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BUSINESS APPROACHES TO NATURAL CAPITAL VALUATION

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Structure

KEY RESULTS

Natural Capital Valuation (NCV) is experiencing a growing interest across major companies, non-governmental organizations, governments, consultancies and academia. The fact that the costs of environmental externalities have gone largely unaccounted for, has been a major reason for risks associated with the depletion of ecosystem services or the natural capital. NCV seeks to provide decision makers with clarity about external environmental costs and how business would be affected should ecosystem services not be maintained.

Companies currently use Natural Capital Evaluations for either (a) evaluating external costs relevant to their business in their supply chains or (b) assessing a particular technology, site or project.

There are, however, a number of challenges associated with NCV such as the lack of a harmonized framework, lack of incentives for business, and difficulties to gain access to data if the impact analysed lies beyond the company premises. In general, putting the impacts into a regional context and to find data with adequate quality are great challenges. One reason for the slow uptake of NCV in the business world is also the need to make the business case clear to the decision makers. Adding to the confusion are the various existing tools and initiatives to value and assess natural capital, most of them at a pilot stage.

However, several initiatives to harmonize the NCV framework are working well, and the more companies work on conducting NCV's, the more refined the tools will become. Some of the most well-known applications of NCV is for green infrastructure (applied by companies such as Dow Chemical) or for the generation of an Environmental Profit & Loss (EP&L) account (the most prominent case being PUMA, but the pharmaceutical company Novo Nordisk has also embarked on a similar endeavour).

Nevertheless, due to the risks stemming from an increasing resource scarcity, it is expected that business will integrate natural capital into their business models to a growing extent. The aim is to obtain a better understanding of costs to the business, to make their companies more resilient, to manage risk more effectively, to concentrate on the right relationships with customers and suppliers and to strengthen their reputations.

(1) INTRODUCTION

Natural capital can be explained as the extension of the economic definition of capital (manufactured means of production) to environmental goods and services. Natural capital is thus the stock of natural ecosystems that yields a flow of valuable ecosystem goods or services now and into the future. For example, a stock of trees or fish provides a flow of new trees or fish, a flow which can be sustainable indefinitely. Natural capital may also provide services like recycling wastes or water catchment and erosion control. Many of the benefits provided by natural capital come from ecological systems - ecosystems. Since the flow of services from ecosystems requires that they function as whole systems, the structure and diversity of the system are important components of natural capital (Constanza et al. 2006; Constanza 2008). One of the first definitions of natural capital was appeared in the book "Small is beautiful" (1973) by Schumacher and describes natural capital as all of the ecosystem services that the earth provides to people.

Up to date, the value of ecosystems and ecosystem services has largely been left unaccounted for in business decisions and market transactions. The reasons for this are manifold, e.g. that the structures of modern accountancy are derived historically from societies and economies which assumed that nature's abundance would last indefinitely, and that the focus of the vast majority of businesses is short-term (CIMA 2014). However, some companies, scholars and non-governmental organizations are pioneering a new way of looking at nature. They recognise that nature's value needs to be accounted for as the lack of transparency about economic costs has been a major reason for risks associated with the depletion of ecosystem services or natural capital. The new model for business seeks to integrate the real value of nature and is not just taking notice of the market price of natural resources. The aim of the businesses applying this model is to make their companies more resilient, to manage risk more effectively, conduct more realistic cost planning and impact assessments, to concentrate on the right relationships with customers and suppliers and to strengthen their reputations. There is, however, currently a lack of a harmonised framework for how to value natural capital and apply it in business decision making (Natural Capital Coalition 2013).

This study has been initiated by WEC's member company F.Hoffmann La-Roche AG, which requested WEC Europe to provide an evaluation of the approaches to Natural Capital Valuation. As the evaluation has been asked for by Roche within the scope of WEC's free Sustainability Advisory Service for member companies, it is also available to other WEC members as well as to the broader business community.

This paper is based on current research and utilizes publicly available data sources.

(2) MONETARY VALUATION TECHNIQUES

Within the field of environmental economics, several natural capital valuation approaches have existed for quite some time, and some of these methods are applied in environmental impact assessments and environmental cost-benefit analyses. However, not until rather recently they have gained more attention as a tool to quantify or 'price' natural capital externalities within the world of business. There are basically two types of valuation techniques, those based on market prices and non-market valuations. The market based valuations are relatively straight-forward. The problem is, however, that for environmental externalities, there are often no well-functioning markets and therefore the price for an environmental service (if existent) may be distorted. For non-market based valuations the cost based method is the simplest. It measures avoided damage costs or replacement costs of a specific ecosystem service. The other two methods – revealed preference and stated preference – are more complex as they are based on people's observed behaviour or on their stated preferences (=willingness to pay).

Table 1 below describes the different valuation techniques and presents for each method an example illustrating what the outcome of the calculation should be.

