



B@B Workstream 1: Natural Capital Accounting for Business

Comparing Natural Capital Accounting approaches, data availability and data requirements: for businesses, governments and financial institutions - a preliminary overview

Final Report

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Supporting companies:



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List of acronyms

ARIES	Artificial Intelligence for Ecosystem Services
B@B	Business and biodiversity
BBOP	Business and Biodiversity Offsetting Program
BSR	Business for Social Responsibility
CDP	Carbon Disclosure Project
CDSB	Climate Disclosure Standards Board
CEV	Corporate Ecosystem Valuation
EROVA	Environmental Risk, Opportunity & Valuation Assessment tool
ESG	Environmental and social governance
ESIA	Environmental and social impact assessment
EU	European Union
FI	Financial Institution
GHG	Greenhouse Gas
GRI	Global Reporting Initiative
IBAT	Integrated Biodiversity Assessment Tool
IFAC	International Federation of Accountants
IFC	International Finance Corporation
IIRC	International Integrated Reporting Council
InVEST	Integrated Valuation of Ecosystem Services and Trade-offs
IIPECA	The global oil and gas industry association for environmental and social issues.
ISO	International Standards Organisation
LCA	Life Cycle Assessment
NC	Natural capital
NCA	Natural capital accounting
NCD	Natural Capital Declaration
NVI	Natural Value Initiative
PS	Performance Standard
R&D	Research and development
TIMM	Total Impact Measurement & Management
WRI	World Resources Institute
WBCSD	World Business Council for Sustainable Development

Contents

Acknowledgements	i
List of acronyms	ii
Executive summary	4
1 Introduction	10
1.1 Context	10
1.2 Objective	10
1.3 Approach	10
1.4 Key definitions and focus of study	11
1.5 Contents	12
2 Comparison of NC reporting and accounts	13
2.1 Overview	13
2.2 Overview of parameters covered in physical and monetary terms	15
2.3 NC reporting and accounts in business	16
2.4 NC reporting and accounts in government	19
2.5 NC reporting and accounts in Public FIs	25
2.6 NC reporting and accounts in Private FIs	25
3 Comparison of other NCA applications	27
3.1 Introduction	27
3.2 Option Appraisal	27
3.3 Risk and opportunity assessments	29
3.4 Mitigation hierarchy approaches	30
3.5 Other applications	32
3.6 Key differences overall	32
3.7 Key links and similarities overall	32
4 Data issues	34
4.1 Introduction	34
4.2 Challenges and needs in general data access	34
4.3 General data availability and opportunities	35
4.4 Recommendations for general data issues	38
4.5 Challenges and needs in data interpretation and valuation	39
4.6 Recommendations for data interpretation and valuation	41
4.7 General NCA recommendations	42
5 Creating an enabling environment for NCA	44
5.1 Introduction	44
6 Recommendations for Phase 3	45
References	46
Annex 1 Contributors to the study	48
Annex 2 GRI G4 indicators	49

Executive summary

Objective

This report represents the second year's main output of the Natural Capital Accounting (NCA) for Business Workstream 1 of the EU Business and Biodiversity (B@B) Platform, Phase 2. The original objective of this 2015 work was to:

'Investigate natural capital accounting linkages between businesses, governments and financial institutions, with a focus on applications (i.e. uses), approaches (e.g. methodologies and tools), data requirements and data sources'

However, during the course of the study, due to its broad nature and complexity, it was decided to focus primarily on comparing natural capital reporting and accounts for the different sectors¹. This is where most of the more significant differences appear to be within NCA approaches. Coverage of tools was dropped, as it is complex and was considered to be addressed by others (e.g. BSR and WBCSD). In addition, because of their different objectives, financial institutions (FIs) have been split into 'Public FIs' and 'Private FIs'.

Approach

The outputs of this study are based on limited desk research, a questionnaire survey and a workshop (held in the European Commission, DG Environment premises in Brussels on July 6th 2015). Details of all contributors to the study through the questionnaire and workshop are detailed in Annex 1.

Definitions and scope

For the purposes of this study, NCA is taken in its broadest sense to cover all forms of decision-making and reporting associated with the environment. Similarly, whilst the report deals with 'natural capital' per se, it effectively covers all environmental issues, but **the main focus of the study is on biotic or living natural capital (i.e. biodiversity, but also water and soil)** rather than non-living non-renewable elements such as fossil fuels and minerals.

We also use the term '**other environmental impacts**' loosely to mean environmental outputs or 'residuals' such as GHGs, NO_x, noise and waste etc. Taken together, natural capital and other environmental impacts effectively equate to what is covered by the UN's System of Environmental-Economic Accounting - SEEA (United Nations, 2014a and 2014b).

Comparison of NC reporting and accounts

Part of the more detailed review of 'reporting and accounts' for natural capital involved determining which parameters are generally covered in physical and monetary terms in some of the main reporting and account based approaches. As shown in Table 1.1, in terms of businesses, the assessment covers the CDSB² and GRI³ business reporting frameworks, and the EP&L⁴ and CNCA⁵ sets of accounts. These are also relevant to private FIs,

¹ The terms Reporting and Accounts are often used inter-changeably in a business context. Indeed, 'financial accounts' have typically been the core element of a company's 'annual report'. However, the term 'account' tends to imply setting out the position of a business or country in terms of its stock of assets and/or the change in flow of values and/or impacts at a set moment in time, or over a particular time period (e.g. similar to a balance sheet or profit and loss account).

² Carbon Disclosure Standards Board

³ Global Reporting Initiative

⁴ Environmental Profit and Loss Account

⁵ Corporate Natural Capital Accounts

although much less so for the CNCA⁶. In terms of government accounts, the assessment covers the UN System of Environmental-Economic Accounts (SEEA) Central Framework and Experimental Ecosystem Accounting, which are also of great relevance to public FIs.

Table 1.1 Comparison of parameters covered in physical and monetary terms

Parameter		Business/Private FI				Government/Public FI		
		Reporting		Sets of accounts		Sets of accounts		
		CDSB	GRI	EP&L	CNCA	SEEA-CF	SEEA-EEA	
Outputs/ Residuals	GHG	P	P	M		P		
	Other air emissions	P	P	M		P		
	Waste and spillages	P	P	M		P		
Inputs (capital and/or flows from)	Renewable energy	P	P	n/a	M	M		
	Non-renewable energy (fossil fuels)	P	P	n/a	n/a	M		
	Land use & ecosystems	P	P	M	M	Partial	M	
	Renewable resources	Agriculture	P	P	n/a	M	M	
		Forests	P	P	n/a	M	M	
		Fish	P	P		M	Partial	M
	Non-renewable materials (minerals, metals)	P	P	n/a	n/a	M		
	Water	P	P	M	M	Partial	M	
	Soil				M	Partial	M	
	Marketed biological resources			n/a	M	M		
	Protected species & habitat status		P		Partial		Partial	
	Other NC/ecosystem services	P		Partial	M		M	
Environmental expenditures		M		M	M			

P	Covered in physical/quantitative units
M	Covered in monetary values (and physical/quantitative)
Partial	Partially covered in monetary values
n/a	Not applicable because covered by financial accounts
	Not covered

The assessment splits parameters into three categories of outputs (or 'residuals'), 12 categories of inputs (i.e. capital and flows from capital), and environmental expenditures.

Key messages arising from the assessment are that:

- The business reporting frameworks are very similar, primarily focusing on quantitative information.
- GRI includes environmental expenditures, as does the CNCA (costs for maintaining natural capital) and UN SEEA-Central Framework approach. However, CNCA costs relate to voluntary actions to maintain natural capital, whereas in the UN SEEA-Central Framework, the costs typically relate to reducing impacts, meeting obligations and clean-up costs.
- The EP&L and CNCA approach both focus more on monetary valuation of non-market values (although the first step is typically a quantitative assessment).
- The EP&L approach focuses on impacts – represented mainly by 'outputs' (i.e. residuals such as emissions and waste), but also impacts to water and land use.
- The CNCA approach focuses on natural capital assets and the flow of benefits from these.
- The SEEA-Central Framework is a statistical standard and only covers outputs (i.e. residuals) in physical units, whilst the SEEA-Experimental Ecosystems Accounting, which is not a standard, does not cover outputs (residuals) at all (as it focuses on ecosystems and ecosystem services instead).

⁶ For more information on CNCA approaches please consult the guide developed in Year 1 of the NCA workstream under the EU B@B Platform on: http://ec.europa.eu/environment/biodiversity/business/workstreams/workstream1-natural-capital-accounting/2014-output_en.htm

- The SEEA-Central Framework only covers natural capital related market transactions in monetary terms. Several of the parameters with some market transactions (e.g. water and land use) are only partially covered using monetary values.
- The SEEA-Experimental Ecosystems Accounting approach explicitly fills the gaps in the Central Framework approach for those parameters only partially covered, as well as potentially allowing all other ecosystem services to be valued in monetary terms.

Key differences overall

- Businesses and private FIs generally seek to optimise financial profits whereas governments and public FIs generally seek to optimise societal benefits. However, there are exceptions to this, with a number of businesses increasingly looking to provide and demonstrate societal benefits too.
- In terms of NCA in general, businesses and private FIs have tended to be more interested in assessing flows of value and impacts related to their business (in monetary and non-monetary terms). However, some large land-owning businesses are becoming more interested in their natural capital asset base and the associated flow of benefits. Governments and public FIs tend to be interested in assessing and maintaining natural capital assets (i.e. stocks) as well as assessing flows of value and impacts.
- Although many of the NCA applications are similar for each sector (see below), there are many slight differences too. For example, for businesses and FIs, the NCA approaches and methodologies cover aspects such as supply chain risk assessment (for businesses) and credit risk assessment (for FIs). For governments and public FIs, there is scope for exploring aspects such as the importation and exportation of ecological debt (if all countries adopt this process).

Key links/similarities overall

- All sectors generally seem to be interested in using NCA for the same types of application, albeit from slightly different perspectives. For example, this includes for reporting and developing accounts for aspects of natural capital they have responsibility for, option and investment appraisals, managing risks and opportunities, mitigating impacts, prioritising and screening options, assessing thresholds, developing and/or understanding environmental markets etc.
- All sectors recognise the need to develop more consistent NCA approaches and methodologies, in particular in relation to what parameters to assess, in what units, and which techniques should be used for monetary valuation.
- Ultimately, it would be ideal if company natural capital accounts aligned with (and in some cases potentially in the future fed into) sub-regional and national government natural capital accounts. This would be true for balance sheets (i.e. stocks of natural capital assets) and profit and loss accounts (e.g. for impacts and flows i.e. annual changes to stocks). However, great care would clearly be needed to avoid double counting supply chain related assets, flows of value and impacts.
- NCA can potentially play an important role in developing and implementing market-based instruments, such as payment for ecosystem services and biodiversity offset markets. This topic is of considerable relevance to all four sectors, so they should have a strong interest and clear role in working together to develop and apply NCA as appropriate to the topic. However, considerable thought is required to minimise any unintended consequences and to prevent inappropriate, unfair and harmful trade in biodiversity.
- Similarly, NCA has a powerful role to play in developing and implementing green infrastructure and ecological restoration, which is of considerable relevance to each

sector. Each sector will have different interests and motivations, but will benefit from working closely together to take advantage of the potential synergies.

- All sectors would gain significantly from improved sharing of the data and information on natural capital and environmental impacts that they collect. However, issues over intellectual property rights; industrial secrets and competition; appropriate compensation and sharing of costs, and guarantees for not using the data to sue the provider need to be resolved.
- Businesses and governments must develop a consistent and comparable approach to measure changes in the status of natural assets that enables early detection of potential thresholds⁷ and safe limits.

Challenges and needs in general data access

Some of the main challenges around data for all sectors relate to:

- Lack of sufficiently detailed datasets available for biodiversity.
- Problems over accessibility of existing available data and constraints such as intellectual property rights, competitive advantage and cost sharing in relation to the sharing of datasets.
- The relatively old age, and hence current inaccuracy of many existing datasets.
- The variability of datasets in terms of what parameters are covered in what detail and in different locations.
- Lack of data, for example, relating to the following:
 - Dose-response of impacts (understanding the cause-effect relationship between impacts such as pollutants and habitat loss and associated environmental changes as well as subsequent consequences for people).
 - Habitat restoration, maintenance and creation costs and outcomes.
 - Regional/country valuation of ecosystem services and biodiversity.
 - Country level land conversion data of original biomes over time.
 - Biodiversity at a site level (except for at specific sites).
 - Annual quantitative data on ecosystem services at a national level.
- Complexity arising from trying to determine data associated with complex supply chains.
- Determining what best to monitor and how.
- The need to agree on terminology used (e.g. for ecosystem services), but not to get held back by semantics.

The following are recommendations in relation to general data issues:

- Explore ways of enhancing data sharing, and showcase good examples.
- Encourage and better incentivise more data collection and reporting of information.
- Find ways to enhance data consistency.
- Develop and promote integrated data and information hubs.
- Further investigate and document key dose-response effects.
- Explore and further expand use of big data and satellite imagery.

⁷ A threshold is a discontinuity in a relationship whereby a small change in a pressure or driver can lead to a large change in the state of natural capital with consequences for the benefits it provides.

- Experiment with available models and tools; and in particular test the assumptions.
- Governments should set out more demands for businesses and FIs in relation to collating and reporting data.
- FI should set out more demands on companies and governments they seek to invest in to better assess their natural capital impacts and dependences.

Data availability between sectors

Each sector has data and information of considerable use to the other sectors. For example, some businesses have detailed site level assessments of biodiversity, comprehensive data sets on emissions, and cost related information on restoration and maintenance of habitats. Governments have national and regional statistics of use, and in the EU are beginning to develop maps of ecosystem assets, ecosystem services and ecosystem condition (including the trends). FIs tend to have specific information on different business sectors and associated issues of risk.

Challenges and needs in data interpretation and valuation:

- Understanding implications of inputs and outputs.
- Challenges over converting physical units to monetary values.
- Challenges with fully understanding ecosystem services.
- Conflicting views on valuation, as not all businesses agree this is appropriate.
- Considerable resources and skills are often required for natural capital assessments.
- Business dependencies are less well covered than business impacts.
- Importance of alignment between government and business regarding biodiversity offsetting, for example in relation to what is and is not possible, what metrics to use, and how successful it is.
- Businesses are keen to have better information provided by governments on the Total Economic Value of stocks (of habitats and biodiversity).
- Businesses should consider reporting using science based targets, for example in relation to carbon emissions required to limit global warming and in relation to biodiversity and meeting the Aichi targets.

Recommendations for data interpretation and valuation:

A number of recommendations have been suggested for improving data interpretation and valuation, with key ones being the need to:

- Facilitate consistent valuation approaches, including at different levels of detail.
- Fund studies to enhance value transfers and coefficients, and valuing changes in land use/habitats.
- Collaborate between the four sectors to develop specific KPIs for biodiversity.
- Develop more case study examples and lessons learned on the topic in general.
- Promote greater awareness of relevant NCA initiatives and foster greater co-operation between the four sectors.
- Review what NCA tools are available and fill any gaps.

General NCA recommendations:

- Encourage closer engagement between experts within the four different sectors.

- Agree over the importance of parameters.
- Develop a unified template for NC accounts for businesses.
- Encourage certified NCA experts within different countries to undertake NCA audits.
- Governments should agree landscape/catchment level NC accounts first, so that businesses and FIs can then agree and align their efforts towards this approach.
- Anticipate and minimise unintended consequences, in particular in relation to evolving environmental and biodiversity markets (especially in relation to habitats and endangered species).
- Governments should provide a greater leadership role in relation to NCA and allow innovation.

