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Climate Smart Mining

FOREST-SMART MINING

Guidance to Applying Nature-Based Solutions in the Large-Scale Mining Sector

Credit: Jeremy Holden/FFI.

Suggested Citation:
Forest-Smart Mining: Guidance to Applying Nature-Based Solutions in the Mining Sector, World Bank, 2021.

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Financing for this study was provided by the Program on Forests (PROFOR).

Design: Michael Bunnya Kalanzi (MeBK)

Cover photo: Pippa Howard/FFI

FOREST-SMART MINING

Guidance to Applying Nature-Based Solutions in the Large-Scale Mining Sector

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2021

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FOREWORD

"Tackling climate change is now as much a political and communications challenge as it is a scientific or technological one. We have the skills to address climate change in time, all we need is the global will to do so.... Decisions taken at this G7 meeting, at the Biodiversity COP in China, and COP26 in Glasgow are the most important decisions humanity has ever taken.

—Sir David Attenborough, COP26 People's Advocate, Statement to the G-7, June 2021

Mining has a potentially important role to play in the delivery of the Sustainable Development Goals and the transition to a low-carbon economy, providing the minerals required to build turbines, solar panels, and improved energy storage, generating jobs and government income, and supporting up to 45 percent of global economic activities. But to achieve this, the sector must address its harmful environmental and social impacts, including contributions to greenhouse gases and impacts on biodiversity and local communities.

Land use impacts including forest loss and degradation do not feature in company climate policies or emissions reporting, whether direct (for example, Scope 1) or indirect (for example, Scope 2). Instead, they tend to be addressed through environmental impact assessments (EIAs) at the project level, which typically focus on biodiversity rather than climate impacts. As such, there is a disjuncture between top-down climate commitments and bottom-up EIAs and conservation efforts. However, the international climate discourse is rapidly advancing in the context of highlighting the critical role of nature in tackling the climate crisis. Nature-based solution (NbS) mechanisms, such as REDD+, are gaining greater profile globally, and the private sector is starting to respond to this.

Nature-based solutions need to be part of the potential response. Defined by the International Union for Conservation of Nature (IUCN) as "actions to protect, sustainably manage and restore natural or modified ecosystems to address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits" (IUCN 2016), NbS could account, by some estimates, for nearly 40 percent of the emission reductions required to meet the 2-degree target of the Paris Agreement. Despite this, they receive relatively little attention, accounting for less than 3 percent of climate-related finance.

The 2021 United Nations Framework Convention on Climate Change Conference of the Parties (COP26), held in Glasgow, finally recognized the importance of nature for both reducing emissions and building resilience to the impacts of climate change, both in the formal text and also through a raft of initiatives announced on the sidelines. The final decision text "emphasizes the importance of protecting, conserving and restoring nature and ecosystems to achieve the Paris Agreement temperature goal, including through forests and other terrestrial and marine ecosystems acting as sinks and reservoirs of greenhouse gases and by protecting biodiversity, while ensuring social and environmental safeguards."[1] This is a promising development since for decades those in power have failed to appreciate that the crises of climate change and biodiversity loss are not separate issues to be dealt with one by one but deeply intertwined problems that must be tackled together. Now those linkages and the power of NbS are well understood.

Clearly, the protection and restoration of nature must be prioritized as a vital route to raise global climate ambition and accelerate the transition to net zero, and to build resilience and capacity to adapt to the increasingly devastating impacts of climate change that are already being faced. Protection of these natural carbon- and species-rich ecosystems on land and in the ocean, combined with natural regeneration, high-quality restoration, and sustainable management, must be prioritized to maintain healthy ecosystems that are able to regulate climate and support local biodiversity and livelihoods.

1 *Glasgow Climate Pact, Decision -/CP.26, advance unedited version, https://unfccc.int/sites/default/files/resource/cop26_auv_2f_cover_decision.pdf.*

To do this and tackle climate change, we must consider the need for actual projects to be delivered on the ground; to ensure that the finance of projects is being directed correctly and is taking into account these objectives; and to confirm there is evidence in implementation of the positive contributions that projects are having for people, nature, and the climate.

While market failures have played a key role in driving the destruction of nature and climate change, market mechanisms that drive significant investment into high-quality NbS have the potential to shift economic incentives in favor of the protection and restoration of nature. The political and technical challenges to doing this well are significant, yet success would be a game changer and drive finance where it is needed most. We urgently need recognition and support to scale the best existing NbS-relevant frameworks—such as REDD+, community-based forest conservation, forest landscape restoration initiatives, and land degradation neutrality—to finance and implement the action needed.

Based on their long-term investment and presence in forested and other important ecosystems, mining companies—and the mining sector as a whole—has an opportunity to play a catalytic role in driving the application and uptake of NbS. Mining companies (based on the business case in operating landscapes) can assist in bridging the financing gap through investment in good, scalable NbS while delivering on its sustainability objectives, closure commitments, and moral/legal obligation to leave impacted landscapes and societies with a future that can sustain generations to come.

We need to increase incentive mechanisms to apply NbS in mining operations and in the landscapes mining influences and impacts. We need these NbS to restore nature, to maintain historically stable, intact, and biodiverse forests, and to generate carbon, water, livelihoods, health, and well-being. We need a rapid paradigm shift away from the use and abuse of nature to one where nature is nurtured, encouraged, and enhanced as solutions. We need to acknowledge that NbS are fundamental to the future of mining. We need them to be future smart, based on sound science, guided by Indigenous knowledge and local communities, supported by fair governance, and incentivized by appropriate funding mechanisms. This report seeks to elaborate on how all those conditions can be met successfully for all – businesses, local communities, governments and, most importantly, for the global environment.