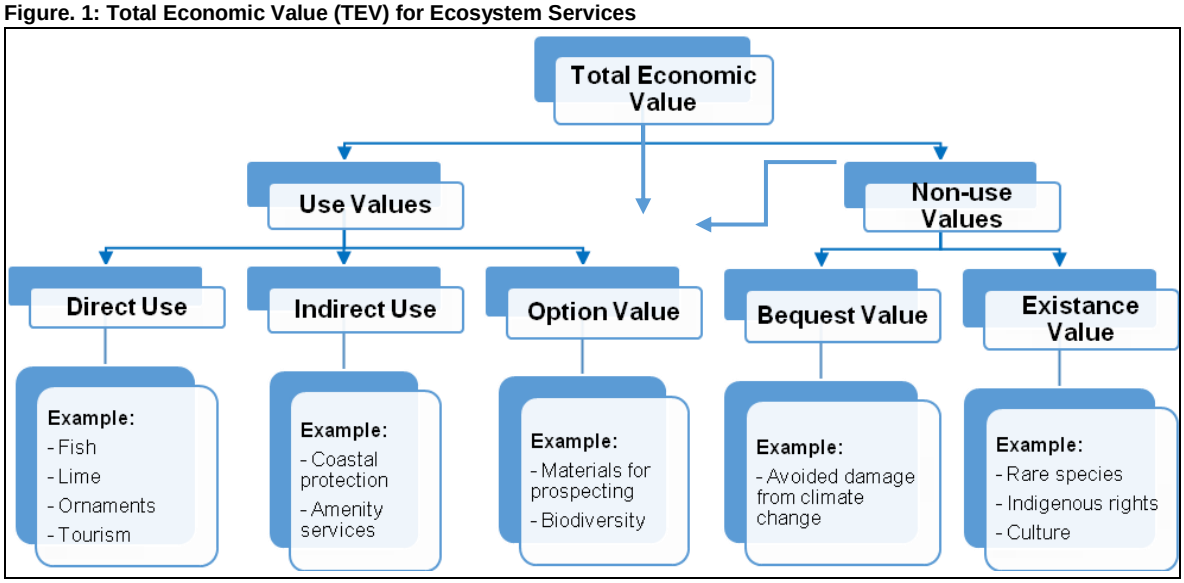
Table 1: Natural Capital Valuation Techniques

Family and methods	Description	Example output
Market valuation		
Market-based direct valuations based on market prices	• In a well-functioning market, the market price depicts the marginal benefit of a good/ service • Net benefit can be calculated by combining price with quantity and cost estimates	Net Present Value of harvested timber (EUR/ha)
Non-market valuation		
Cost based • Avoided damage costs • Replacement costs	• Costs incurred in the absence of the service, measuring prices of equivalent non-ecosystem services	Value of avoided water treatment costs (EUR)
Revealed preference • Hedonic pricing[1] • Travel cost	• Use observed behaviour to identify value in a surrogate market	Time and travel costs incurred in recreation
Stated preference • Contingent valuation • Choice experiments	• Methods based on surveys in which people give responses to hypothetical situations that demonstrate values	Willingness to pay for conserving a specific species
Valuation without using primary data		
Value transfer • Point, function and meta-analysis transfer[2]	• Apply existing value estimates to new cases with similar characteristics	The Environmental Valuation Reference Inventory (EVRI) is a searchable storehouse of empirical studies on the economic value of environmental benefits and human health effects. Using the EVRI to do a benefits transfer is an alternative to doing new valuation research

Source: Natural Capital Coalition (2014b), modified

The Total Economic Value (TEV) is one of the most commonly used conceptual frameworks for understanding all components of social well-being, and hence all constituents of value. The application of TEV to ecosystem services is illustrated below in Figure 1.

Figure. 1: Total Economic Value (TEV) for Ecosystem Services



Source: Natural Capital Coalition (2014b)

[1] A method of pricing based on the principle that, the price of a marketed good is affected by certain external environmental or perceptual factors that can raise or lower the "base" price of that good. This is commonly applied to the housing market, where the price of a house can be affected by factors such as scenic views, house appearance, and neighborhood demand. The hedonic pricing model is used to estimate the extent that price and demand can be affected by such factors i.e. how much people are willing to pay for that good when considering these factors.

[2] Depending on what is to be valued, data can come from different sources: e.g. value transfer from one wetland to another, value transfer of a specific ecosystem function, or from multiple studies that examine the same phenomenon

The TEV framework details all aspects of anthropocentric value (value to people) that can be considered in terms of both use (e.g. ecosystem services used for production) and non-use (e.g. ecosystem services that have a value to people without being consumed). Many natural capital accounting and ecosystem service valuation methods and tools typically take an anthropocentric approach. Economists tend to support this view point which is inherent in tools such as cost-benefit analysis. Some methods and tools also take a 'biocentric approach' which asserts that nature's value results from the ability to provide wellbeing or utility to humans and to other species. Some ecosystem service tools, such as InVEST, include models that value ecosystem services in terms of benefits to people, but also allow users to map and quantify impacts on biodiversity and risks to habitat, without valuing these characteristics in terms of how they affect society. This allows comparison of trade-offs and synergies between values to people and intrinsic value or rights of ecosystems and species (Natural Capital Coalition 2014b).

(3) Approaches, methodologies and Frameworks to Natural Capital Valuation

Although there are various tools and methods available for measuring biodiversity and ecosystem services, there are basically two different approaches:

(a) Assessment of a particular technology, site or project: This approach has been used by Dow Chemical and most of the WBCSD member companies that have tested the WBCSD Guide to Corporate Ecosystem Valuation (please see 3.1 below). It is a more local and detailed approach, mostly used to assess different management alternatives (The Global Nature Fund 2014).