Creating an enabling environment for NCA

More work needs to be done on determining what changes and actions are required to improve co-ordination and co-operation between the four sectors on NCA. Further work on this can usefully build on the outputs of this study.

Recommendations for Phase 3 NCA studies include:

Based on the year 1 and 2 work, the following potential study options for Phase 3 of the NCA workstream are proposed⁸:

1. Continue to work on comparing NCA applications and identifying ways to fill data gaps and enhance synergies amongst the four sectors (business, governments and both public and private FIs). This could include, for example, investigating the extent to which different EU countries are meeting their goal of mapping ecosystem services.
2. Explore the role of and value to be gained from reporting on company expenditures on managing natural capital – in particular maintaining and restoring habitats.
3. Investigate how NC impacts and values can be better linked into LCA.
4. Investigate how companies can best address, measure and disclose information on their natural capital dependencies (as opposed to impacts).
5. Explore further the concept of NC balance sheets (i.e. for land holding companies, and those that have major suppliers with large landholdings).
6. Investigate the extent to which investment-rating agencies are considering how companies adopt NCA approaches.
7. Update the NCA Guide and Decision-matrix tool developed in 2014 (Year 1 of the Platform).

⁸ Note that these will be further reviewed by participants at the Annual B@B Conference (October 2015) and by the B@B Bureau, but can be considered as a starting point.

1 Introduction

1.1 Context

This report represents the second year's main output of the Natural Capital Accounting (NCA) for Business Workstream 1 of the EU Business and Biodiversity (B@B) Platform, Phase 2. It follows on from last year's study, which involved NCA workstream Full Member businesses helping to develop a guide⁹ and decision-matrix tool¹⁰ to assist companies in deciding which form of NCA approach is best for their needs.

1.2 Objective

The original objective of the 2015 work was to:

'Investigate natural capital accounting linkages between businesses, governments and financial institutions, with a focus on applications (i.e. uses), approaches (e.g. methodologies and tools), data requirements and data sources'.

Given the broad scope of the study, efforts have been focused and directed by the interests and involvement of members of the B@B platform, and in particular those engaging in the study.

Due to key differences in NCA uses and approaches adopted, financial institutions (FIs) have been split into 'Public FIs' that include multilateral and regional development banks such as the World Bank and European Investment Bank, and 'Private FIs'. The former have more of an emphasis on providing public benefits whereas the latter are more focussed on making profits for their shareholders. Together with 'businesses' and 'governments', these make up the four 'sectors' covered in the study.

In addition, (also see 1.3 below) the main focus of the comparison has been on comparing different approaches associated with 'reporting on' and 'sets of accounts' for natural capital and wider environmental impacts¹¹. This is where most of the more significant differences appear to be within NCA approaches. Coverage of tools was also dropped, as it is complex and was considered to be addressed by others (e.g. BSR and WBCSD).

Furthermore, due to the broad and complex scope of the study and the relatively limited resources available, the output is best-considered a 'preliminary overview'.

The revised title of the study is thus: ***'Comparing Natural Capital Accounting approaches, data availability and data requirements for businesses, governments and financial institutions: an initial overview'.***

1.3 Approach

The study has involved a combination of desk research, a questionnaire survey and a workshop. Initially a briefing note and questionnaire survey were sent to all Platform members with an interest in workstream 1, as well as to several other selected public and private FIs. The questionnaire asked questions covering each sector's main

⁹ <http://ec.europa.eu/environment/biodiversity/business/assets/pdf/b-at-b-platform-nca-workstream-final-report.pdf>

¹⁰ <http://ec.europa.eu/environment/biodiversity/business/workstreams/Workstream1-Natural-Capital-Accounting/Outputs-to-date.html>

¹¹ The terms Reporting and Accounts are often used inter-changeably in a business context. Indeed, 'financial accounts' have typically been the core element of a company's 'annual report'. However, the term 'account' tends to imply setting out the position of a business or country in terms of its stock of assets and/or the change in flow of values and/or impacts at a set moment in time, or over a particular time period (e.g. similar to a balance sheet or profit and loss account).

uses/applications of NCA, key linkages with other sectors, and a set of questions relating to associated data availability and requirements.

A total of 23 questionnaire responses were obtained, including from seven Full Member businesses, one other business, five government organisations, five FIs and nine other organisations including consultants and NGOs (see Annex 1 for full details).

A telephone conference call was also held with the World Bank Group/IFC, Natural Capital Declaration, the Dutch Government, IUCN and UNEP FI to facilitate co-ordination and alignment between related on-going projects.

Based on the questionnaire responses, a **workshop briefing paper** was compiled and sent to all workshop attendees in advance of the workshop. The workshop was held at the European Commission, DG Environment premises in Brussels on July 6th 2015 with 16 attendees, representing four businesses (all Full Members), three government organisations, five financial institution organisations and four other organisations (see Annex 1 for details).

The briefing note originally identified 16 different categories of NCA application (or use) based on analysis of the questionnaire responses. However, a key recommendation from those attending the workshop was, for the purposes of this study, to merge them into a more manageable set and focus the analysis on just a few. Based on a workshop exercise in which participants grouped and selected priority NCA approaches, as well as subsequent analysis, the following list was developed:

1. **Reporting and sets of accounts** – at a company or national (and sub-national) level, covering stocks (assets) and flows (impacts).
2. **Option appraisals** – to inform selection of materials, projects suppliers etc., using trade-off analysis, encompassing investment appraisal (e.g. cost-benefit analysis).
3. **Risk and opportunity assessments** – to help identify and manage risks and opportunities, as well as assist with prioritization and screening.
4. **Mitigation hierarchy related** – covering various applications relating to avoiding and minimising impacts, restoration, offsetting, decommissioning, damage assessments and net positive approaches.
5. **Other applications** – which include a broad range of uses, for example informing payments for ecosystem services, sustainable financing, pricing, marketing, shared value, enhancing developments, setting thresholds and communication.

The analysis in this study primarily focuses on the first item above - comparing 'reporting/sets of accounts' associated with natural capital and other environmental impacts for each of the four sectors. Due to study constraints, the other applications are only compared in a more high-level manner. Furthermore, it was agreed to spend less time covering NCA tools because other initiatives are already working on this and are planning to extend their coverage on it in the near future (e.g. BSR and WBCSD).

The comparison of NCA applications covers a number of aspects including: the aims, frequency of analysis, scope (organisational, boundary and issues covered), how/why used, main components (approaches used) and examples of guidelines available.

1.4 Key definitions and focus of study

This year's work builds on that undertaken in 2014. It maintains a broad scope in that for the purposes of this study, NCA is taken to cover all forms of decision-making and reporting associated with the environment.

When we use the term **‘natural capital’**¹² we effectively cover all environment issues, but the **main focus of the study is on biotic or living natural capital (i.e. biodiversity, but also water and soil)** rather than non-living non-renewable elements such as fossil fuels and minerals¹³.

We also use the term **‘other environmental impacts’** loosely to mean environmental ‘residuals’ such as GHGs, NOx, noise and waste etc. Taken together, natural capital and other environmental impacts effectively equate to what is covered by the UN’s System of Environmental-Economic Accounting (United Nations, 2014a and 2014b).

1.5 Contents

Section 1 introduces the objective and scope of the study.

Section 2 briefly compares natural capital and associated environmental impact reporting and ‘sets of accounts’ approaches, in the context of business, government and FIs.

Section 3 provides and a very high level comparison of the other categories of NCA applications.

Section 4 highlights the main points coming from the questionnaires and the workshop on data and interpretation/valuation challenges, availability and requirements.

Section 5 introduces the need to create an enabling environment to facilitate alignment and further adoption of NCA approaches by the four sectors.

Finally Section 6 identifies a number of potential topics that could be covered in Phase 3 of the NCA workstream.

¹² For the sake of brevity, this report sometimes uses the term ‘natural capital’ and ‘NCA’ to have a broader meaning of ‘environmental’ and ‘environmental accounting’.

¹³ It is recognized that non-living components such as fossil fuels and minerals are typically covered anyway by standard accounting approaches, and are not a priority area of focus for the EU to cover in the NCA workstream.

2 Comparison of NC reporting and accounts

2.1 Overview

Natural capital reporting and accounts (i.e. corporate reporting and corporate accounts, and national accounts) are the NCA applications that differ the most in terms of the methodological approach taken by the four different sectors.

The terms Reporting and Accounts are often used inter-changeably in a business context. Indeed, 'financial accounts' have typically been the core element of a company's 'annual report'. However, the term 'account' in the context of natural capital tends to imply setting out the position of a business or country in terms of its stock of assets or the change in flow of values and impacts at a set moment in time, or over a particular time period.

Table 2.1 summarises some of the key contrasting features for each sector. Meanwhile, Section 2.2 provides a summary of which parameters are covered in physical and monetary terms for a selection of six reporting and accounting approaches. This is supported by an explanation of approaches for the different sectors.

In the case of **business NCA reporting and accounts**, a number of companies, consultancies and other organisations are currently developing and experimenting with various different approaches that companies can adopt.

One strand is business **NCA 'reporting'**, which is focussed on reporting natural capital issues and environmental impacts predominantly in physical terms and through the use of indicators. This has been evolving steadily for a number of years now, led by organisations such as the Global Reporting Initiative (GRI), the Carbon Disclosure Project (CDP) and the Climate Disclosure Standards Board (CDSB). This facilitates broad coverage of all potential issues (i.e. natural capital and other environmental impacts). The associated guidance emphasises the need to focus on covering those issues that are most material to the business.

Another strand is focussed more on developing '**sets of accounts**'. Which typically (but not always) use monetary valuation to account for natural capital (i.e. actual environmental assets or stocks) and/or environmental impacts (flows of value and changes in assets).

Valuing company environmental impacts has received much more attention than valuing environmental assets, with several companies and consultancy firms publishing and promoting methodologies for the former (e.g. Kering, 2015 and PwC, 2015). Valuing company related environmental assets is only just beginning to receive more attention, for example, with the DEFRA (2015) Corporate NCA (CNCA) approach recently being published.

In the case of **governmental NC accounts**, the UN SEEA - Central Framework (United Nations 2014a) and UN SEEA – Experimental Ecosystem Accounts (United Nations, 2014b) have only relatively recently been published. There are a number of different accounting options specified within these, in particular the latter (which is not considered as an international standard since it is a field where consensus is still missing). In addition, the approaches are demanding and resources available to undertake them are limited, so it will take a number of years before countries get to grips with them, and decide what approaches best suit them. Key Issues of contention with the Experimental Ecosystem Accounts include aspects such as whether to focus on cost or value based approaches, dealing with consumer surplus values, and what combination of metrics is needed to adequately measure ecosystem degradation and improvement (as a single indicator or index is unlikely to be suitable).

Based on a very brief investigation, it appears that there is a discrepancy between what is set out in the UN SEEA Central Framework and Experimental Ecosystem Accounts and what governments are currently actually doing. This is partly because the documents are

relatively new but also due to capacity and data issues within different countries. It is particularly the case for the Experimental Ecosystem Accounts, which are, as the title states, still only experimental.

A key difference is that business NCA accounts have tended to determine monetary values for environmental residuals whereas government accounts do not. However, governments are beginning to use monetary valuation of environmental residuals in other NCA applications (e.g. in option and investment appraisals). Also, not all businesses agree that monetary valuation is appropriate for company reporting (or decision-making) given the complexity and uncertainties involved.

Overall, businesses tend to have focussed more on environmental impacts (flows) whereas governments seem to have a stronger focus and interest in natural capital stocks as well as flows and impacts. However, there are of course exceptions to these generalizations.

Table 2.1 Summary comparison of NC reporting and accounts

	Business	Government	Public FIs	Private FIs
Aim	To report on either: i) the annual environmental impacts incurred by part or all of the business value chain, or ii) the state and change in environmental assets owned or under the responsibility of the company. Or a variation of these.	To report on contributions to economic production, the state and value of environmental assets, and associated annual changes.	Have contributed to the development of UNSEEA Central Framework and Experimental Ecosystem Accounts, and are supporting other governments (non-EU) to implement NCA reports.	To report on the natural capital related impacts of their direct operations and investments. However, this is very early days.
Frequency of assessment	Usually annually, but may be less often, especially if adopting a monetary or demanding approach.	Usually annually, but may be less often, especially if adopting a monetary approach or a demanding approach.	See equivalent Gov. box for this and other boxes below,	Most may ultimately aim to be annual.
Boundary scope	May be for any of Tier 1 (Direct operations), Tier 2 (production of finished products and services), Tier 3 (processing of materials) and/or Tier 4 (extraction of raw materials). Usually for company as a whole, but may be for a product, project or site.	Typically it is meant to be at a national level, covering all organisations. It may be undertaken at a sub-national level, such as for region, town or national park.	See Gov.	Tier 1 - their own operations, plus potentially Tiers 2 to 4 of their investments.
Scope of issues covered	Typically only covers material issues for the business. It tends to cover all types of potential impact at least in physical terms, with some companies also assessing all impacts in monetary terms too (e.g. residuals). Some companies are beginning to assess extent and condition of natural capital assets too, with associated ecosystem services.	May cover a broad range or selection of issues only. In physical terms it may cover all types of environmental impacts and assets. In terms of monetary assessment, environmental residuals are generally not covered (at present).	See Gov.	Carbon appears to be the only issue as yet covered by a bank. Water, solid waste and biodiversity are under consideration by one bank.

How/why used	Used for multiple purposes such as informing decision-making, understanding dependencies and impacts, prioritising actions, identifying risk and opportunity hotspots, communicating with stakeholders etc.	Used for multiple purposes such as informing decision-making, prioritising actions, exploring risks and opportunities, communicating with stakeholders etc.	See Gov.	To help select investments for their portfolio.
Key components (approaches)	<p>Various approaches have been and are being developed:</p> <p>Environmental reporting – that covers environmental impacts.</p> <p>Integrated Reporting</p> <p>Environmental profit and loss account (EP&L) – that covers environmental impacts.</p> <p>Corporate natural capital accounts (CNCA) – that covers assets and ecosystem services.</p>	<p>Based on the SEEA – Central Framework: Supply and use tables, asset accounts, sequence of economic accounts and functional accounts.</p> <p>Based on the SEEA – Experimental Ecosystem Accounts: Accounting for ecosystem assets and ecosystem services.</p>	See Gov.	The equivalent of an EP&L but just covering carbon at present.
Key guidance (examples)	<p>Various guidance documents being produced:</p> <p>CDSB (2015) and GRI – G4 (2013) for reporting physical units.</p> <p>Integrated reporting (IIRC, 2014)</p> <p>Kering (2015) and PwC (2015) for EP&L</p> <p>DEFRA (2015) CNCA</p> <p>NCP (2016) in development, but not focussed so much on reporting.</p>	<p>System of National Accounts (SNA)</p> <p>SEEA – Central Framework</p> <p>SEEA – Experimental Ecosystem Accounts</p>	See Gov.	SNS Bank is developing its own approach.

