wood and Paper-based Products Guide". This is a toolbox designed to help corporate managers understand and find the best advice on how to purchase products originating from the world's forests.

Valuation guidelines:

- Bateman et al (2009): "Valuing Environmental Impacts: Practical Guidelines for the Use of Value Transfer in Policy and Project Appraisal". Report to Defra.
- Business and Biodiversity Offsets Program (BBOP) (2009): "Biodiversity Offset Cost-Benefit Handbook".
- Defra (2007): "An introductory guide to valuing ecosystem services".
- Dixon et al (1994): "Economic analysis of environmental impacts". Published in association with the Asian Development Bank and the World Bank.
- HM Treasury (2004): "Green Book" for undertaking economic appraisals.
- Pearce D, Atkinson G and Mourato S (2006): "Cost Benefit Analysis and the Environment: Recent Developments". OECD
- Navrud S. and Brouwer R. (2007): "Good practice guidelines in benefit transfer of forest externalities". Draft report for EuroForex.
- UK Department of Transport (2002): "Economic valuation with stated preference techniques: a manual".

Valuation databases:

- Benefits Table (BeTa): a database developed for the European Commission to estimate externality costs (health and environmental) of air pollution in Europe. http://ec.europa.eu/environment/enveco/air/pdf/betaec02a.pdf
- Environmental Valuation Reference Inventory (EVRI): currently the most comprehensive database of ecosystem service values with the greatest coverage of UK studies. www.evri.ca
- ExternE: database of energy-related externality values in Europe. www.externe.info
- National Oceanographic and Atmospheric Administration (NOAA): provides databases and annotated bibliographies for coastal and marine resources. http://marineeconomics.noaa.gov/bibsbt/welcome.html
- Natural Resource Conservation Service (NRCS), US Department of Agriculture: a database and listing of unit value estimates for different recreational activities. www.economics.nrcs.usda.gov/technical/recreate
- Review of Externality Data (RED): a listing of studies related to environmental costs (from a life cycle perspective) of energy and other sectors. www.red-externalities.net

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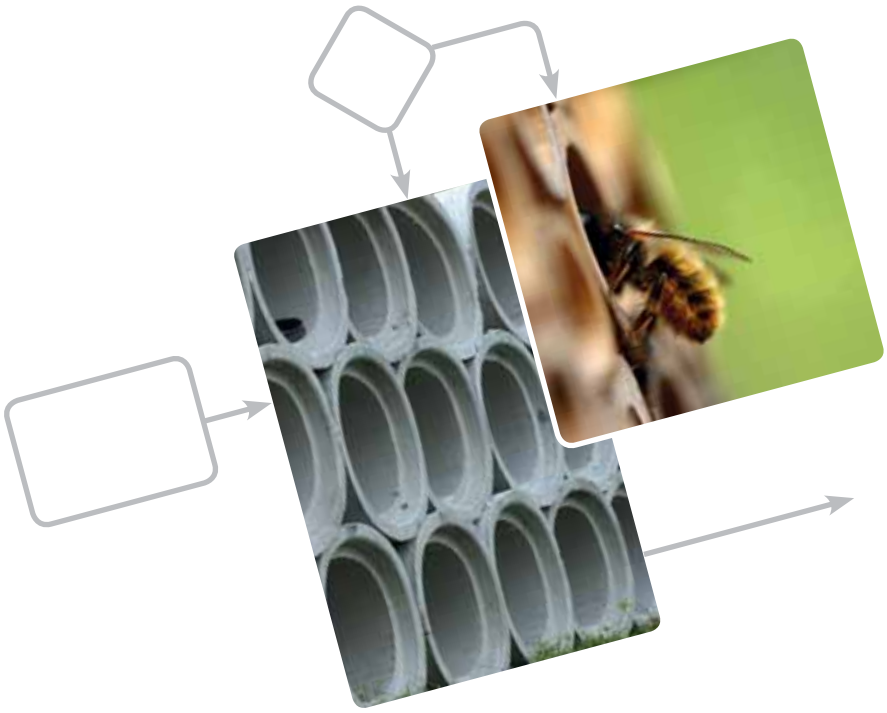

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