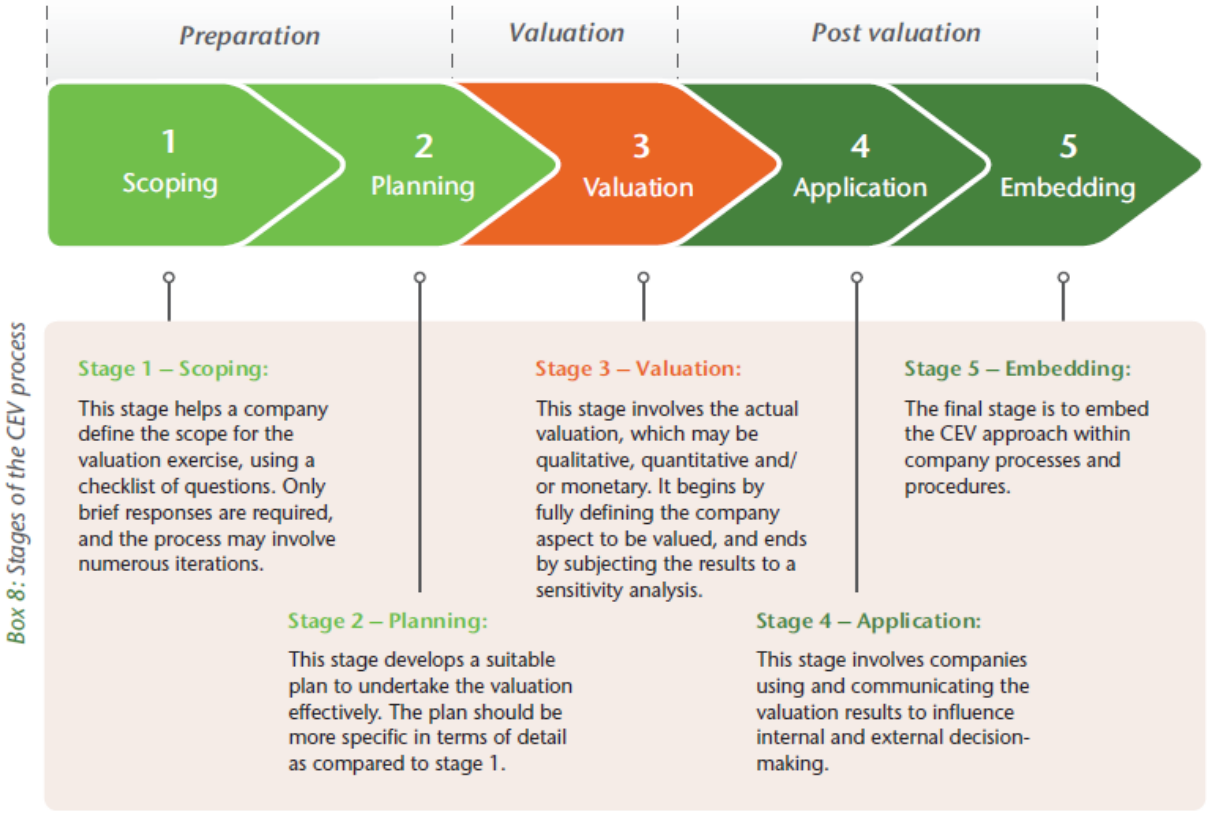
(b) Assessments of a company's supply chains: This approach has been used by the Otto Group or PUMA and is based on econometric modelling. The entire supply chain, down to the raw material stage is covered. However, this wide coverage comes at a price as it involves a certain level of abstraction;

3.1 WBCSD's Guide to Corporate Ecosystem Valuation (CEV)

WBCSD's Guide to CEV has gained much attention. It was developed in 2011 through an 18-month process of close collaboration with business, and constitutes a detailed and business oriented explanation of what natural capital valuation is and for what purposes it can be used. Step by step, the guide takes the reader through the process of conducting a valuation of a company's externalities, including preparatory phases such as priority setting. The Guide to CEV is thus a framework to improve corporate decision-making by taking ecosystem services into account, and it provides a set of resources to support the process of natural capital valuation. It is not a price list of biodiversity and ecosystem services, a calculator to "crunch numbers", nor is it a stand-alone methodology (WBCSD, 2011). The Guide is divided into five main steps: Scoping, Planning, Valuation, Application and Embedding (see fig. 2 below), that explain what a company needs to do to prepare, conduct and integrate a natural capital valuation into its business strategy.

A CEV can be linked with many other existing company processes and analytical techniques. For example, a CEV may be integrated into full cost accounting, life cycle assessments, land management plans, economic impact assessments, company reporting, and sustainability appraisals, depending on the scope of the valuation.

Figure 2: The five stages of a CEV according to WBCSD (For a more thorough explanation of step 3, please see the Annex)



Source: WBCSD (2011)

3.2 Valuation Methodologies and Approaches

A Natural Capital Valuation (often also described as Ecosystem Valuation) can be qualitative, quantitative and/or monetary. As a general rule a valuation should generally begin with a *qualitative* assessment to identify priority ecosystem services. Based on this information, a *quantitative* assessment can be undertaken, analyzing the different units such as hectares, tonnes or m^3, and finally a *monetary* valuation may be carried out for some or all of the ecosystem costs and benefits identified, if necessary. (WBCSD 2011).