2.2 Overview of parameters covered in physical and monetary terms

Based on the review of reporting and accounts for natural capital in the subsequent sections of the report (Sections 2.3 to 2.5), Table 2.2 provides a summary of which parameters are generally covered in physical and monetary terms. In terms of businesses, the assessment covers the CDSB and GRI business reporting frameworks, and the EP&L and CNCA sets of accounts. These are also relevant to private FIs, although much less so for the CNCA. In terms of government accounts, the assessment covers the UN SEEA Central Framework and Experimental Ecosystem Accounting.

Table 2.2 Comparison of parameters covered in physical and monetary terms

Parameter		Business/Private FI				Government/Public FI		
		Reporting		Sets of accounts		Sets of accounts		
		CDSB	GRI	EP&L	CNCA	SEEA-CF	SEEA-EEA	
Outputs/ Residuals	GHG	P	P	M		P		
	Other air emissions	P	P	M		P		
	Waste and spillages	P	P	M		P		
Inputs (capital and/or flows from)	Renewable energy	P	P	n/a	M	M		
	Non-renewable energy (fossil fuels)	P	P	n/a	n/a	M		
	Land use & ecosystems	P	P	M	M	Partial	M	
	Renewable resources	Agriculture	P	P	n/a	M	M	
		Forests	P	P	n/a	M	M	
		Fish	P	P		M	Partial	M
	Non-renewable materials (minerals, metals)	P	P	n/a	n/a	M		
	Water	P	P	M	M	Partial	M	
	Soil				M	Partial	M	
	Marketed biological resources			n/a	M	M		
	Protected species & habitat status		P		Partial		Partial	
Other NC/ecosystem services	P		Partial	M		M		
Environmental expenditures			M		M	M		

P	Covered in physical/quantitative units
M	Covered in monetary values (and physical/quantitative)
Partial	Partially covered in monetary values
n/a	Not applicable because covered by financial accounts
	Not covered

The assessment splits parameters into three categories of outputs (residuals), 12 categories of inputs (capital and flows from capital), and environmental expenditures.

Key messages arising from the assessment are that:

- The business reporting frameworks are very similar, primarily focusing on quantitative information.
- GRI also includes environmental expenditures, as does the CNCA (costs for maintaining natural capital) and UN SEEA-Central Framework approach.
- The EP&L and CNCA approach both focus more on monetary valuation (although the first step is quantitative assessment).
- The EP&L approach focuses on impacts – represented mainly by outputs, but also impacts to water and land use.
- The CNCA approach focuses on assets and flows of benefits from these.
- The SEEA-Central Framework only covers outputs (residuals) in physical units, whilst the SEEA-Experimental Ecosystems Accounting does not cover outputs (residuals) at all.
- The SEEA-Central Framework only covers natural capital related market transactions in monetary terms. Several of the parameters with some market transactions (e.g. water and land use) are only partially covered using monetary values.
- The SEEA-Experimental Ecosystems Accounting approach explicitly fills the gaps in the Central Framework approach for those parameters only partially covered (i.e. it provides a means of valuing the additional non-market values of those parameters), as well as potentially allowing all other ecosystem services to be valued in monetary terms.

2.3 NC reporting and accounts in business

Some of the main approaches that businesses are taking to NC reporting/accounts are briefly outlined below.

2.3.1 Physical measurement/indicator based reports

GRI and CDSB both provide a framework for companies to report on their corporate natural capital dependencies and other environmental impacts

A list of the GRI (2013) G4 indicators used in corporate reporting is provided in Annex 2. These focus extensively on consumption of resources (i.e. use of materials such as water and energy use) and impacts (e.g. emissions of GHG, other air pollutants, waste etc.). It also includes reporting on environmental protection expenditures and fines. In relation to biodiversity, it covers identification of land owned or operation within or near protected areas; impacts to biodiversity within protected areas and areas of high conservation value; risks of impacts to habitats used by protected species, and details on restoration of habitats.

The latest CDSB (2015) Framework for reporting environmental information and natural capital requires companies to, amongst other things: disclose material current and anticipated environmental risks and opportunities; qualitative and quantitative information on sources of material impacts (i.e. caused by activities and outputs) and comparative results in relation to associated targets; and effects of environmental impacts, risks and opportunities on the company. Sources of impact covers: GHG emissions; renewable/non-renewable energy generation, use and consumption; LULUCF; non-GHG emissions to air, land and water for example, noise, odour, particulates, pollutants, etc.; renewable and non-renewable material resource use for example, forest products, fish stocks, minerals, metals, etc.; water use and consumption; and waste and spillages for example, mining and hazardous waste, radiation and industrial by-products.

2.3.2 Integrated Reporting

An integrated report is defined by IIRC (2013) as a concise communication about how an organization's strategy, governance, performance and prospects lead to the creation of value over the short, medium and long term. It is about value created both for the organization (to enable financial returns to stakeholders) but also to stakeholders and society at large. The main focus is around six forms of capital, one of which is natural capital. The capitals are stocks of value that are increased, decreased or transformed through the activities and outputs of the organization. Natural capital is defined as *'all renewable and non-renewable environmental resources and processes that provide goods or services that support the past, current or future prosperity of an organization. It includes: air, water, land, minerals, forests, biodiversity and ecosystem health'*.

When interactions, activities, and relationships affecting societal values are material to the organization's ability to create value for itself (e.g. linked to licence to operate, reputation etc.), they are to be included in the integrated report. Integrated reports should also identify specific risks and opportunities that affect the organization's ability to create value over the short, medium and long term, and how is the organization dealing with them.

In theory then, all natural capital and other environmental impacts (i.e. those affecting other capitals such as human capital) should be identified and quantified if they are material to the business potentially creating or destroying value either directly or indirectly. The guidance recommends quantifying values and changes in value, but not necessarily determining associated monetary values. The guidance does not specify any particular parameters to cover, although some are obviously listed in its definition of natural capital.

2.3.3 Environmental Profit and Loss Accounts (EP&L)

In recent years, a number of companies have experimented with monetary valuation of their environmental impact and natural capital. Valuing company environmental impacts has received much more attention than valuing environmental assets, with several companies and consultancy firms publishing and promoting methodologies for the former (Kering, 2015, and PwC, 2015).

Kering (2015) sets out their methodology which involved quantifying and monetizing outputs comprising GHGs, air pollution (e.g. PMs, NO_x, VOCs etc.), waste and water pollution, and inputs comprising water and land use. They do this not only for their own operations but also their whole supply chain, involving the following supply chain Tiers:

- Tier 1: direct operations
- Tier 2: Production of finished products and services
- Tier 3: Processing of materials
- Tier 4: Extraction of raw materials

The valuation of land use effectively covers impacts to biodiversity based on change in the value of ecosystem services due to changes in land use. For example, this includes conversion of forest to agriculture to provide the materials used in production. The approach involves determining which ecosystem services change and making appropriate adjustments e.g. for income and relative urbanisation of population. Values are based on the TEEB database supplemented by additional references and use of regional proxies where information is lacking.

AkzoNobel (2015), LafargeHolcim (Holcim, 2015) and NS Rail (2015) are other examples of companies doing this. AkzoNobel, a Dutch chemicals company, published an Integrated P&L that included an account of profit and loss in terms of financial, natural, human and social capital for a selection of their sites in Brazil. The study was supported by TruePrice and covers the whole value chain (direct, downstream and upstream operations). LafargeHolcim, a French/Swiss building materials company, also included environmental values within an overall 'integrated P&L statement' that includes social and economic aspects too. In relation to the environment, Holcim covered Co₂ emissions, air emissions, water, biodiversity, waste, secondary resources and environmental incidents. NS Rail, a private Dutch railway company, quantified and determined monetary values for GHGs and other air emissions (NO_x, SO_x, fine particles, VOC, NH₃), waste incineration, noise, water consumed and ecosystem impacts from land use. Many other businesses are beginning to undertake such assessments, typically with consultancy support, by for example companies such as Sustain Consulting GmbH.

2.3.4 Asset Based (Balance Sheet) Accounts

Valuing company related environmental assets or stocks (which is what 'natural capital' is effectively defined as) is only just beginning to receive more attention. In the UK, DEFRA (2015) has recently published the Corporate Natural Capital Accounting (CNCA) approach, initiated by the Natural Capital Committee (UKNCC¹⁴). The intention of the CNCA is to enable organisations to gather natural capital information in a more coherent and comparable format to aid decision-making about the management of natural assets under their ownership or responsibility, for the benefit of both the organisation and society. The framework establishes a system for measuring and valuing natural capital over time along with the explicit recognition of the funding required for its maintenance and enhancement. However, comparisons may not always be straightforward as the CNCA is relatively flexible and non-prescriptive, especially regarding physical metrics used to assess the state of natural capital.

The CNCA framework features two main reporting statements:

1. **Natural capital balance sheet:** this reports the value of natural capital assets, and the costs (liabilities) of maintaining those assets.

¹⁴ The Natural Capital Committee is an independent advisory body set up in 2012 to provide advice to the UK government on the state of England's natural capital.

2. **Statement of changes in natural assets:** this reports the change (gain or loss) in asset values and liabilities over an appropriate accounting period.

The reporting statements are underpinned by:

- a. **Financial and environmental information systems.** These help define and measure the natural capital that is in the scope of the account, value the benefits derived from it, and determine the costs of maintaining it.
- b. **Supporting schedules.** These are used to compile the data and calculations needed to populate the reporting statements, and include: a natural capital asset register (an inventory of natural assets and their condition); a physical flow account (the quantities of goods and services that depend on natural capital); a monetary account (the value of the flow of goods and services); and a maintenance cost account (the maintenance activities/liabilities associated with natural capital assets).

To inform the development of the CNCA, the methodology was piloted with four major UK landowners, National Trust, Lafarge Tarmac, The Crown Estate and United Utilities.

2.3.5 Environmental Financial Accounting

Some companies may decide to just specify financial components of a conventional financial profit & loss account and balance sheet that directly or indirectly relate to NC and other environmental impacts (ACCA et al, 2012). This allows the company to determine the actual financial implications relating to natural capital and other environmental impacts in terms of assets, liabilities, profits and losses.

Separate sections may also highlight relevant environmental protection expenditures. Note that the latter item is one of the GRI – G4 indicators, and it also aligns with the environmental protection expenditure item specified in the UN SEEA Central Framework.

2.3.6 Integrated Financial NCA & reporting

Another proposed new approach (Houdet et al, 2014) involves including physical units as well as societal and financial values within a fully integrated set of balance sheets and profit & loss accounts. This would comprehensively account for all company impacts and dependencies using a mix of physical, societal value and financial metrics, reporting changes in stocks and flows of value on an annual basis. However, at present this approach remains theoretical, as it has not yet been applied in practice.

2.4 NC reporting and accounts in government

Government approaches to national accounting for natural capital and the environment in general is covered in several different ways. Over the past decade it has been linked to national accounts. The most widely and consistently used and promoted approach at present involves incorporating environmental related market transactions within national accounts as set out in the United Nations (2008) System of National Accounts (SNA). This has recently been supplemented by wider environmental satellite accounts.

However, other approaches exist too, for example developing: sustainability indicators encompassing natural capital and environmental features; inventories of environmental data (e.g. protected species and habitats under the Convention on Biological Diversity); and more recently, mapping of biodiversity (especially habitats) and ecosystem services. The main discussion set out below is on national and satellite environmental accounts.

2.4.1 System of National Accounts and satellite accounts

The SNA accounting framework allows economic data to be compiled and presented in a comprehensive, consistent and integrated way for economic analysis, decision-making and policymaking. It comprises many sets of different accounts and tables (e.g. production and

income distribution that relate to flows, as well as balance sheets and asset accounts that relate to stocks) and helps generate indicators such as the Gross Domestic Product (GDP). However, these accounts only cover components with market-based transactions, for example relating to minerals, energy, timber, cultivated biodiversity (e.g. crops and livestock). Stock valuations are typically based on net present values (NPV) of resource rents¹⁵.

In addition, countries are increasingly developing **satellite environmental accounts**, which expand the coverage of environmental aspects without affecting the comparability of national accounts. This allows for a much greater level of detail and also for further sub-national analysis. The main guidance for this is the United Nations (2014a) System of Environmental-Economic Accounting (SEEA) 2012 – Central Framework. However, this has also been supplemented by the United Nations (2014b) System of Environmental-Economic Accounting 2012 – Experimental Ecosystem Accounting document. The Central Framework is a standard, whilst the latter is still just an experimental guide undergoing further research.

The **SEEA Central Framework** starts from the perspective of the economy and its economic units, and incorporates relevant environmental information concerning natural inputs, residual flows and environmental assets. On the one hand it helps further identify and account for market based environmental transactions already covered in national accounts under the SNA, but it also helps identify and quantify related physical units. The guidance on environmental related monetary valuation only covers market related transactions (as already covered within the SNA).

The **SEEA Experimental Ecosystem Accounting** starts from the perspective of ecosystems and links ecosystems to economic and other human activities. It effectively covers non-market related stocks and flows of value. Together these approaches provide the potential to describe in a complete manner the relationship between the environment, the economy and other human activity.

These are both briefly explained below, with examples from the UK and Holland provided in Sections 2.4.4 and 2.4.5.

2.4.2 SEEA Central Framework

The SEEA Central Framework comprises the following four main types of table and accounts:

1. **Supply and use tables.** These tables show all flows (measured in monetary or physical terms), in terms of supply and use of natural inputs, products and residuals (see definitions below) and how these relate to industries, households, accumulation¹⁶, the rest of the world and the environment. Only products are measured in monetary terms (based on market transactions), whilst the natural inputs and residuals are measured in physical units. In addition, supporting physical flow accounts can be set up for products, energy, water, materials (e.g. air, water and solid emissions) and the economy as a whole to track flows specifically associated with any of these.

The monetary tables contain information potentially consistent with that in company financial profit and loss accounts. The physical related information covering inputs and residuals contains information potentially consistent with that covered by GRI G4 and as covered by Steps 6 and 7 of the NCP (i.e. measuring impact drivers and dependencies and changes to the status of associated natural capital).

¹⁵ Resource rent represents the natural value accruing to the natural asset after other economic returns from the use of the asset have been taken into account (e.g. the cost of other inputs such as materials and labour).

¹⁶ Relates to scrapping and demolition of produced assets.

2. **Asset accounts.** These focus on recording stocks and flows associated with environmental assets¹⁷. It includes accounts for seven environmental assets comprising: mineral and energy resources, land (covering 14 classes identified in the FAO (2009) Land Cover Classification System (LCCS 3)), soil resources, timber resources, aquatic resources, other biological resources (i.e. other than cultivated biological resources) and water resources. These are all covered in physical terms, (e.g. barrels, tonnes, m³ and hectares) and where possible in monetary terms too, based on market transactions. Regarding the latter, it highlights limitations for monetary accounts for water, soil and other biological resources. They show the stock of environmental assets at the beginning and end of each accounting period and the changes (e.g. additions such as growth and discoveries, and reductions such as catastrophic loss or reclassification) in the stock.

This is where company accounts could be developed to assist with alignment. They are somewhat aligned with the CNCA approach.

3. **Sequence of economic accounts.** This presents the relationship between all stocks and flows recorded in an accounting system. The main table highlights additional transactions and flows not covered by the supply and use tables and asset accounts. This includes payments of rent for extraction of natural resources, and payments of environmental taxes, subsidies and grants etc. It is made up of 'main entries' for production, distribution and use of income, capital and financial accounts, plus 'balancing items' to balance out net inflows and outflows. A complementary balance sheet can be put together to record assets and liabilities at the beginning and end of each period, with the balance being the overall net worth (i.e. total value of assets less liabilities).