There is to some extent always the need for trade-offs between conducting a very detailed and time-consuming exercise and the need for rapidly generated decision-support information based on available data and knowledge. Natural Capital Valuations can be one or the other and in most cases, do not need to be lengthy or expensive (WBCSD 2011). A summary of different methods and approaches, which can be found in the Annex in table A1, was published by the Natural Capital Coalition (2014b) and lists existing tools, guides and methodologies to conduct Natural Capital Valuation. Below, in Table 2, is a summary of a selection of the valuation methods that have been tested by various organizations.

Table 2: Valuation methods for Natural Capital Evaluation

a) InVEST- Integrated Valuation of Environmental Services and Tradeoffs	
Who:	Developed by Stanford, The Nature Conservancy, WWF and the University of Minnesota
What:	Free, open-access suit of software models used explore how changes in ecosystems are likely to lead to changes in benefits that flow to people.
Purpose:	To assess quantified trade-offs at site or landscape scale associated with alternative management choices and to identify areas where investment in natural capital can enhance human development and conservation.
Use areas:	Basic risk screening, scenario planning, sensitivity analyses – can include up to tier 1. Outputs describe natural resources in terms of their biophysical supply, the service they provide to humans, or their projected socioeconomic value. The tool includes models that

	analyse different aspects of marine and terrestrial environments
Used by:	A number of businesses, including Lafarge and Dow Chemical.
Data used:	GIS based data; for tier 1: globally available data; valuation uses market prices and avoided costs.

b) CEV – Corporate Ecosystem Valuation	
Who:	Offered by WBCSD (www.wbcsd.org)
What:	A framework and a set of resources. It is not a price list, neither a calculator, nor a stand-alone methodology.
Purpose:	(1) to screen which business valuation is relevant and which kinds of assessments are needed before valuation can take place; (2) to show how to determine the scope and how to plan the valuation study depending on the kind of business, the budget, the time frame etc. (3) to conduct the valuation itself; (4) to show how to include the results of the valuation study.
Use areas:	Usually an assessment of a particular technology, site or project.
Used by:	10+ companis, e.g. Holcim, Syngenta, AkzoNobel, Veolia.
Data used:	Depends on the valuation method used.

c) EP&L – Environmental Profit & Loss	
Who:	Developed by PUMA with support from Trucost and PwC
What:	A means of placing a monetary value on environmental impacts along the entire supply chain of a business.
Purpose:	It provides an overarching metric to assess and compare risk and opportunity across operations, products and supply chains.
Use areas:	Values the environmental impacts of a company along the entire supply chain.
Used by:	PUMA, Keering, Novo Nordisk
Data used:	Bottom up data sources used to quantify environmental key performance indicators (eKPIs) across the supply chain, supplemented with top-down environmentally extended input output (EIO) modelling data to simplify impact assessment.

d) Natural Capital Analyzer	
Who:	Offered by Trucost (www.trucost.com)
What:	A secure online data platform enabling the assessment of the environmental impacts and natural capital costs of a company's supply chain.
Purpose:	To screen high-impact suppliers, assess financial risk and opportunity from regional natural capital cost scenarios, including carbon taxes, water availability and land use, and manage natural capital impacts through customisable dashboards and reports.
Use areas:	Regional supply chain sustainability issues such as carbon taxes, water availability and ecosystem services provided by land.
Used by:	Trucost clients, e.g. General Mills
Data used:	Trucost data base, primary data

e) TIMM – Total Impact Measurement and Management	
Who:	Offered by PwC (www.pwc.com)
What:	A tool that assigns a monetary value, to both individual and aggregate business impacts. Based on other methods such as EP&L or the WBCSD Guide to Corporate Ecosystem Valuation.
Purpose:	To understand the impact and the trade-offs between alternative strategies and to identify the optimal decision for stakeholders.
Use areas:	Social, environmental, tax and economic impacts on an individual as well as aggregate business level.
Used by:	PwC clients (e.g. Scottish Hydro Electric)
Data used:	Primary data collection combined with Life Cycle Inventory data, multi-regional input-output data, material flow data.

f) Estell	
Who:	Offered by Systain (www.systain.com)
What:	An extended multi-regional input output model covering 45 regions and 135 sectors
Purpose:	Generates an environmental cost statement to gain transparency on the impacts caused by business activities.
Use areas:	The model identifies resource consumption, environmental pollution and social hotspots caused by a company in its own operations and its respective supply chain.
Used by:	15+ companies, e.g. Otto Group, Siemens (for its carbon and water footprint across the complete supply chain).
Data used:	Environmental input output tables, publicly available env. and social statistics, primary data

Source: WEC Europe (2014) (based on PwC, Natural Capital Coalition, The Global Nature Fund, Trucost, WBCSD)

(4) Applications of a Natural Capital Valuation

4.1 Investments in Green Infrastructure (GI)

GI solutions are defined as “planned and managed natural and semi-natural systems that often enhance or even replace a functionality that is traditionally provided by man-made structures, referred to as gray infrastructure. While GI solutions are designed to fulfil a specific need, such as water purification or carbon sequestration, they can provide more categories of co-benefits, such as location-specific enhanced habitat for wildlife” (The Nature Conservancy, 2013) or to facilitate the approval process of an Environmental Impact Assessment.

The key differences between green and grey infrastructure solutions are summarized in table A4 of the Annex. It illustrates the trade-offs involved when evaluating green versus grey solutions. These trade-offs help identify the specific areas of opportunity for a resilient infrastructure which are often combinations of new GI solutions integrated into existing facilities, creating so-called hybrid solutions.

Companies that are interested in implementing GI solutions need to a) build in-house expertise in designing and managing such green infrastructure, b) understand the local ecosystem c) test and optimize the system performance, and d) understand and manage permit requirements. A range of companies have evaluated Green Infrastructure Investments, most prominently Dow Chemical, Webcore Builders, Shell and Unilever.

Dow Chemical's implementation of GI in collaboration with the Nature Conservancy

A partnership between The Nature Conservancy and Dow Chemical demonstrates how valuing natural capital can benefit business and the environment. At a large Dow facility in Freeport, South Texas, the company, supported by environmental scientists, implemented an innovative solution consisting of a man-made 110-acre wetland in lieu of their industrial wastewater treatment plant. The purpose was to meet regulatory requirements for water discharge. After a few years of successful operation a recent analysis shows that the constructed wetland design offered – in comparison with a grey infrastructure design – the advantages of lower capital expenses, lower operating costs, lower labor support, 100% compliance and lower project implementation time. The main disadvantages were the necessity to dedicate a relatively large area of land to this use as well as the need to implement a 1-2 years pilot project to find the optimum design.

In addition to meeting Dow's compliance obligations for water treatment, trees now deliver a range of ancillary benefits in this semi-arid region.

4.2 Environmental Profit & Loss Accounting

An EP&L assesses how much a company would need to pay for the environmental impacts it causes along the entire supply chain, providing a monetary value for goods and services for which normally no market exists, to support a risk and opportunity analysis. In contrast to traditional approaches to environmental impact measurements that provide a variety of metrics such as hectares (for land use), tonnes (for carbon and other pollutants), and cubic meters (for water), the monetary value provided by an EP&L makes it easier for decision-makers to compare the relative contribution of environmental impacts upon the ecosystem and on society to the overall impact of a company or a product. The EP&L measures and values both reductions in ecosystem services and increases in environmental impacts which may occur as a result of a company's operational and supply chain activities. Environmental benefits can also be accounted for, e.g. when reforestation or remediation of contaminated sites take place.

The results of an EP&L account (like many other valuation methodologies) rely significantly on estimation techniques such as environmental input- output (EIO) modelling*[3] and sourcing location information limited to the country level. For a business this can be a significant challenge, especially where the impact is occurring deep in the supply chains (PPR, 2012). To-date, the most prominent case of EP&L was conducted by PUMA. According to the company, the motivation to conduct the EP&L was to better understand the real environmental impact of the company in order to focus its sustainability strategy. At the time, PUMA's sustainability targets only covered 15% (tier 1 and 2) of the impacts identified in the EP&L. Thus, the EP&L helped to adjust the targets and made the company look for more sustainable raw materials.

4.3 Natural Capital Valuation in the Pharmaceutical Industry – Novo Nordisk

There is very limited evidence of systematic Natural Capital Valuation (or Ecosystem Valuation) activities by pharmaceutical companies – something of interest to the initiator of this analysis, F. Hoffmann-La Roche. However, in February 2014 Novo Nordisk became the first pharmaceutical company to publish an Environmental Profit and Loss account (EP&L). The EP&L was developed in partnership with several consulting firms and draws on PUMA's experiences. Novo Nordisk's EP&L was commissioned by the Danish environment protection agency in response to PUMA's call for contributions to develop the EP&L methodology. Thus PUMA's approach was evaluated and made more robust wherever possible. For example, the geographical scope of the Novo Nordisk approach used three different regional environmental input output (EIO) tables. (1) the Danish market, (2) European Union member nations, and (3) Rest of the World (ROW). In addition, for the water footprint in all regions, the EIO table from the US was applied.

[3] EIO are Environmental Input-Output tables available for a number of countries and processes. The CREEA project, which will provide final results in 2014, is about to create tables for 130 sectors and products, 30 emissions, 80 natural resources, and 43 countries plus a rest of world (Danish Environment Protection Agency, 2014)

Experts state that more improvements can be made by taking into account even more EIO tables that match the geographical locations of companies' spend and consumption. This will be facilitated, once more national EIO tables developed by the CREEA* research project (due in 2014) will be available that can be matched with corporate data. An additional improvement by Novo Nordisk to enhance the data quality was to assess its largest purchase category, glucose, by using a hybridized approach which incorporated traditional Life-Cycle Analysis data from the EcoInvent database. For further readings on the methodology please refer to the report by the Danish Environmental Protection Agency, 2014.

*CREEA is an European Union FP7 project on compiling and refining environmental and economic accounts. The project runs from April 2011 to March 2014.