Companies interested in highlighting environmental related items in their financial accounts can align with the breakdown provided here.

4. **Functional accounts.** These focus on identifying economic transactions covered in the SNA and the above SEEA Central Framework accounts that can be considered environmental, in particular relating to environmental activities. This includes:
- **Environmental Protection Expenditure Accounts (EPEA)**, covering expenditures on environmental protection, resource management and environmental taxes and subsidies; and
 - **Statistics on Environmental Goods and Services Sector (EGSS)**, covering expenditures on producing environmental goods and services.

Again, companies interested in highlighting environmental related items in their financial accounts can align with the breakdown provided here.

The monetary values component of the Central Framework is based on market prices, split into basic, producer's and purchaser's prices. These are broadly aligned with information recorded in company's financial statement. Monetary transactions are recorded using quadruple entry, covering both parties to a transaction in addition to the entry of output/consumption and change in asset/liability. This is the same for physical transactions except that no financial transaction element is captured.

Within the SEEA, of particular relevance is the definition and coverage of: natural inputs, products and residuals.

- **Natural Inputs** comprise three categories of input to production:
 - **Natural resource inputs** (e.g. minerals, timber and water). These lead to 'extraction used in production' (e.g. oil, soil, timber, fish water etc.) and natural

¹⁷ 'Environmental assets' are encompassed within the concept of natural capital.

- resource residual (e.g. mine overburden, dredging spoil, discarded fish and re-injection).
- Inputs of energy from renewable sources (e.g. solar, hydro, wave); and
- **Other natural inputs** (e.g. soil nutrients, nitrogen and oxygen).
- **Products** are the goods and services that result from a process of production in the economy.
- **Residuals** are flows of solid, liquid and gaseous materials, and energy, that are discarded, discharged or emitted to the environment (e.g., emission to air) by establishments and households through processes of production, consumption or accumulation but may also flow within the economy. This comprises solid waste, wastewater and emissions (to air, water and soil) plus ‘dissipative uses’ of products (i.e. products such as fertilizers and pesticides deliberately released to the environment as part of the production process) and ‘dissipative losses’ (i.e. material residues that are an indirect result of production and consumption activity, such as particulate abrasion from car tyres).

2.4.3 SEEA Experimental Ecosystem Accounting

The SEEA Experimental Ecosystem Accounting document sets out an initial proposed approach (i.e. it is not a standard) to extend the SNA by accounting for ecosystem services beyond those that provide input to the production of marketed goods and services. It considers environmental assets from a broader ‘systems’ perspective (rather than an ‘individual’ or isolated perspective, as covered in the SEEA). It also focuses on smaller sub-national spatial areas. The guidance covers both ecosystem services and ecosystem assets, but stresses that ecosystem services from assets providing private benefits (e.g. agricultural production) will already be included in the SNA. It is those giving rise to public benefits that are the focus of the Experimental Ecosystem Accounts.

1. **Accounting for ecosystem services in physical terms.** This sets out a framework for identifying ecosystem services based on the Common International Classification of Ecosystem Services (CICES) and quantifying physical flows associated with them for different levels of spatial unit. Ecosystem services are split into provisioning, regulating and cultural, with examples provided for each.

Spatial units include basic spatial units¹⁸ (BSU), land cover/ecosystem functional unit¹⁹ (LCEU), and ecosystem accounting units²⁰ (EAU). Physical flows relating to the generation and use of ecosystem services can also be evaluated and split by type of economic unit. A number of weighting and aggregation approaches are proposed based on different unit currencies and monetary values. The guide highlights that piloting exercises may want to focus on just a few ecosystem services.

2. **Accounting for ecosystem assets²¹ in physical terms.** The assessment of ecosystem assets is considered to encompass measurement of: ecosystem extent, ecosystem condition and expected ecosystem service flows for different spatial units. Ecosystem extent may be measured in m² or hectares, whilst condition may be

¹⁸ BSU are small spatial areas, for example determined by laying 1km² grids over a map or linked to small parcels of land or using remote sensing pixels.

¹⁹ LCEU is a larger unit that should satisfy a predetermined set of criteria relating to the characteristics (e.g. land-cover type, water resources, climate, altitude and soil type) of an ecosystem. It should be possible consistently to differentiate an LCEU from neighbouring LCEUs based on differences in its ecosystem characteristics.

²⁰ EAU are delineated based on the purpose of analysis and should take into consideration administrative boundaries, environmental management areas, large-scale natural features (e.g., river basins) and other entities relevant to defining areas for reporting purposes (e.g., national parks and other protected areas).

²¹ Ecosystem assets are spatial areas containing a combination of biotic and abiotic components and other characteristics that function together.

measured using a set of indicators for different characteristics (e.g. relating to biodiversity, water, soil, vegetation etc.) ideally related to a reference condition. Expected ecosystem service flows should take into account the capacity of the ecosystems to generate a range of different ecosystem services taking into account extraction and regeneration rates. Future uses and scenarios may also be introduced, for example to optimize the flows over time.

Accounts may also be set up to record changes in ecosystem condition over a period of time, showing opening and closing conditions as well as key improvement and reductions in condition. In addition, suggestions are made with respect to developing specific carbon and biodiversity accounts. The latter includes identify opening and closing populations of Kingdom, Class, Order etc. as well as a range of other alternative indicators.

3. **Approaches to valuation for ecosystem services and ecosystem assets.** The EEA aims to enable compilers and analysts of ecosystem accounts to make decisions regarding valuation, while remaining aware of the required assumptions and their implications for interpretation. It does this by outlining:
 - a. Various motivations for valuation in monetary terms;
 - b. Various valuation concepts and principles that may be applied;
 - c. Relevant SNA valuation principles when the intent is to compare ecosystem valuations with existing national accounts valuations; and
 - d. A range of possible valuation methods and associated measurement challenges.
4. **Accounting for ecosystems in monetary terms.** Rather than specify a particular approach, the EEA highlights several possible ways for accounting for ecosystems in monetary terms, because there are still discussions and controversies amongst the national accounting experts. This includes:
 - a. **Creating combined presentations of standard economic measures** from the SNA and SEEA Central Framework, with measures of physical terms for ecosystem services and ecosystem assets.
 - b. **Developing an ecosystem asset account in monetary terms by determining ecosystem stock values.** This is achieved by applying net present value calculation to the expected ecosystem service flows. Values for restoration and degradation can then be added in, as well as changes made for reclassifications and revaluations. This is what the UK government has done (see below).
 - c. **Augmenting economic accounts through the addition of ecosystem accounts in monetary terms.** This can be done by i) using balance sheets of assets and liabilities and applying wealth accounting approaches; ii) adding the monetary value of ecosystem service flows and ecosystem degradation to sequence of economic accounts; and iii) deriving aggregate measures of economic activity such as incomes and savings, by adjusting with the monetary value of ecosystem degradation.

2.4.4 UK government experience

Following the production of TEEB (2010), the UK government conducted its own National Ecosystem Assessment (NEA, 2011), which represented, amongst other things, a statement regarding the general state and value of habitats and ecosystem services within the UK. The UK National Ecosystem Assessment Follow-on (NEA, 2014) went on to provide new information and tools to help decision-makers across all sectors understand the wider value of the UK's ecosystems and the services they provide. One output of the latter was a Natural Capital Asset Check (NCAC) which assesses: how much of each 'asset' of our natural capital there is; the condition of those assets; what each asset produces (goods and services), and how decisions affect the stocks, condition and flows of assets over time.

Subsequently, the UK Office for National Statistics (ONS, 2014) undertook an experimental NC account in line with SNA, SEEA-CF and SEEA-EEA. The accounts include monetisation of energy (oil and gas, and coal), timber, minerals (e.g. limestone, chalk, sand and gravel, peat and salt), agriculture, fisheries, water abstraction, outdoor recreation and GHG sequestration. The valuations are generally based on a 'resource rent' approach, except for outdoor recreation and GHG sequestration²².

Various other types of account are being investigated, for example forests, marine accounts. For the forestry accounts, spatially disaggregated ecosystem accounts have been developed, covering four ecosystem services (timber, carbon sequestration, recreation and water flow regulation). Physical and monetary accounts are also presented, showing stocks and flows.

To overcome the many challenges of applying SEEA-EEA guidelines in a consistent way among various ecosystem accounts, the UK published in July 2014 a Statement of methodological principles to inform development of the various habitat-based accounts. These principles will be revised and updated in the light of on-going learning and experience with the accounts.

In the UK, national NCA accounting is still considered as experimental, so it is difficult to identify specific applications. As the accounts develop, they will be increasingly able to:

- Highlight the values, losses and gains provided by natural assets
- Highlight links with economic activity and pressures on natural capital
- Inform priorities for resourcing and management decisions

The UK government has found that a number of generic issues need addressing if natural capital accounts are to have practical and policy application. This includes: producing a reasonable time series which can highlight changes and trends; assessment of stocks (assets) as well as flows (services) so that accounts shed light on sustainability considerations; data limitations and methodological approaches need to be clearly understood so that they are not misinterpreted; accounts and the underlying data need to reflect changes in resource management, ecosystem condition and service delivery in a timely way; spatial accounts need to build on existing forms of ecosystem service mapping; and the role for restoration and maintenance cost information within the accounting framework needed to be assessed.

2.4.5 Dutch government experience

The Dutch government developed a set of national environmental accounts for 2013 based on the SEEA Central Framework (Statistics Netherlands, 2012). It presents a broad quantitative overview of the recent key developments in the relationship between the environment and the economy using the three main SEEA Central Framework accounts. The accounts cover energy, water, materials, greenhouse gas emissions and air pollution, as well as exploring policy instruments and economic opportunities.

Statistics Netherlands is currently carrying out a pilot project on NCA to assess how the experimental SEEA guides provisional guidelines can be implemented in the Netherlands, so that, in the future, a full set of Natural Capital Accounts can be developed at a national level. In the first phase of this project (finished in May 2015), land accounts, an essential building block for compiling Natural Capital Accounts, were compiled (based on use and activity) for the Netherlands, and an inventory was carried out of available data for the Netherlands, on ecosystem services, asset and condition.

In the second phase of this project (May 2015-September 2015) the aim is to: a) develop and conceptually design Natural Capital Accounting Tables, and b) populate the proposed

²² Due to a lack of data on capital inputs for these.

tables for the Dutch province Limburg, for a selected number of ecosystem services and ecosystem types, using physical, and where possible monetary, units.

2.4.6 Finland's approach

In Finland, Jäppinen, J-P, and Heliölä (2015) make the following recommendations concerning the development and uptake of natural capital accounting within Finland.

- Align on-going work on indicators with the existing framework for national and environmental-economic accounts, with a view to develop a set of pioneering ecosystem (capital) accounts for water, forests (including forest carbon), fisheries and fish stock and nature-based tourism.). This should be carried out within the general framework currently being developed under the EU-wide MAES initiative.
- In the longer run, explore the opportunities to link the ecosystem accounts to spatial data (ecosystem types, land use practices, proximity to population centres), to make the accounts increasingly useful for decision-making at different levels.
- Focus largely on the biophysical data in accounts in the immediate future, as this will allow a wider range of issues to be addressed. Selective use of monetary indicators could be useful if and where they can help contribute to important policy questions and provide meaningful results.

2.5 NC reporting and accounts in Public FIs

A number of public financial institutions are encouraging governments to better understand the importance of natural capital to their economies through national natural capital accounting. An example of this is the World Bank Group (WBG), which, through the WAVES²³ Partnership, is working with central banks, ministries of planning and finance, and statistics and sector institutions across the world to integrate natural resources into development planning. This is mainly achieved through supporting governments to implement NCA using the UN SEEA Central Framework, and piloting methodologies and implementation of SEEA Experimental Ecosystem Accounting with governments. The intention is to enable governments to make more informed decisions that can ensure genuine green growth and long-term advances in wealth and human well-being.

The WBG is also looking into promoting the use of natural capital concepts in World Bank operations and policy dialogue, thereby leveraging World Bank activities to better introduce natural capital applications in developing countries. To achieve this, World Bank Group, through its WAVES Partnership program, would leverage its data and methodologies to better inform activities in which wealth accounting and natural capital valuation are relevant.

The UK's Green Investment Bank (GIB) has recently developed its own set of 'green statements' within its annual integrated report. This is informed using risk assessment; quantification of GHGs, abiotic resource depletion, waste to landfill avoided, waste recycled; and qualitative assessment of natural environment and biodiversity benefits.

2.6 NC reporting and accounts in Private FIs

Private Financial institutions are much more similar to businesses with respect to natural capital accounts. However, apart from office use and staff travel related environmental impacts (e.g. particularly paper, energy and carbon), the more material natural capital issues for private FIs are linked to their value chain. This encompasses significant potential indirect impacts associated with the natural capital and environmental impacts and dependencies of the businesses, governments, and others that they lend to or invest in. Consequently,

²³ The Wealth Accounting and the Valuation of Ecosystem Services project, which is a global project aiming to promote sustainable development by ensuring that natural resources are mainstreamed in development planning and national economic accounts through ecosystem accounting. The focus is on developing countries.

private FIs tend to be less advanced in terms of developing natural capital accounts and reports.

However, SNS bank, a Dutch bank, has started assessing carbon emissions within its portfolio of investments and has developed a carbon profit and loss account. This is measured in tonnes of Co2 equivalents and in monetary terms. The intention is to move away from investments with high carbon footprints. They are now considering how to integrate biodiversity, water and waste related data within their portfolios.

This situation is likely to change as the Natural Capital Declaration's (NCD) Roadmap for the Financial Sector gets under way from 2015 – 2020²⁴. The NCD was launched at the UN Conference on Sustainable Development (Rio+ 20 Earth Summit) in 2012 by UNEP FI and the UK-based non-governmental organisation, Global Canopy Programme (GCP). It is a worldwide finance led initiative to integrate natural capital considerations into financial products and services, and to work towards their inclusion in financial accounting, disclosure and reporting. Signatory financial institutions are working towards implementing the commitments in the Declaration through NCD projects. These are overseen by a steering committee of signatories and supporters and supported by a secretariat formed of the UNEP FI and GCP.

Under the NCD, over 40 financial institutions have committed to understanding and embedding natural capital into financial products and services, and working towards accounting and reporting on natural capital.

One of the NCD Working Groups (WG4) specifically aims to 'investigate how to increase the level of transparency, disclosure and external reporting about the use of natural capital within operations and the 'value chain' of financial institutions'. WG4 will develop a disclosure programme and guidance to build capacity of financial institutions to report primarily on their indirect use of and effect on natural capital. WG4 will focus on the financial 'activities' of FIs, focusing on exposure to natural capital as providers of financial products and services (loans, investments, insurance). The direct impacts and dependencies of an FI's own corporate 'operations' (offices etc.) and supply chains, which are relatively minor, will be included as a minor element in the scope of work.

²⁴ www.naturalcapitaldeclaration.org/working-group-2/

3 Comparison of other NCA applications

3.1 Introduction

This section provides a very high level comparison of other NCA applications between the four sectors.

3.2 Option Appraisal

As set out in Table 3.1, and discussed below, there appears to be good degree of consistency between approaches used by the different sectors for option appraisals that factor in natural capital and other environmental impacts.

Table 3.1 Summary comparison of NCA option appraisals

	Business	Government	Public FIs	Private FIs
Aim	To consider natural capital and wider environmental issues to select a preferred option.	To consider natural capital and wider environmental issues to select a preferred project, programme or policy.	To consider natural capital and wider environmental issues to select a preferred project or programme to invest in.	Much less experience in applying this approach
Frequency of assessment	Ad-hoc			
Organisational & boundary scope	Particularly focussed on projects and primarily direct operations. However, option appraisal may cover any aspect of an organisation (e.g. materials, products, suppliers etc.)	Particularly focussed on projects and primarily direct operations.	Particularly focussed on projects and primarily direct operations.	
Scope of issues	Potentially cover all natural capital and wider environmental issues.			
How/why used	Used to help take into account natural capital and environmental issues to select the preferred option.			
Key components (approaches)	Historically mainly done using financial analysis, but increasingly now use EIAs, LCAs, MCAs and monetary valuation of environmental impacts.	Have historically used economic analysis and EIAs, within some government departments, and monetary valuation of environmental impacts for some time.	Have commonly used economic analysis, financial analysis and EIAs for many years. Some have used environmental valuation for many years too.	
Key guidance (examples)	EIA, LCA and MCA guidance. Various environmental valuation guidance documents that Govs and public FIs use NCP will help to harmonise approaches.	Some Govs (e.g. UK HM Treasury and DEFRA) have developed own economic and environmental valuation guidelines over the years. Other countries (e.g. Holland) beginning to develop their own too.	World Bank and Asian Development Bank pioneered economic analysis and environmental valuation guidance (e.g. Dixon et al, 1986, Economic analysis of environmental impacts).	

Businesses. Companies are used to undertaking option appraisals with a focus on financial aspects (i.e. assessing private or ‘financial’ costs and benefits). For example, these are commonly used for undertaking capital investment appraisals. They tend to use discounted cash flow (DCF) analysis to calculate net present values (NPVs) and internal rates of return (IRR). Increasingly, businesses are now taking into account environmental issues, for example through Environmental Impact Assessments (EIAs). Some are beginning to use economic analysis, for example, extended cost-benefit analysis (CBA) to include monetary values for environmental impacts. There is plenty of guidance available on this (e.g. see governments and public FIs below), although there is flexibility in terms of how exactly this is undertaken. It is the intention of the Natural Capital Protocol to help ensure additional harmonisation in this respect.

As mentioned in the workshop, option appraisal tools are being developed specifically to help businesses evaluate options and conduct site level assessments. This includes, for example, InVEST, ARIES and Sustain Value’s EROVA tool (Environmental Risk, Opportunity and Valuation Assessment). The latter has recently been extended to provide a more holistic assessment by covering social and economic aspects too, hence becoming the ESE-ROVA tool. The EU B@B NCA workstream 2014 report provides more examples of such tools in relation to different NCA applications (Spurgeon, 2014).

Governments. Governments have, to differing degrees, used financial, economic and environmental/ social assessments for evaluating projects, and to a lesser extent, for evaluating policies and programmes. There has been a recent move towards increased use of extended CBA, particularly following TEEB (2010).

The **UK government** has been investigating and including environmental valuation in option-appraisals, particularly for certain sectors (e.g. water resources and flood defence schemes) for many years. The main guidance is the HM Treasury Green Book guidance including supplementary guidance on accounting for environmental impacts in policy. This includes links to specific guidance including stated preference and value transfer. Various government departments have created their own guidance on specific issues such as DECC’s carbon valuation, DEFRA’s air quality valuation, and the Ministry of Defence’s Defence Related Environmental Appraisal Methodology (DREAM) and Sustainability and Environmental Appraisal Toolkit (SEAT).

Similarly, the **Dutch government** has a Societal Cost-Benefit Analysis (MKBA) manual that is mandatory for major governmental projects on spatial development and infrastructure. It includes various methods for evaluating non-use values²⁵ of nature, such as:

- Nature points method (PBL): Non-monetary, quantitative indicators to compare changes in nature-values of alternatives
- Ecological Quality Ratio (EKR): Non-monetary, quantitative indicator to compare the policy relevance of measures to improve water quality (e.g. applications for Water Framework Directive projects).
- Contingent Valuation Method (CVM): Subjective inquiries (interviews) to measure public preferences based on willingness to pay (WTP) values for a specified change in nature.

It also includes methods for evaluating use values for nature, based on the TEEB method. This includes identification and quantification of most relevant/significant effects of the project on ecosystems and related ecosystem services, and where possible, their monetary valuation.

For the valuation/monetisation step, potential methods include: market prices, comparable prices, price-indicators (e.g. of avoided technical projects with comparable effects), costs of compensation, hedonic pricing and travel cost methods. An additional chapter dedicated to valuing nature/natural capital is under development, covering state of the art of ecosystem

²⁵ Values people gain without any actual ‘use’, for example, just knowing that something exists.

services accounting, with do's and don'ts of application of different monetisation and discounting methods.

Public financial institutions. Public FIs have very similar approaches to governments. They have historically tended to use financial appraisal and economic cost benefit analysis. Financial appraisal is to assess the financial viability of a proposed project from an entity's perspective. The unit of analysis is the project rather than the economy.

Economic appraisal is undertaken to determine whether the project generates a net benefit to society – and how much that is. Over the years, Public FIs such as the World Bank and Asian Development Bank have helped pioneer environmental valuation techniques and have developed extensive guidance on the topic (e.g. Dixon et al 1986).

Private Financial institutions. Private FIs are similar to businesses and have historically focus on financial values in their option appraisals. As such they tend to use discounted cash flows for calculating NPVs and other financial return on investment type approaches. However, some in recent years have begun to take into account wider environmental considerations in such appraisals, and will be looking to the forthcoming NCP and accompanying financial sector guide.

3.3 Risk and opportunity assessments

Risk and opportunity assessment tend to follow relatively approaches and principles amongst the different sectors. Table 3.2 summarises some of the main relevant features. Again, businesses and private FIs are focussed on the risks and opportunities of relevance to their financial situation, relating to both natural capital impacts and dependencies. Governments and public FIs are more focussed on risks to natural capital and associated consequences to society as well as to local and national economies. A range of indicator, hot spot analysis and materiality assessment type techniques are available to assist with such assessments.

Table 3.2 Summary comparison of NCA risk and opportunity assessments

	Business	Government	Public FIs	Private FIs
Aim	To identify and help manage NC related business risks and opportunities.	To identify and help manage risks and opportunities related to the nation's natural capital	To help governments identify and manage risks and opportunities related to their nation's natural capital.	To identify and manage NC related risks and opportunities associated with their, and their client's, investments.
Frequency of assessment	Ad hoc, but increasingly common.			Ad hoc, and rather limited at present.
Boundary scope	To products and projects and all Tiers of operation, increasingly for the supply chain (and to lesser extent the value chain).	National and sub-national level. Potentially to other issues too (e.g. assets at risk)	Natural capital and environmental issues relating to government nations and projects/sites.	Applied to their portfolios, to countries (e.g. Brazil), to sectors (e.g. mining) and issues (e.g. water).
Scope of issues covered	Covering natural capital stocks and flows and other environmental issues (e.g. residuals).			As per others, but so far to a lesser extent, mainly focussing on carbon and water etc.

	Business	Government	Public FIs	Private FIs
How/why used	To assess materials, projects/sites, suppliers etc. to change them, prioritise them or seek to better manage them etc.	To identify natural capital assets, ecosystem services and environmental residuals that need to be better managed.	To help governments do appropriate risk and opportunity assessments.	To investigate which issues are becoming material for different sectors and companies; to establish which companies, sectors and countries to avoid or more closely monitor investing in; and to help advise companies to take action etc.
Key components (approaches)	As for reporting (e.g. EP&L) Hot spot analysis, materiality assessment LCA for products, EIA for projects, EMS for sites etc. Indicators	As for reporting Natural capital asset risk register Indicators	As for reporting Hot spot analysis, materiality assessment Indicators	Research into specific topics (e.g. ecosystem services, water etc.) Hot spot analysis, materiality assessment Indicators
Key guidance (examples)	Ecosystem services review Reporting guidance LCA and EIA guidance	Natural capital asset risk register (Defra)	Ecosystem services review As for reporting	NCD is developing a number of tools to assist FIs.

Private financial institutions have in particular focused on the topic of risk assessment associated with natural capital. For example, Schroders (Stathers et al, 2013) surveyed chief economists at investment banks to explore how ecosystem services related risks were being factored into bank economic forecasts, HSBC (Knight et al, 2013) investigated the extent to which natural capital risks are affecting macro-economics and thereby affecting investment decisions, and the NCD has developed several tools to integrate natural capital risks within FI decision-making.

The latter include for example, the Soft Commodity Risk Tool enabling portfolios to be reviewed for policies linked to investment and lending in supply chains linked to deforestation²⁶, the Water Risk Valuation Tool (WRVT) to evaluate the implications of water stress for mining equities valuations²⁷, and the Corporate Bonds Water Credit Risk Tool to benchmark companies and assets in water-intensive industries, such as mining, power and beverages industries on exposure to water stress.²⁸

3.4 Mitigation hierarchy approaches

This category of NCA approaches comprises a number of different approaches that generally aim to adhere to the mitigation hierarchy, which advocates action in the following order of importance: to avoid, minimise, restore and offset. It also includes damage and compensation assessments and net positive/net impact approaches. Table 3.3 summarises the key features associated with the four main sectors.

²⁶ <http://www.naturalcapitaldeclaration.org/softcommoditytool/>

²⁷ <http://www.bloomberg.com/bcause/new-tool-integrates-water-risk-considerations-in-equity-valuation-process>

²⁸ <http://www.naturalcapitaldeclaration.org/bonds-water-scarcity/>

Table 3.3 Summary comparison of NCA Mitigation Hierarchy related approaches

	Business	Government	Public FIs	Private FIs
Aim	To apply the mitigation hierarchy to their own natural capital impacts. In context of damage assessments, to ensure appropriate level of damages are paid to 'compensate for/offset' the impacts. Companies also applying concepts to claim net positive credentials.	To apply the mitigation hierarchy and ensure others, including businesses, apply it to their natural capital impacts. In context of damage assessments, to ensure adequate damages are paid to 'compensate for/offset' the impacts.	To apply the mitigation hierarchy to major projects they invest in, and encourage other governments to adopt such approaches to help manage their natural assets.	To apply the mitigation hierarchy to their own natural capital impacts and encourage those they invest in to consider doing the same. Some are beginning to explore becoming net positive too.
Frequency of assessment	Ad hoc			
Organisation & boundary scope	Major focus at project/site level, typically for direct operations only (Tier 1). Certain issues (e.g. carbon, water, biodiversity) also covered at a product and company level too, with mitigation and offsetting mainly for direct operations. Damage assessments for direct incidents they are responsible for.	Key focus at a project/site level when authorising/ permitting projects. Interested at a national and local level. Damage assessments relate to public resources.	Primarily focus is at a project/site level for direct operations of projects being financed.	Main focus is own operations, but exploring concept in relation to who they invest in.
Scope of issues covered	All issues typically covered for projects in EIAs – but mainly biodiversity that entails offsetting.			Early days yet – focus on carbon initially, with others potentially covered in the future.
	Carbon, water and biodiversity are main issues considered for offsetting in general (e.g. in relation to products, project and company level).	Carbon and biodiversity are main areas of focus for offsetting.	Carbon and biodiversity are main areas of focus for offsetting.	
How/why used	To manage and minimize environmental impacts and risks. To gain permit approvals for projects. To promote 'net positive' credentials.	To try to reduce loss of national natural capital stock, especially biodiversity, and minimise other environmental impacts from developments etc.	To influence developers and governments (borrowing money) to include mitigation hierarchy and offsetting in their activities.	Early days, but used for reputational reasons and to reduce future investment risks.
Key components (approaches)	Assessment of impacts (e.g. using EIA/LCA) Application of mitigation hierarchy Assessing NPV and distribution analysis			
Key guidance (examples)	BBOP offsetting guidance. IFC Performance standards (especially PS6 on biodiversity). CSBI guidance documents on biodiversity and	Many environmental related Directives and associated national laws (e.g. Environmental Liability Habitats and EIA Directives etc.) Specific national guidance (e.g. UK	BBOP offsetting guidance. IFC Performance standards (especially PS6 on biodiversity). CSBI guidance documents on	Greenhouse Gas Protocol and forthcoming Natural Capital Protocol – Finance sector guide.

	Business	Government	Public FIs	Private FIs
	mitigation hierarchy. Greenhouse Gas Protocol and forthcoming Natural Capital Protocol. Forum For the Future guidance on Net Positive.	DEFRA offsetting guidance).	biodiversity and mitigation hierarchy	

3.5 Other applications

There are many other potential NCA applications covering a broad range of uses, for example informing environmental markets/payments for ecosystem services, sustainable financing, pricing, to inform marketing and product design, evaluating shared value, enhancing developments, setting thresholds and communication. Evaluating and comparing these is beyond the scope of this study.

3.6 Key differences overall

Based on the questionnaire survey, workshop, brief literature review and above analysis, some of the key differences in relation to NCA for the four sectors are:

- Businesses and private FIs generally seek to maximise profits whereas governments and public FIs seek to optimise societal benefits.
- Businesses and private FIs tend to be more interested in assessing flows of value and impacts, whereas governments and public FIs have greater interest in assessing and maintaining natural capital assets (i.e. stocks).
- While for governments there is great interest in creating natural capital accounts (Environmental-Economic Accounts) that expand on the national accounts, for business and FIs, the NCA scope tends to be broader. The approaches and methodologies they apply cover aspects such as supply chain risk assessment (for businesses) and credit risk assessment (for FIs), which are fundamentally quite different.

3.7 Key links and similarities overall

Based on the questionnaire survey, brief literature review and workshop, some of the key similarities in relation to NCA for the four sectors are:

- All sectors generally seem to be interested in using NCA for the same types of application, albeit from slightly different perspectives. For example, for reporting, options appraisal, managing risks and opportunities, mitigating impacts, developing and/or understanding environmental markets etc.
- All sectors recognise the need to develop more consistent NCA approaches and methodologies, in particular in relation to what parameters to assess, in what units, and which techniques should be used for monetary valuation.
- Ultimately, it would be ideal if all company natural capital accounts aligned and fed into sub-regional and national government natural capital accounts. This would be true for balance sheets (i.e. stocks of natural capital assets) and profit and loss accounts (i.e. impacts and annual changes to stocks).
- All sectors should have a strong interest and clear role in working together to develop and implement natural capital markets, such as payment for ecosystem services and biodiversity offset markets. This should be based on an understanding of the underlying biodiversity stock and flow of ecosystem service values, who damages the stock and benefits from the flows, and who should pay to help maintain the stocks and flows.

Governments should be promoting options that maximise societal benefits in an equitable way, businesses should contribute based on any damages they cause or benefits they potentially gain, and FIs should support the development of appropriate associated financing mechanisms. It is potentially a win-win situation for all. However, considerable thought is required to minimise any unintended consequences and to prevent inappropriate, unfair and harmful trade in biodiversity.