Evaluation of Novo Nordisk's EP&L

Novo Nordisk has a large pool of well-processed input data, which can be obtained in a relatively short time span. Where data for the EP&L account was not available, environmental costs were derived from using life-cycle assessment modelling. The analysis is based on 2011 numbers and includes Novo Nordisk's own operations and all tiers in the supply chain. The distribution to end users and disposal of products are not included in the analysis. In the process, environmental key performance indicators were identified based on their materiality to Novo Nordisk and these included water use, GHG emissions and other air pollutants.

According to Novo Nordisk, the final result of the analysis revealed some surprises. For example, when looking at the company's different expenditure groups, the EP&L showed that the biggest contributor to the environmental costs was related to sourcing of products and services that do not form part of the final consumer product – the so-called 'indirect spend' which includes items such as production equipment and consultancy services. This group constitutes 70% of the total environmental costs in Novo Nordisk and was bigger than expected. 87% of the total environmental costs lie across tier 1,2 and 3 (this includes the most important: greenhouse gases released from the agricultural production of maize to make glucose, the main ingredient in Novo Nordisk's major product insulin).

Novo Nordisk was able to eliminate some of the methodological weaknesses that could be found in PUMA's EP&L, mostly by using additional EIO's. Furthermore, Novo Nordisk's long-standing and large data pool and established life cycle processes made it comparatively easy and cost effective to do the calculations.

As a final conclusion, however, even though the EP&L provided important insights, Novo Nordisk staff currently state that they do not see the EP&L account becoming part of Novo Nordisk's standard reporting in the near future. Instead, the key strength of the EP&L lies in its ability to map impacts and identify potential risks and opportunities (Novo Nordisk, 2014). However, according to Novo Nordisk, this is not something which needs to take place every year.

(5) Natural Capital Valuation - Business case & Challenges

There can be different business cases for natural capital accounting, depending on the industry and the needs of a company (Global Nature Fund, 2014). They include:

- Companies can use the tools to identify hotspots and increase the transparency in their supply chains as a means to improve their management decisions. The tools can help, for example, to develop priority sustainability initiatives.
- The tools can be used to manage risks in the supply chain, as they can be applied to identify potential disruptions caused by environmental damages or resource scarcities.
- Natural capital accounting provides one metric (i.e. a monetary value) for different environmental damages, whether it is carbon emissions, land-use or water pollution. By providing this metric the environmental indicators can more easily be integrated into commonly used business-decision making tools such as cost benefit analysis – it translates the impacts into the language of business.
- Companies with a large direct impact on nature, such as the extractive industries, use the tools to show the value that they are creating for society (for example rehabilitating a mining site after the "use phase"). Thus, it is used to strengthen the "social license to operate".
- Some companies use the instruments to identify possible business opportunities, e.g. in ecotourism.
- Most corporate sustainability targets are linked to stakeholder requirements, but they also need to be linked to business logic which cannot be done by relying solely on stakeholder dialogues. Here, natural

capital valuation can be used as a tool to show where the greatest impacts occur, how effective the current goals are, and which additional measures are needed.

Challenges to valuing Natural Capital

There are a variety of current analytical challenges to the application of natural capital valuations. They include:

- Upstream and downstream impacts can be very large and are often hard to assess. Further it is especially difficult to gain access to data if the impact analysed lies beyond the company premises. In general, putting the impacts into a regional context and to find data with adequate quality are great challenges. There is a relative lack of primary studies for global ecosystem services, constituting a significant limitation and potentially a source of bias in the results. Furthermore, sometimes generic valuations or uncertain databases are used as a result of lack of validated data.
- It's not yet clear how to avoid the risk of double counting some natural capital benefits (e.g. when land serves two purposes (e.g. a farmer harvests a crop of winter wheat and then plants corn to harvest in the fall), it is important not to count the land area twice. Instead, the yield factor is adjusted to reflect the higher bio productivity of the double-cropped land).
- There is a risk of excluding important ecosystem benefits and costs as it is rarely possible to quantify or monetize each and every ecosystem value.
- Some valuation models are highly complex and time consuming
- More involvement from governments, ISO and other supranational bodies is needed with regards to promoting the harmonization of standards as well as setting the overall policy framework -- for example, when it comes to drivers such as sustainability reporting, accounting or other company incentives that encourage natural capital valuation.
- Some companies would prefer not to know about their external environmental impacts for fear of facing liability claims and/or because they benefit from outsourcing these costs to society.
- Even if a company has the data on its externalities, it is unclear what it should do with this information. Compensation of impacts could be a next step, but this is very costly.
- The real business case for valuation is not yet clear.

(5) CONCLUSIONS

Integration of natural capital considerations in business and their valuation is at an early stage. There is a growing number of fragmented initiatives of how to evaluate natural capital underway, which have been developed as a response to different user needs. Thus, Natural Capital Valuation can be conducted in several ways, depending on what a company wants to measure. The Annex to this advisory presents various valuation methods, approaches and initiatives for further reading.

One of the challenges at present is the lack of a harmonized framework for how to value natural capital and apply it in business decision making. The Natural Capital Coalition - comprised of various stakeholders from business, NGOs and government – is currently addressing the topic in its work on a "Natural Capital Protocol".

Another challenge is the fact that wider enabling policy and market conditions to incentivize corporate uptake of natural capital are minimal at present.