- The same arguments as above are true for the sectors to work together to develop green infrastructure. Each is interested for different reasons and can contribute in their own way.
- All sectors would gain significantly from improved sharing of the data and information on natural capital and environmental impacts that they collect. Actors within each sector have plenty of data of relevance to others, and all stand to gain from sharing it. It is up to governments and interested groups (e.g. based around industry sectors) to work together to facilitate and make this happen.
- Businesses and private FIs both seek to maximise profits, although they are increasingly recognising the importance of, and inter-relationship with, trying to create social value too.
- Governments and public FIs both seek to optimise societal benefits, but in the most cost-effective way.
- Governments are beginning to, and should increasingly, consider natural capital and environmental impact criteria within their business procurement selection approaches and state aid policies.
- Businesses and FIs are increasingly interested in supply chain risks. As a result, some are recognising the need to better understand potential impacts and dependencies relating to natural capital and environmental impacts in other countries that feature in their supply chain.
- The identification and disclosure of a business' risks (and opportunities) associated with natural capital and environmental impacts and dependencies is highly pertinent to FIs in relation to investing, insuring, making loans and providing investment advice. This includes for example: monitoring impacts; engaging with companies on disclosure and/or management; reducing exposure to risk; investing in solutions; and integrating natural capital related analysis into mainstream investment processes.
- Businesses and governments especially, must understand and develop a consistent and comparable approach to meaningfully measure changes in the status of natural assets that enables early detection of potential thresholds²⁹ and safe limits. As economic values, metrics and methodologies are developing there is a need to incorporate natural capital characteristics such as thresholds, non-linear degradation paths and (ir)reversibility. Governments undertaking national ecosystem assessments and developing natural capital accounts, need economic and ecological researchers to derive information on thresholds and limits that can be incorporated into measurement by business. This is particularly pertinent when measurement and valuation needs to reflect spatial and temporal variation of goods and services.

²⁹ A threshold is a discontinuity in a relationship whereby a small change in a pressure or driver can lead to a large change in the state of natural capital with consequences for the benefits it provides.

4 Data issues

4.1 Introduction

This section highlights the main points coming out of the questionnaire survey and workshop in relation to data challenges, needs, availability and opportunities. It has been split into aspects relating to general data and to interpretation and valuation.

4.2 Challenges and needs in general data access

Lack of sufficiently detailed datasets for biodiversity. For all sectors there is a lack of both national and international data sets to develop a systematic and consistent quantitative approach to valuing biodiversity. Many of the current data sets, particularly those used to assess the relative importance of biodiversity on maps are not granular enough (e.g. based on 1km squares). Even at resolutions of 1 hectare (100m squares) the actual feature of importance may only occupy a fraction of the area identified as of high biodiversity value. More continuous and accessible data sets would be helpful (e.g. from remote sensing, infrared and thermal imaging and satellite imaging).

The assumption that all parts of a protected area are of equal value may be a helpful stance from a policy perspective but does not assist in realistic valuation of biodiversity.

Linked to this, there is a need to develop a way of capturing and sharing data sets relating to 'green infrastructure' and a methodology to assess stocks and flows based on a dynamic infrastructure model rather than static areas.

Accessibility and sharing of datasets. Detailed data sets on biodiversity, for example, from comprehensive ecological surveys, is rarely made available. Part of the challenge is that businesses may have paid a great deal of money to collect the information, and possess intellectual property rights over that information.

While access to comprehensive and nationally available data is crucial for businesses to develop long-term planning (e.g. where to or not to expand quarries) and taking decisions, there are various challenges in obtaining and sharing such data. These include: lack of transparency, competition issues (intellectual property issues), private property, and various levels of data accreditation making comparison and compilation difficult. Smaller organisations find matters even more challenging due to a lack of financial/human resources for data management. Data collection is indeed often time-consuming and costly and requires considerable resources to be updated.

Similarly, WBG experience working with governments has revealed significant institutional challenges in sharing existing data, even with accounts (water, forest, mineral etc.) within the SEEA-CF. The WAVES Partnership works with governments that produce data (e.g. forest, water accounts) used for NCA under the UN SEEA framework. However, this data belongs to the governments, and not the WBG, so the WBG cannot share it.

Age of datasets. Many datasets are now getting old and becoming out of date. Although this can provide valuable historical information, one also needs to be wary about how things have changed and what the implications are for your context. For example, the Natura 2000 data sets are becoming dated and the original reasons for site selection may no longer be relevant. One of the biggest challenges is a lack of up-to-date comprehensive land cover (and ideally condition) mapping. The UK's Countryside Survey is the best data source to compile land cover accounts in the UK, but there is uncertainty as to whether it will be conducted again in its same format. It was last conducted in 2007, with four other years covered going back to 1978.

Variability of datasets. There are so many different datasets and ways of measuring and collating data that it presents significant complications when trying to make comparisons over time and in different locations. Related to this is the fact that there is a considerable

difference in the quantity and quality of data available within countries and between different countries. This presents a major challenge for companies operating in multiple locations and especially in different countries, and in particular, developing countries. It also presents difficulties when doing large landscape level/watershed studies, as it is often difficult to obtaining consistent detail across all sites for all issues.

Lack of data. There is a need by all for more information and data on, amongst other things:

- Dose-response of impacts. This includes better understanding the nature and extent of value erosion and creation to business and society from different impacts and actions. It includes regional/country effects of toxic materials/nutrients on ecosystems, soil quality and biodiversity, and also regional/country effects of toxic materials on human health.
- Habitat restoration, maintenance and creation costs and outcomes.
- Regional/country valuation of ecosystem services and biodiversity.
- Country land conversion of original biomes over time.
- Biodiversity at a site level.
- Annual quantitative data on ES at a national level.

Complexity due to supply chains. The challenge for many businesses is that many of their impacts and dependencies are linked to biotic and abiotic material flows that occur in their supply chains. It is time consuming and demanding to obtain actual relevant information on outputs, inputs and impacts from suppliers. Although one can use econometric modelling such as LCAs and EEIOs to derive approximations, they often don't adequately reflect the actual regional or local context, especially relating to biodiversity and ecosystem services. The key question that needs to be answered is therefore how existing data and indicators can be supplemented with localized information as well as aggregated and integrated into models and subsequently into corporate decision making.

What to monitor? Monitoring is a big issue given the coverage and complexity of natural capital and environmental impacts. There is a need for governments, businesses and FIs to agree on the most appropriate indicators and proxy measures to establish what is most efficient and effective to monitor. Earth observation (e.g. remote sensing) could also play a major role in monitoring natural capital.

Difference in terminology used (e.g. for ecosystem services). There are currently several evolving classification systems for referring to ecosystems services, amongst them TEEB and CICES (see Maes, 2013), final ecosystem goods and services (FEGS) (see Landers and Nahlik, 2013) and the National Ecosystem Services Classification System (NESCO) (see Rhodes, 2015). This needs to be resolved, although equally, it is essential not to get held back purely by semantics.

4.3 General data availability and opportunities

4.3.1 In relation to businesses

Businesses generate a considerable amount of information on natural capital and environmental impacts of potential use to governments and FIs. This particularly includes publically available information within annual sustainability and environmental reports and data within permit applications, for example within Environment Impact Assessments, and for other legal and regulatory requirements. Some relevant data (especially for example on costs) can also be found within mainstream annual reports (which include financial statements and management commentary).

Environmental data within **annual company reports** is now increasingly plentiful, but comes in many different formats, units and styles. It can also be time consuming to extract, although GRI does offer a service to obtain information from its database of over 18,000 sustainability reports from companies globally. Similarly, CDSB's framework for reporting on environmental information and natural capital in mainstream corporate reports should also give rise to considerable useful information for governments and FIs (see below). Metrics and indicators used to report results and performance however are most effective where they serve the needs of the user, considering the objective of disclosure and the circumstances of the organization.

Past EIA Statements and accompanying appendices of data are not always readily obtainable. Even if the Statements and appendices are available, they don't always contain all of the raw data and information collected. Businesses may also have considerable additional site level information collected for their own purposes, or to provide information for other requirements, which is not shared or made publically available. This may include considerable useful information on the presence and abundance of different species in specific locations, and monitoring data of air emissions and background air quality (e.g. large extractive companies). It may be for very specific issues, such as Coca-Cola developing a comprehensive set of information on water in areas it operates in.

Certain types of business will have considerable data available on the **cost of mitigation and offsetting measures**, as well as useful data regarding their effectiveness. For example, this may include information on habitat restoration and habitat and species translocation, which species come to the site naturally and at what rate, and under what circumstances etc.

Companies are likely to have a number of quite **specific yet valuable datasets** of use to other businesses, governments and FIs. For example, Bord na Mona, an Irish peat company, has GHG monitoring data from different peatlands, with comparisons to wind energy, and details of community projects etc. BAT has historical qualitative data and knowledge on a number of ecosystem services relating to agriculture covering a number of its global operating sites.

Some businesses (e.g. Landmarc) hold data on the true commercial **costs of establishing and maintaining features of biodiversity** value on a large, landscape, scale. Much of the other data readily available on this can be skewed by a volunteer or subsidy led approach or is only relevant to small, dense areas. Such 'maintenance' cost information is important for factoring into valuation of natural capital 'stocks', as they typically rely on maintenance to maintain their value.

Data coming from businesses can have global coverage, although this tends to be focused on the scope of their operations and interests, and may only cover the key areas of operation.

4.3.2 In relation to governments

Governments typically tend to collect and have available significant amounts of information on natural capital and environmental impacts. This is often collected and maintained by a variety of departments and government agencies. The nature and extent to which this is made publically available also varies between different countries and departments/agencies. One of the most valuable contributions from government's would be from comprehensive national accounts and statistics, in particular covering sectoral data on natural resources (such as water, forests, minerals, energy, land use, habitats etc.) to serve the needs of businesses and FIs.

Within the EU, according to Action 5 of the EU Biodiversity Strategy to 2020³⁰, all Member State governments will **map and assess the state of ecosystems and their services**

³⁰ <http://ec.europa.eu/environment/nature/biodiversity/comm2006/2020.htm>

within their national territory by 2014. This information should be of considerable use to businesses, and potentially FIs. A good example is the Dutch Atlas of Natural Capital, which is still in development.

Data coming from governments is predominantly country-based. However, not many countries, in particular developing countries, are engaged in this work yet.

Governments tend to have data on **biodiversity** at a national and local level. This can include distribution data for species and habitats. They may also help provide access to national and regional scale remote sensing data.

Information and data relating to the impacts and dependencies of business upon biodiversity and ecosystem functions and services, as well as their efforts to address these impacts can inform more effective and efficient policy and regulatory decisions with respect to biodiversity protection and business activities. Consolidated information across sectors and jurisdictions could allow integration into national inventories and develop our understanding of contributions to the Aichi Biodiversity Targets. Parallels are evident here with corporate GHG Reporting Programs such as the US EPA Mandatory Reporting Rule and the incorporation of corporate results into the national US GHG Inventory. The EPA takes a measured approach to incorporating the GHG Reporting Program data into the Inventory, considering the coverage within a sector, consistency of definitions, the availability of a time series, and transparency. The EPA is evaluating the data collected through the GHGRP, and will begin incorporating specific data elements in Inventory submissions. Over time, the EPA will use additional data elements from the GHGRP to improve the accuracy of the Inventory.

4.3.3 In relation to financial institutions

The WBG mostly has project-level data related to natural resources, biodiversity and ecosystem services.

FIs and service providers that specialize in ESG risk analytics for the financial sector have a wealth of data of potential use to businesses and governments.

FIs are increasingly investigating and collating data on issues relating to environmental markets (e.g. PES) and climate risks and adaptation (e.g. flood risks and prevention). They tend to be interested in determining where the financial capital/value associated with these risks is currently held. For example, the value of flood risk reduction lies with property owners, emergency services, flood alleviation authorities, insurance companies, banks who hold property in the area as collateral, as well as local and national governments.

Data coming from FIs can have **global coverage**, but again it tends to be focused on the scope of their operations and interests, and may only cover the key areas of operation. FI datasets normally span across industries and can cover many indicators.

Business data and information from annual reports on natural capital impacts and dependencies can usefully inform FIs about specific natural capital risks. For example, in the case of assessing and managing risks associated with deforestation, FIs could (at least potentially in the future) find out from annual reports:

- A company-wide policy on deforestation
- The percentage of purchases of palm oil, soya, sugar and wood pulp that are traceable to suppliers verified by credible third parties as not engaged in deforestation, expansion into peatlands or natural forests, with clear goals for each commodity
- Results of audits to ensure raw materials in its supply chain are traceable and verified as not contributing to deforestation
- Identification of certification systems and programs that the company uses to ensure sustainable sourcing of each of these commodities.

4.3.4 Other sources of information

Many other organisations hold potentially useful and valuable information for businesses, governments and FIs to use. For example, this includes NGOs, universities and consultancy firms.

There are hundreds of potential sources of information on the topic, which can make working on this topic rather bewildering at times. Below just a few examples mentioned during the workshop discussion:

- Eurostat, EU Joint Research Centre (JRC) and the European Environment Agency (BISE³¹ – Biodiversity Information System for Europe) databases
- Natura 2000 databases and GIS³²
- Natura 2000 network coverage³³
- UNEP-WCMC³⁴ has many databases on habitat types and suitability for species
- IUCN Red Lists³⁵
- IPIECA has a shared geospatial database³⁶ for marine related information and data – any company can upload and download information.
- A number of other initiatives are exploring and filling data gaps (e.g. ESPA³⁷ - Ecosystem Services for Poverty Alleviation, OpenNESS³⁸ - Operationalisation of Natural Capital and Ecosystem Services, and OPERA³⁹ - Operational Potential of Ecosystem Research Applications).

4.4 Recommendations for general data issues

Enhance data sharing. There is a real need to encourage and incentivise greater sharing of business collected data. Governments should ensure that all data collected by businesses as part of a permitting exercise should be made readily available on websites or in searchable databases. Initiatives should be set up whereby companies can share costs for collecting information that may be useful for others, or be part paid for information that is subsequently used by others. It is also important that businesses should work with governments and NGOs in order to compile and share aggregated data, drawing upon data collated at a local level.

Governments should make all natural capital and environmental impact information they have available, and provide relevant information about planned developments to assist those undertaking cumulative impact assessments.

Governments should highlight that biodiversity is a public good and encourage all information on it to be publically shared. There will of course be constraints on this in relation to expensive research and development and associated intellectual property rights, for example for food, pharmaceutical and biotechnology companies.

³¹ <http://www.biodiversity.europa.eu/>

³² http://ec.europa.eu/environment/nature/natura2000/db_gis/index_en.htm

³³ http://ec.europa.eu/environment/nature/natura2000/access_data/index_en.htm

³⁴ <http://www.unep-wcmc.org>

³⁵ <http://www.iucnredlist.org>

³⁶ <http://www.ipieca.org/publication/marine-geospatial-bibliography>

³⁷ <http://www.espa.ac.uk>

³⁸ <http://www.openness-project.eu/>

³⁹ <http://operas-project.eu>

Businesses should try to find ways of sharing more information they have on supply chains, but again taking into account issues around confidentiality and competitive advantage.

Encourage more obtaining and reporting of information. Governments need to create the right incentives for companies to report on and manage their natural capital and environmental impacts. This includes more appropriate pricing of resources, introducing environmental taxes, and removing perverse subsidies.

Enhance data consistency. There is a need for common Protocol for collecting and collating data. This is something the NCC is looking into for the future. In particular there is a need for greater government coordination for creating and managing databases of values and ensuring data collection done in a consistent way, with more standardised accreditation approaches. So, for example, when a business undertakes a site-specific study for a limited topic and area (typically the area in the vicinity of the project intervention), the data should be organized in a database with the same standard for all.

All data providers should ensure greater consistency over data type and terminology, coding etc. making it as clear and simple as possible.

Develop integrated data and information hubs. Ideally there should be fewer but more comprehensive sites that offer freely available data and information. This would require much greater cooperation between the many organisations providing data. Government available information should also be provided on fewer web-sites and web-pages.

Further investigate dose-response effects. There is generally much good data on 'impact drivers', such as quantities of emissions and discharges etc. However, there seems to be very poor data and information on the dose-response effects (i.e. what the actual natural capital and human impact/consequence is).

Explore use of big data and satellite imagery. This is a considerable potential for applying the concept of 'big data' to this topic, including historic and up-to-date use of satellite/remote sensing imagery (Earth Observation). Indeed Google⁴⁰ and others⁴¹ are beginning to explore opportunities in relation to this.

Use and verify models and assumptions. It is possible and necessary to use models and assumptions to fill data gaps. Ideally models should be verified and all assumptions should be made explicit.

Governments should set out more demands. Governments should set stronger and clearer demands on what companies should disclose in their annual reports. Governments should also use measures of NCA more as a criteria in green procurement.

FI should set out more demands. There would be a powerful stimulus for businesses to increase their application of NCA if FIs (especially rating agencies) included more NCA information in their assessments. FIs should ask companies and governments to provide more natural capital and environmental impact type information, for example when seeking loans.

4.5 Challenges and needs in data interpretation and valuation

Understanding implications of inputs and outputs. Businesses may have extensive data on natural capital related inputs and outputs/residuals in quantitative terms, as may governments for their country or parts of the country. However, they tend to currently lack the information and understanding to convert that into something meaningful in terms of its significance for stakeholders.

⁴⁰ <http://www.google.com/earth/outreach/stories/wwf.html>

⁴¹ http://www.esa.int/Our_Activities/Observing_the_Earth/Nature_valued_from_space

Challenges of monetary valuation. A key priority for companies and governments now is to better understand the potential use of monetary valuation in decision-making and reporting, as it is expected to receive more attention from, and traction with, senior business and government leaders. Nonetheless, it was acknowledged that organisations are still facing considerable difficulties in using biophysical data and translating it into (monetary) indicators that can inform strategic decisions at the organisation level.

Challenges in understanding ecosystem services. This is partly explained by a lack of understanding of ecosystem services and the challenges of translating physical data into monetized values, especially as the values vary considerably based on the context and stakeholders affected.

In many cases, the fundamental challenge is about understanding how final ecosystem goods and services are functionally related to the ecosystem assets; this will be clearer in some cases (e.g. timber production) than others (e.g. marine recreation services).

Conflicting views on valuation. When it comes to monetary valuation in a business context, opinion is still highly divided. Not all businesses want monetary valuation, as some don't believe it can provide the right level of granularity required for certain decisions, and that there is too much uncertainty. It can also be a major challenge for SMEs to undertake, with many not thinking they will be able to afford it. There are also concerns that it will become a marketing tool misrepresenting the truth. There is scepticism over its ability to provide accurate enough statements because it is based on numerous assumptions and it is extremely challenging to have international agreements on monetising impacts.

In addition there are major differences in opinions between whether welfare values should be used or cost based approaches (Rambaud and Richard, 2015)

Resources and skills required. As demonstrated by experience in all sectors, one of the main barriers to wider implementation of NCA is the resources required. There is generally considerable interest in the potential application of toolkits or models to help populate natural capital accounts, reducing the resources needed for site level data collation.

Dependencies less well covered. NCA applications provide an opportunity to address the dependency aspect of natural capital (as opposed to the impact side that is often well covered anyway, for example through ESAs). Given the impending predicted natural resource shortages, this is a topic of considerable relevance to all four sectors, and one that they should all devote more effort to investigating.

Importance of alignment regarding biodiversity offsetting. There is still a significant debate by governments and business to align and agree on the concept of biodiversity offsetting. This includes agreeing on the need for it, the circumstances where it is/is not appropriate, and measurement of what and how much is required, and how successful it is. A challenge is that different countries are developing their own approaches, although IFC⁴², BBOP⁴³ and CSBI⁴⁴ are developing internationally accepted guidance documents.

TEV of stocks. Businesses would like to have more information made available by governments on what the Total Economic Value is from different stocks of natural capital, such as habitats and water bodies.

Reporting using science based targets. Indicators used to report company results and performance are most effective where they serve the needs of the user. This may be for example in relation to legal requirements (e.g. for environmental protection and transparency), pressure from stakeholders (such as investors), participation in indices (such as the DJSI) and peer pressure. Typically companies use 'inside-out' processes that set the

⁴² International Finance Corporation – Performance Standard 6.

⁴³ Business Biodiversity Offset Programme – various biodiversity offset guidance documents.

⁴⁴ Cross Sectoral Biodiversity Initiative – Mitigation hierarchy guidance documents.

level of ambition of sustainability goals analysing the companies' historical performance, benchmarking with industry peers, projecting trends and scenarios, and taking a conservative approach that builds on what seems achievable. Recently, however, leading companies have started to apply an 'outside-in' approach that evaluates their sustainability goals against benchmarks based on absolute standards or on goals for society as a whole. An example of this outside-in framing is the Science Based Targets⁴⁵ initiative intended to increase corporate ambition on climate action by changing the conversation on GHG emissions reduction target setting and creating an expectation that companies will set targets consistent with the level of de-carbonization required by science to limit global warming to less than 2°C compared to pre-industrial temperatures. A similar process and methodology for natural capital will allow business to understand and consider the private sector contribution to other government and international community commitments such as the Aichi Biodiversity Targets.

4.6 Recommendations for data interpretation and valuation

Facilitate consistent valuation approaches. All sectors recognise the need for consistent methods for valuing natural capital and environmental impacts, which would increase the comparability and confidence in business, government, and FI assessments. In the business context, it is essential to develop agreed standards early on; otherwise there is a risk of many years of duplication and abortive effort (as happened with measuring carbon). This is what has provided a strong rationale for the Natural Capital Coalition's Natural Capital Protocol that is seeking to harmonize approaches across business valuation and NCA. Different approaches for valuation (e.g. welfare values versus cost-based approaches) should also be clearly articulated, with advice provided on their relative uses and weaknesses.

Ensure consistent approaches at different levels. Going forwards it is important to ensure the relationship between national, corporate, and site-specific approaches to measuring natural capital are consistent (although the purposes are likely to be distinctive), with information and data being interoperable.

Fund studies to enhance value transfers and co-efficients. Governments and other joint initiatives should fund: i) additional detailed primary valuation studies that can generate monetary values for use in value transfers; and ii) studies that review scientific literature to identify key factors affecting values thereby helping to generate standard values, adjustment factors and other co-efficients/proxies that can be applied in different contexts, countries and regions, for different parameters (e.g. how do carbon emissions / sequestration rates vary according to the condition of peatland). This would make monetary valuation far more cost-effective, and more practical for SMEs.

Fund studies on valuing changes in land use/habitats. There needs to be more work looking at different ecosystem services and their values associated with different habitats, and what the trade-offs are between them. For example, how do ecosystem services and their values change with different farming practices? What ecological and social surveys are needed to determine and value the changes? Where practicable, this type of information should be linked to national mapping datasets (as is happening in Holland with their Atlas of Natural Capital).

If possible, a simple tool should be developed to help determine how values change with habitat type, habitat quality, species, surrounding context etc. Advice is also needed on the scale of ecosystem service assessments needed.

Collaborate to develop specific KPIs for biodiversity. Governments should work with businesses to agree a suitable single or set of KPIs for biodiversity, for example to cover product, site and company level assessments. The challenge is the complexity of

⁴⁵ <http://sciencebasedtargets.org/about-us/>

biodiversity (and natural capital) and the lack of a single unit of measurement (in contrast to carbon). The high degree of local variability in the type and scale of benefits adds to the complexity. There is a need for simple, replicable methods that can be applied by all.

Greater research and overall collaboration is needed on this. For example, the EU should prioritise and speed up efforts to cover biodiversity within Product Environmental Footprints.

Develop more case study examples and lessons learned. A number of organisations asked for more real life case study examples of frameworks, practical indicators, and measurement and valuation approaches being applied. This should include information on costs and resources used to undertake the study together with related information on the business case for action. Feedback and case studies covering lessons learned from NCA applications in all sectors would be valuable too. The WBG are hoping to pilot a Natural Capital Protocol application in a WAVES country to learn about links between business NCA and the wider national environmental accounting context.

Promote awareness of initiatives. It would be useful for all sectors to be aware of different initiatives in different countries that linked governments, businesses and FIs together on NCA issues so that more rapid progress can be made on NCA valuation.

Foster greater co-operation. On this topic it is imperative to establish non-competitive areas of mutual interest between business and other parties. This can be challenging and further exploration as to how best this is addressed is required.

Review tools and fill gaps. There is a need to review available tools and models and help fill any obvious gaps. This could include data management systems as well as the development of standardised approaches to assessing natural capital assets, ecosystem services and environmental impacts.

Undertake study to investigate FI ratings approaches. For many companies pressure and motivation to be active in sustainability issues (and thus NCA) comes from financial institutions, and in particular sustainability rating agencies (such as RobecoSAM, CDP, Sustainalytics). A better insight into the scoring methodology used and the relative benchmark position of companies especially on key natural capital indicators would be helpful.

Use open peer reviews more often. Greater use should be made of sharing approaches being developed by organisations, either for comment before finalizing approaches or afterwards, to take into account for future updates. Kering and the UK Green Investment Bank are good examples of organisations taking this approach.

Align work with other key initiatives. Thought should be given by the different sectors to alignment of their NCA approaches with the SDG Compass work of GRI, WBCSD and UNGC. The guide is aimed to help business understanding which SDGs are most relevant for their company, assessing impact on those SDGs through the value chain, KPI selection, goal setting, and communicating. The guide builds on existing methodologies, tools and indicators.

Another example would be for businesses in certain sectors, for example food, beverage, agriculture and extractives, to frame similar work with the Aichi Biodiversity Targets and Strategic Goals.

4.7 General NCA recommendations

Encourage closer engagement. Business, government and FI organisations and experts involved in environmental accounting should engage much more closely on this topic. This seems to be happening in the UK and Holland, but in few other EU countries.

Agree over the importance of parameters. The four sectors should better align the parameters (issues) and metrics used in their NCA applications and approaches, and

improve articulation as to what data is needed for each parameter, why is important to collect and how it will be used.

Develop a unified template. Overall there should be one template for all companies, which should ideally be aligned with the UN SEEA Central Framework and Experimental ecosystems Accounting. This should aim to integrate and ‘balance’ all natural capital stock accounts (i.e. balance sheets), at a business, local, regional and national level. The same should ideally be done for annual flows of change/impacts (i.e. profit and loss accounts).

Encourage certified experts. There should be recognised certified experts and agencies/organisations in each EU country to undertake NCA accounting and auditing of those accounts.

Agree landscape/catchment level accounts first. If landscape or catchment scale natural capital accounts are developed by governments and accepted by stakeholders, then the linkages between business, government and FIs are likely to follow. The scale would be sufficient to interest each of these groups.

Focus NCA on discrete decisions first. National natural capital and environmental accounts require a great deal of time and money to develop, and they are often met with a great deal of resistance. The learning curve for decision makers is often large too. By identifying discrete decisions that involve a particular watershed or forest, and developing accounting frameworks for those, greater successes can often be gained with less political resistance.

Anticipate and minimise unintended consequences. It is essential to minimise unintended consequences, for example relating to the creation of inappropriate financial markets for biodiversity and ecosystem services. This is particularly the case for living and endangered species.

Governments should lead and allow innovation. The standards for NCA need to be set by governments, ensuring that all businesses and FIs are required to report in some form. The innovation should then be left to business and FIs to push the boundaries of that reporting.

Share success stories. Where solutions have been found for improved co-operation and data sharing, such examples should be showcased and shared.

5 Creating an enabling environment for NCA

5.1 Introduction

While private and public sector' NCA approaches may differ in a number of ways, there seem to exist a common ground (e.g. metrics and data are similar within each sector) on which both sectors can build to create an enabling environment for NCA. This would require strong cooperation between the private (including financial institutions) and public sector as well as international organisations and NGOs. While companies have a strong demand for this, governments are best placed to create the rewards and enabling conditions capable of triggering widespread use of NCA methods and tools in companies.

This enabling environment could consist of regulatory conditions and softer policies aiming at facilitating data availability and common approaches to valuation. A pragmatic approach is also necessary to facilitate cross-fertilization of ideas and knowledge-sharing between the private and public sector and the academic world.

There is a need to **identify the key gaps between applications and data needs/uses of the public, private and finance sector and make recommendations on what could be potentially done to address these gaps.**

Some key questions on gaps include:

- How to create open access to data for companies and governments and to what extent can it be open source?
- How to ensure a level-playing field and transparency where private-sector actors have access to the same basic data (i.e. overcoming Intellectual Property issues)? Which organisations could be the main data provider at international, EU and national level? How to ensure that data is provided at the same level (e.g. aggregated vs. site-level)?
- How can data consistency be ensured for better comparability in order to avoid comparing proxies vs. site-specific data?
- What is the role of each actor for creating an enabling environment? Will governments as well as banks create specific data requirements?
- Which are the most promising methods for affecting decision-makers through NCA – data availability, valuation, cost-benefit analysis and ground projects/case studies?
- How can you ensure additionality and avoid double counting in NC accounts, as valuations of companies are often different from valuations of governments/society?
- What are the safe limits we can operate in with respect to the future effects on biodiversity and ecosystem services based on existing data (and past information)?
- What are the key areas to focus on for further data development (in order to identify the key data, which needs to be collected, analysed and shared)?

6 Recommendations for Phase 3

Based on the year 1 and 2 work, the following potential study options for Phase 3 of the NCA workstream are proposed:

1. Continue to work on comparing NCA applications and identifying ways to fill data gaps and enhance synergies amongst the four sectors (business, government and both private and public FIs). This could include, for example, investigating the extent to which different EU countries are meeting their goal of mapping ecosystem services.
2. Explore the role of and value to be gained from reporting on company expenditures on managing natural capital – in particular maintaining and restoring habitats.
3. Investigate how NC impacts and values can be better linked into LCA.
4. Investigate how companies can best address, measure and disclose information on their natural capital dependencies (as opposed to impacts).
5. Explore further the concept of NC balance sheets (i.e. for land holding companies, and those that have major suppliers with large landholdings).
6. Investigate the extent to which investment-rating agencies are considering how companies adopt NCA approaches.
7. Update the NCA Guide and Decision-matrix tool developed in 2014 (Year 1 of the Platform).