It is expected that companies will continue to integrate natural capital into their business models. In fact, the more companies conduct natural capital evaluations, the more refined the tools available will become. At the same time, the social aspects such as working conditions in the supply chain will gain importance. The level of detail of a Natural Capital Valuation largely depends on the availability of environmental data. For this reason, robust methods for estimating corporate environmental data are often as important as those for direct collection at the source. Sufficient quality data are a pre-requisite for any subsequent quantification of actual changes in the environment and valuation of associated impacts on society (PwC 2013).

Although Natural Capital Valuation may be in its beginnings, it may still be worthwhile for companies to start looking at possibilities to include and value externalities of their operations and along their supply chain. In a world where the demands of an expanding and more prosperous global population will result in an increasingly resource-constrained world, accounting for an organization's natural capital impacts and dependencies will become important, either to build a more resilient business strategy or to comply with regulations.

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(9) ANNEX

Table A1: Examples of tools, guides and methodologies to Ecosystem Valuation

Examples: tools and methodologies	
ARIES	ARtificial Intelligence for Ecosystem Services (ARIES) is an integrated ecosystem service modelling methodology and web-accessible platform. It allows users to model, map and quantify ecosystem service flow, and delivery between source and use locations. It can be used for baseline studies and assessments of different future scenarios, including the effects of climate and land cover change. It has primarily been used by academic, NGO and governmental actors to date. There have been corporate applications, mostly from the extractive sector, none of which are publicly available.
Co$ting Nature	Co$ting Nature is a web-based tool for analysing ecosystem services, identifying beneficiaries of those services and assessing the impacts of human interventions such as land use change upon them. It calculates a baseline for current ecosystem service provision and allows a series of interventions or scenarios of change to be used to understand their impacts on ecosystem service delivery. The tool has been used experimentally by a number of companies but no public summaries are available.
Ecologically Based Life Cycle Assessment	Ecologically Based Life Cycle Assessment is an online accounting system software that quantifies the direct and indirect role of various natural resources for supporting various economic activities. It complements other life cycle assessment (LCA) tools by taking into account a broad range of ecosystem services when seeking to understand the environmental impacts of products.
InVEST	Integrated Valuation of Environmental Services and Trade-offs (InVEST) is a free, open-access software tool for mapping, quantifying and valuing ecosystem services at the site or landscape scale. InVEST quantifies nature's benefits in biophysical terms, such as water flows and economic terms, such as avoided cost or net present value. InVEST can be used for basic risk screening, or for scenario planning and sensitivity analysis. It has been used by a number of businesses, including Lafarge and Dow Chemical. Tier 1 InVEST models are designed to run on globally available data.
E P&L	The Environmental Profit & Loss (E P&L) is a means of placing a monetary value on environmental impacts along the entire supply chain of a business. By valuing environmental impacts in monetary terms it provides a metric to assess and compare risk and opportunity across operations, products and supply chains. Puma and its parent company Kering conceived and developed an E P&L with the support of Trucost and PwC, and published Puma's 2010 EP&L results in 2011. Bottom up data sources are used to quantify environmental key performance indicators (eKPIs) across the supply chain, supplemented with top-down environmentally extended input output modelling data to simplify impact assessment. The eKPIs include: greenhouse gases (GHGs), water consumption, air pollution (sulphur dioxide, nitrogen oxides, particulates, carbon monoxide and ammonia), land use and waste generation. Kering evolved the methodology to include water pollution and is currently implementing E P&L analysis across its 22 luxury and sport and lifestyle brands and supporting E P&L adoption outside the Group.
TIMM	PwC's Total Impact Measurement and Management (TIMM) framework values social, environmental, tax and economic impacts, enabling business to compare the total impacts (both positive and negative) of their strategies and investment choices. TIMM assigns a monetary value, to both individual and aggregate business impacts
SERVES	Simple Effective Resource for Valuing Ecosystem Services (SERVES) is a subscription-based tool for rapid, preliminary estimates of the value of an area's ecosystem services. SERVES uses benefits transfer to obtain an estimate for the value of ecosystem services through the analysis of valuation studies which have been previously carried out to value similar goods or services in similar geographies and contexts. SERVES is a component of the Earth Economics Ecosystem Service Valuation Toolkit, developed by Earth Economics.
ESTELL	Sustain's estell used by Otto Group measures and values the use of natural capital covering all major activities including downstream activities, and environmental and social hot spots. Estell uses an extended multi-regional input output model covering 45 regions and 130 sectors and aggregates and evaluates the environmental impacts to external costs and thus generates an Environmental Cost Statement. Estell has been used by different corporates, including for the carbon and water footprint of Siemens' full supply chain
Eco-Synergy	The Techno-Ecological Synergy (Eco-Synergy) approach enables the assessment and design of sustainable products and processes by accounting for ecosystem services. Current projects using Eco-Synergy include design of residential systems, biosolids management, and assessment of bio-based materials.
Total Contribution	Developed by The Crown Estate with advice from nef consulting and partners Total Contribution is a way to measure the broader value that a company creates across economic, social and environmental indicators.
Natural Capital Analyzer	Trucost's Natural Capital Analyzer enables companies to assess the environmental impacts and natural capital costs associated with company operations and supply chains through a secure online data platform. Companies can apply Trucost's natural capital costs, or apply tailored economic or natural capital costs. The EKPIs include: greenhouse gases, water consumption, air pollution, land use and waste generation.
WBCSD Guide to Corporate Ecosystem Valuation	The Guide to Corporate Ecosystem Valuation (CEV) provides a framework and resources for improving corporate decision making through valuation of ecosystem services. The guide provides a screening process to help businesses decide whether valuation is likely to be useful, and provides a step-by-step process to illustrate how to undertake valuation to inform various corporate decision contexts. It helps business users new to valuation understand concepts, engage in the valuation process and evaluate and interpret results.
WBCSD Guide to Water Valuation	The Business Guide to Water Valuation builds on the Guide to Corporate Ecosystem Valuation to provide more clarity on the terms and concepts related to the valuation of water and of all the water-related ecosystem services. It draws on business practice and incorporates 25 case studies.