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ANNEXES

Annex 1 Contributors to the study

Sector	Expert name	Organisation	Completed questionnaire	Attended workshop	
				In person	By phone
Business	Catherine Farrell	Bord na Mona	Yes	-	-
	Cécile Leclere	*EIFER/EDF	Yes	-	-
	Charles Le Maitre	*Vicat	Yes	Yes	-
	Christoff Reissfelder	*HeidelbergCement	Yes	Yes	-
	Jim Rushworth	*LafargeHolcim	Yes	-	-
	Joseph Yalley-Ogunro	*BAT	Yes	Yes	-
	Mikkel Kallesoe	*Shell	Yes	Yes	-
	Peter Smith	*Interserve Defence/Landmarc Support Services	Yes	-	-
Rudi Daelmans	*Desso	Yes	-	-	
Government	Helen Dunn	UK Defra	Yes	-	-
	Joop van Bodegraven	Min of Economic Affairs (NL)	Yes	-	-
	Martin Lok	Min of Economic Affairs (NL)	Yes	Yes	-
	Pat Snowdon	UK Forestry Commission	Yes	-	-
	Saskia Ras	Min of Infrastructure & Environment (NL)	Yes	-	-
	Strahil Christov	EU – DG Environment	n/a	Yes	-
Wieger Dijkstra	Min of Infrastructure & Environment (NL)	-	Yes	-	
Financial Institution	Anders Nordheim	UNEP-FI	-	-	Yes
	Anita de Horde	SNS Bank	-	Yes	-
	Ekaterina Grigoryeva	World Bank Group	Yes	-	Yes
	Elizabeth White	World Bank Group	Yes	-	-
	Emma Strong	Green Investment Bank (GIB)	Yes	-	-
	Eva Meyerhofer	EIB	-	Yes	-
	Leisel van Ast	Natural Capital Declaration	-	-	Yes
Other	Andrea Peiffer	Global Nature Fund	Yes	-	Yes
	Antonio Martini	*Studio Ing. Martini S.r.l.	Yes	-	-
	Derek Eaton	Global Footwork Network	-	Yes	-
	James Spurgeon	Sustain Value	n/a	Yes	-
	John Finisdore	Sustainable Flows	Yes	-	-
	Katja Kriege	Global Reporting Initiative	Yes	-	-
	Luke Blower	CDSB	Yes	Yes	-
	Michel Scholte,	Trueprice	Yes	-	-
	Moritz Nil	Systain Consulting	Yes	-	-
	Stefan Hormann	Global Nature Fund	Yes	-	-
	Yann Verstraeten	ICF - Workshop note-taker	n/a	Yes	-

*NCA Workstream Full Members

Experts shown in bold kindly completed a questionnaire and attended the workshop.

Annex 2 GRI G4 indicators

G4-EC2

FINANCIAL IMPLICATIONS AND OTHER RISKS AND OPPORTUNITIES FOR THE ORGANIZATION'S ACTIVITIES DUE TO CLIMATE CHANGE

a. Report risks and opportunities posed by climate change that have the potential to generate substantive changes in operations, revenue or expenditure, including:

A description of the risk or opportunity and its classification as either physical, regulatory, or other

A description of the impact associated with the risk or opportunity

The financial implications of the risk or opportunity before action is taken

The methods used to manage the risk or opportunity

The costs of actions taken to manage the risk or opportunity

G4-EN1

MATERIALS USED BY WEIGHT OR VOLUME

a. Report the total weight or volume of materials that are used to produce and package the organization's primary products and services during the reporting period, by:

Non-renewable materials used

Renewable materials used

G4-EN3

ENERGY CONSUMPTION WITHIN THE ORGANIZATION

a. Report total fuel consumption from non-renewable sources in joules or multiples, including fuel types used.

b. Report total fuel consumption from renewable fuel sources in joules or multiples, including fuel types used.

c. Report in joules, watt-hours or multiples, the total:

Electricity consumption

Heating consumption

Cooling consumption

Steam consumption

d. Report in joules, watt-hours or multiples, the total:

Electricity sold

Heating sold

Cooling sold

Steam sold

e. Report total energy consumption in joules or multiples. f. Report standards, methodologies, and assumptions used. g. Report the source of the conversion factors used.

G4-EN4

ENERGY CONSUMPTION OUTSIDE OF THE ORGANIZATION

a. Report energy consumed outside of the organization, in joules or multiples.

b. Report standards, methodologies, and assumptions used.

c. Report the source of the conversion factors used.

G4-EN8

TOTAL WATER WITHDRAWAL BY SOURCE

a. Report the total volume of water withdrawn from the following sources:

Surface water, including water from wetlands, rivers, lakes, and oceans

Ground water

Rainwater collected directly and stored by the organization

Waste water from another organization

Municipal water supplies or other water utilities

b. Report standards, methodologies, and assumptions used.

G4-EN9

WATER SOURCES SIGNIFICANTLY AFFECTED BY WITHDRAWAL OF WATER

- a. Report the total number of water sources significantly affected by withdrawal by type:
 - Size of water source
 - Whether or not the source is designated as a protected area (nationally or internationally)
 - Biodiversity value (such as species diversity and endemism, total number of protected species)
 - Value or importance of water source to local communities and indigenous peoples
- b. Report standards, methodologies, and assumptions used.

G4-EN11

OPERATIONAL SITES OWNED, LEASED, MANAGED IN, OR ADJACENT TO, PROTECTED AREAS AND AREAS OF HIGH BIODIVERSITY VALUE OUTSIDE PROTECTED AREAS

- a. Report the following information for each operational site owned, leased, managed in, or adjacent to, protected areas and areas of high biodiversity value outside protected areas:
 - Geographic location
 - Subsurface and underground land that may be owned, leased, or managed by the organization
 - Position in relation to the protected area (in the area, adjacent to, or containing portions of the protected area) or the high biodiversity value area outside protected areas
 - Type of operation (office, manufacturing or production, or extractive)
 - Size of operational site in km²
 - Biodiversity value characterized by:
 - The attribute of the protected area or high biodiversity value area outside the protected area (terrestrial, freshwater, or maritime ecosystem)
 - Listing of protected status (such as IUCN Protected Area Management Categories⁶⁷, Ramsar Convention⁷⁸, national legislation)

G4-EN12

DESCRIPTION OF SIGNIFICANT IMPACTS OF ACTIVITIES, PRODUCTS, AND SERVICES ON BIODIVERSITY IN PROTECTED AREAS AND AREAS OF HIGH BIODIVERSITY VALUE OUTSIDE PROTECTED AREAS

- a. Report the nature of significant direct and indirect impacts on biodiversity with reference to one or more of the following:
 - Construction or use of manufacturing plants, mines, and transport infrastructure
 - Pollution (introduction of substances that do not naturally occur in the habitat from point and non-point sources)
 - Introduction of invasive species, pests, and pathogens
 - Reduction of species
 - Habitat conversion
 - Changes in ecological processes outside the natural range of variation (such as salinity or changes in groundwater level)
- b. Report significant direct and indirect positive and negative impacts with reference to the following:
 - Species affected
 - Extent of areas impacted
 - Duration of impacts
 - Reversibility or irreversibility of the impacts

G4-EN13

HABITATS PROTECTED OR RESTORED

- a. Report the size and location of all habitat protected areas or restored areas, and whether the success of the restoration measure was or is approved by independent external professionals.
- b. Report whether partnerships exist with third parties to protect or restore habitat areas distinct from where the organization has overseen and implemented restoration or protection measures.
- c. Report on the status of each area based on its condition at the close of the reporting period.
- d. Report standards, methodologies, and assumptions used.

G4-EN14

TOTAL NUMBER OF IUCN RED LIST SPECIES AND NATIONAL CONSERVATION LIST SPECIES WITH HABITATS IN AREAS AFFECTED BY OPERATIONS, BY LEVEL OF EXTINCTION RISK

a. Report the total number of IUCN Red List species and national conservation list species with habitats in areas affected by the operations of the organization, by level of extinction risk:

- Critically endangered
- Endangered
- Vulnerable
- Near threatened
- Least concern

G4-EN15

DIRECT GREENHOUSE GAS (GHG) EMISSIONS (SCOPE 1)

- a. Report gross direct (Scope 1) GHG emissions in metric tons of CO₂ equivalent, independent of any GHG trades, such as purchases, sales, or transfers of offsets or allowances.
- b. Report gases included in the calculation (whether CO₂, CH₄, N₂O, HFCs, PFCs, SF₆, NF₃, or all).
- c. Report biogenic CO₂ emissions in metric tons of CO₂ equivalent separately from the gross direct (Scope 1) GHG emissions.
- d. Report the chosen base year, the rationale for choosing the base year, emissions in the base year, and the context for any significant changes in emissions that triggered recalculations of base year emissions.
- e. Report standards, methodologies, and assumptions used.
- f. Report the source of the emission factors used and the global warming potential (GWP) rates used or a reference to the GWP source.
- g. Report the chosen consolidation approach for emissions (equity share, financial control, operational control).

G4-EN16

ENERGY INDIRECT GREENHOUSE GAS (GHG) EMISSIONS (SCOPE 2)

- a. Report gross energy indirect (Scope 2) GHG emissions in metric tons of CO₂ equivalent, independent of any GHG trades, such as purchases, sales, or transfers of offsets or allowances.
- b. Report gases included in the calculation, if available.
- c. Report the chosen base year, the rationale for choosing the base year, emissions in the base year, and the context for any significant changes in emissions that triggered recalculations of base year emissions.
- d. Report standards, methodologies, and assumptions used.
- e. Report the source of the emission factors used and the global warming potential (GWP) rates used or a reference to the GWP source, if available.
- f. Report the chosen consolidation approach for emissions (equity share, financial control, operational control).

G4-EN17

OTHER INDIRECT GREENHOUSE GAS (GHG) EMISSIONS (SCOPE 3)

- a. Report gross other indirect (Scope 3) GHG emissions in metric tons of CO₂ equivalent, excluding indirect emissions from the generation of purchased or acquired electricity, heating, cooling, and steam consumed by the organization (these indirect emissions are reported in Indicator G4-EN16). Exclude any GHG trades, such as purchases, sales, or transfers of offsets or allowances.
- b. Report gases included in the calculation, if available.
- c. Report biogenic CO₂ emissions in metric tons of CO₂ equivalent separately from the gross other indirect (Scope 3) GHG emissions.
- d. Report other indirect (Scope 3) emissions categories and activities included in the calculation.
- e. Report the chosen base year, the rationale for choosing the base year, emissions in the base year, and the context for any significant changes in emissions that triggered recalculations of base year emissions.
- f. Report standards, methodologies, and assumptions used.
- g. Report the source of the emission factors used and the global warming potential (GWP) rates used or a reference to the GWP source, if available.

G4-EN18

GREENHOUSE GAS (GHG) EMISSIONS INTENSITY

- a. Report the GHG emissions intensity ratio.
- b. Report the organization-specific metric (the ratio denominator) chosen to calculate the ratio.
- c. Report the types of GHG emissions included in the intensity ratio: direct (Scope 1), energy indirect (Scope 2), other indirect (Scope 3).
- d. Report gases included in the calculation.

G4-EN19

REDUCTION OF GREENHOUSE GAS (GHG) EMISSIONS

- a. Report the amount of GHG emissions reductions achieved as a direct result of initiatives to reduce emissions, in metric tons of CO₂ equivalent.
- b. Report gases included in the calculation (whether CO₂, CH₄, N₂O, HFCs, PFCs, SF₆, NF₃, or all).
- c. Report the chosen base year or baseline and the rationale for choosing it.
- d. Report standards, methodologies, and assumptions used.
- e. Report whether the reductions in GHG emissions occurred in direct (Scope 1), energy indirect (Scope 2), other indirect (Scope 3) emissions.

G4-EN20 EMISSIONS OF OZONE-DEPLETING SUBSTANCES (ODS)

- a. Report production, imports, and exports of ODS in metric tons of CFC-11 equivalent.
- b. Report substances included in the calculation.
- c. Report standards, methodologies, and assumptions used.
- d. Report the source of the emission factors used.

G4-EN21

NO_x, SO_x, AND OTHER SIGNIFICANT AIR EMISSIONS

- a. Report the amount of significant air emissions, in kilograms or multiples for each of the following:
 - NO_x
 - SO_x
 - Persistent organic pollutants (POP)
 - Volatile organic compounds (VOC)
 - Hazardous air pollutants (HAP)
 - Particulate matter (PM)
 - Other standard categories of air emissions identified in relevant regulations
- b. Report standards, methodologies, and assumptions used. c. Report the source of the emission factors used.

G4-EN22

TOTAL WATER DISCHARGE BY QUALITY AND DESTINATION

- a. Report the total volume of planned and unplanned water discharges by:
 - Destination
 - Quality of the water including treatment method
 - Whether it was reused by another organization
- b. Report standards, methodologies, and assumptions used.

G4-EN23

TOTAL WEIGHT OF WASTE BY TYPE AND DISPOSAL METHOD

- a. Report the total weight of hazardous and non-hazardous waste, by the following disposal methods:
 - Reuse
 - Recycling
 - Composting
 - Recovery, including energy recovery
 - Incineration (mass burn)
 - Deep well injection
 - Landfill
 - On-site storage
 - Other (to be specified by the organization)
- b. Report how the waste disposal method has been determined:
 - Disposed of directly by the organization or otherwise directly confirmed
 - Information provided by the waste disposal contractor
 - Organizational defaults of the waste disposal contractor

G4-EN24

TOTAL NUMBER AND VOLUME OF SIGNIFICANT SPILLS

- a. Report the total number and total volume of recorded significant spills.
- b. For spills that were reported in the organization's financial statements, report the additional following

information for each such spill:

- Location of spill
- Volume of spill
- Material of spill, categorized by: Oil spills (soil or water surfaces)
- Fuel spills (soil or water surfaces)
- Spills of wastes (soil or water surfaces)
- Spills of chemicals (mostly soil or water surfaces)
- Other (to be specified by the organization)

c. Report the impacts of significant spills.

G4-EN26

IDENTITY, SIZE, PROTECTED STATUS, AND BIODIVERSITY VALUE OF WATER BODIES AND RELATED HABITATS SIGNIFICANTLY AFFECTED BY THE ORGANIZATION'S DISCHARGES OF WATER AND RUNOFF

a. Report water bodies and related habitats that are significantly affected by water discharges based on the criteria described in the Compilation section below, adding information on:

- Size of water body and related habitat
- Whether the water body and related habitat is designated as a protected area (nationally or internationally)
- Biodiversity value (such as total number of protected species)

G4-EN27

EXTENT OF IMPACT MITIGATION OF ENVIRONMENTAL IMPACTS OF PRODUCTS AND SERVICES

- a. Report quantitatively the extent to which environmental impacts of products and services have been mitigated during the reporting period.
- b. If use-oriented figures are employed, report the underlying assumptions regarding consumption patterns or normalization factors.

G4-EN33

SIGNIFICANT ACTUAL AND POTENTIAL NEGATIVE ENVIRONMENTAL IMPACTS IN THE SUPPLY CHAIN AND ACTIONS TAKEN

- a. Report the number of suppliers subject to environmental impact assessments.
- b. Report the number of suppliers identified as having significant actual and potential negative environmental impacts.
- c. Report the significant actual and potential negative environmental impacts identified in the supply chain.
- d. Report the percentage of suppliers identified as having significant actual and potential negative environmental impacts with which improvements were agreed upon as a result of assessment.
- e. Report the percentage of suppliers identified as having significant actual and potential negative environmental impacts with which relationships were terminated as a result of assessment, and why.

G4-EN31

TOTAL ENVIRONMENTAL PROTECTION EXPENDITURES AND INVESTMENTS BY TYPE

- a. Report total environmental protection expenditures by:
 - Waste disposal, emissions treatment, and remediation costs
 - Prevention and environmental management costs

G4-EN29

MONETARY VALUE OF SIGNIFICANT FINES AND TOTAL NUMBER OF NON-MONETARY SANCTIONS FOR NON-COMPLIANCE WITH ENVIRONMENTAL LAWS AND REGULATIONS

- a. Report significant fines and non-monetary sanctions in terms of:
 - Total monetary value of significant fines
 - Total number of non-monetary sanctions
 - Cases brought through dispute resolution mechanisms
- b. Where organizations have not identified any non-compliance with laws or regulations, a brief statement of this fact is sufficient.