Source: Natural Capital Coalition (2014b)

Table A2: New initiatives under development

New initiatives under development	
Climate Earth Natural Capital Management System	NCMS is a cloud-based software system that allows a company to gain insight and actively manage the risks and opportunities associated with natural capital consumption. Browser based reporting and analysis aligns with organisational structure. NCMS uses a 'big data' approach to model impacts across value chains and apply valuations. The NCMS has been piloted by Webcor Builders, a California-based general contractor.
EROVA	The Environmental Risk, Opportunity and Valuation Assessment (Erova) Tool is a flexible framework-based tool that helps companies evaluate their impacts, dependencies, risks, and opportunities associated with natural capital e.g. biodiversity and minerals and other environmental parameters such as GHG emissions, noise and dust. The approach allows qualitative, quantitative, and monetary valuation of landholdings and project impacts, as well as assessing the distribution of values and impacts among stakeholders. The methodology draws upon WRI's ESR, WBCSD's Guide to CEV and IFC's Performance Standard 6, among other initiatives.
E.Valu.A.Te	The Externality Valuation Assessment Tool is an online tool that guides users through the evaluation process for environmental externalities. It provides more evidential support around the process of valuation using a stepwise, bottom-up approach and is driven by business. There is a full SABMiller case study that punctuates the tool as well as the practical guide that supports it.

Source: Natural Capital Coalition (2014b)

Table A3: Valuation steps in WBCSD's CEV model (describes stage 3 of the CEV stages)

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.

Source: WBCSD (2011)

Practice example: Valuation step 2 (environmental 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.

Practice example: Valuation step 5 (significance of ecosystem service effects)

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.

Practice example: Valuation step 6 (monetizing changes)

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.

Practice example: Valuation step 7 (identifying benefits and costs)

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.

Practice example: Valuation step 9 (sensitivity analysis)

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.

Source: WBCSD (2011)

Table A4: Evaluation of green versus gray infrastructure

Evaluation criteria	Green infrastructure	Gray infrastructure
Stakeholder involvement	Extended stakeholders are often required to support the project and may have an active and ongoing role in the project design and operation	Stakeholders are often engaged with the aim to create local support for the project, but without active involvement in the project design and operation
Engineering approach	GI solutions require a custom-made, location-specific design and do not lend themselves to standardization and replication	Traditional engineering solutions enable standardization and replication which can significantly reduce project costs and delivery times
Physical footprint	A large physical footprint is often required due to low energy density	Usually, only a small physical footprint is required due to high energy density
Environmental footprint	Often reduced environmental footprint due to GI solutions being nature-based and self-regenerating	Often increased environmental footprint due to material and energy intensive processes (manufacturing, distribution, operation)
Speed of delivering the functionality	GI solutions may take time (years) to grow to provide a certain service and capacity	Traditional engineering solutions provide a certain service and capacity from day 1 of operation
Susceptibility to external factors	GI solutions are susceptible to extreme weather conditions, seasonal changes in temperature or rainfall and disease.	Gray infrastructure is susceptible to power loss, mechanical failure of industrial equipment and price volatility.
Operational and maintenance costs	Operating and maintenance costs are often significantly lower (only monitoring and feedback is required)	Operating costs are often significantly higher due to power consumption, operational and maintenance requirements
Risk of price volatility	GI solutions are relatively insensitive to fluctuations in the cost of raw materials, oil, gas and power	Traditional engineering solutions are sensitive to fluctuations in the cost of raw materials, oil, gas and power
Approach to system monitoring and control	GI solutions are living and complex systems that can be monitored and effectively managed by a deep understanding of the key control variables	Traditional engineering solutions are man-made systems that are typically designed with established monitoring techniques to effectively manage and control system performance
Required operating personnel	No need for 24/7 operational supervision	Complex control and safeguarding systems typically require 24/7 operational supervision
Expenses for increasing capacity of system	Relatively inexpensive to extend the capacity of the GI solution, provided there is physical footprint available	Extension of capacity could be relatively inexpensive as long as significant modification or redesign is not required
Need for recapitalization	Recapitalization during the life of the GI solution is usually not significant. The end of life replacement/ decommissioning will vary greatly depending on the GI technology selected but is usually not necessary as GI solutions are self-sustaining and do not depreciate	Gray solutions are depreciating assets with a finite performance capacity and usually require significant replacement/decommissioning at end of life

Source: Dow Chemical; Swiss Re; Shell; Unilever; The Nature Conservancy (2013): "The Case for Green Infrastructure. Joint industry white paper