EXECUTIVE SUMMARY

In 2017, the World Bank began work on forest-smart mining as a unique concept as part of its Climate-Smart Mining program, building upon the successes of prior work on forest-smart agriculture. The PROFOR Trust Fund financed three related studies on ASM, LSM, and offsets, implemented by a consortium of Levin Sources (as lead), Fauna & Flora International, and the Swedish Geological Survey (SGAB) in cooperation with Freshfields Consulting, which concluded in 2019 with the publication of three reports as well as an executive summary (World Bank 2019a, 2019b, 2019c, 2019e). These reports sought to identify good and bad FSM practices in the mining sector, to extract lessons learned and define the key principles for diverse stakeholders on how to be forest smart. These studies were presented at numerous international forums, with the official launch of the studies at Chatham House, London, and at the World Bank's Climate-Smart Mining Facility at the World Bank headquarters in Washington, D.C., in March and May 2019, respectively.

In 2019, a report commissioned by the World Bank and PROFOR exploring the forest impacts of large-scale mining (World Bank 2019a) together with companion reports on artisanal mining and the application of biodiversity offsets painted a stark picture. Mining in forests is a significant and rising issue. The analysis of mining activities across 52 case studies in 19 countries showed declining forest health scores in a circle of influence of at least 50 kilometers from the mine site. While the direct impacts of the sector on forests are relatively well understood, the indirect and cumulative impacts of projects and associated infrastructure can be much more significant and are frequently unrecognized or addressed. "Forest smart" mining requires a new approach from mining companies, governments, and finance. This work has subsequently been followed by a growing interest from the mining companies and financiers in environmental, social, and governance performance metrics as a way of identifying resilient companies and investments for the future, a trend that is set to increase in the wake of COVID-19 as vulnerability to environmental and social change is highlighted more clearly than ever before.

As part of these significant developments, in 2020, the Forest Carbon Partnership Facility (FCPF) made funds available to the Extractives Industries and Environment & Natural Resources Units of the World Bank to carry out a study providing Guidance to Applying Nature-Based Solutions in the Large-Scale Mining (LSM) Sector and a sister study on Developing Forest-Smart Artisanal and Small-Scale Mining Standards/Guidance. The FCPF funded these studies to get the private sector more directly involved in financing nature-based solutions.

As part of the World Bank Climate Facility's focus on forest-smart mining, the LSM report provides support for the participation of the mining community in NbS. The work comprises two parts:

1. This guidance.

2. Case studies, published separately, to pilot the appli-cation of the principles outlined in the guidance, learnings and examples from which have been iteratively included in the guidance.

The report introduces NbS to the mining sector and is aimed at an audience of large-scale mining companies and the governments that regulate them. It explains what NbS are, why they are relevant to the mining sector, and frames the business case for why mining practitioners should engage with and apply NbS in a variety of contexts across the life of mines and within the landscapes in which they operate. It goes on to provide a suite of examples of practical application and importantly presents a strong focus on the financing instruments and funding models necessary to ensure mainstreaming and sustainable outcomes.

The document navigates the reader through the finance options available. It starts by looking at the various objectives that different potential sources of finance might have, for example, donors, impact investors, multilateral lenders, and commercial investors. It goes on to look at the different options relevant to different stakeholders in a project with multiple actors, investors, and regulators.

In the final chapter, the IUCN Global Standard for NbS is used to provide the framework for how to integrate NbS into mining projects, with a comprehensive description

of the multiple elements required to be considered, for NbS project implementation.

Eight fundamental principles are identified to ensure Nbs are designed and delivered sustainably and equitably, in the final chapter, namely:

1. Setting the goal
2. Setting the appropriate scale
3. Ensuring a net gain in biodiversity
4. Ensuring economic viability
5. Arranging appropriate governance
6. Maximizing co-benefits
7. Integrating adaptive management
8. Ensuring sustainability and mainstreaming

The guidelines have been piloted with four mining operations located in diverse sociopolitical, environmental, and geographical contexts. A supplementary report summarizes the case studies, providing practical examples of existing NbS already under implementation, and possible opportunities that may exist for NbS in the future.


Credit: Roel Slootweg

Guidance

Nature-based solutions for **Forest smart mining**

What are NbS and why are we talking about them?

NbS is an umbrella term for a multitude of similar labels, including natural Climate Solutions (NCS) - NbS activities that focus on the challenge of climate change.

Nature-based Solutions involve working with and enhancing nature to address societal challenges. The concept is grounded in the knowledge that healthy, biodiverse and functioning ecosystems, are fundamental for human wellbeing and a wide range of services we rely on. Substantial benefits for climate, biodiversity and socioeconomic outcomes.

Why are NbS relevant to mining projects?

NbS help to mitigate impacts of mining, including rehabilitation of disturbed land, delivering sustainable development commitments such as livelihoods for local communities, water security and climate mitigation and adaptation.

Mine operations: *NbS activities that might facilitate normal mine operations and adherence to licensing requirement.*
Managing externalities: *NbS activities that could be employed to mitigate mine impacts but are not necessarily mandated by the terms of the license.*
Going beyong no net loss: *NbS activities that are entirely additional to normal mining operations.*

Identifying the **Business case** for NbS activities

What is the financial feasibility and how can NbS be delivered and integrated into business objectives and wider landscape objectives?

Setting up the business case for NbS investment:

- *The value proposition* - benefits to whom, revenue streams.
- *The operating/delivery model* - owner, manager.
- *The value capture* - what will it cost and who will pay for it?

How to design NbS according to IUCN Principles

Eight fundamental principles to ensure NbS are designed and delivered sustainably and equitably.

1: *Setting the goal*
2: *Setting the appropriate scale*
3: *Ensuring a net gain in biodiversity*
4: *Ensuring economic viability*
5: *Arranging appropriate governance*
6: *Maximising co-benefits*
7: *Integrating adaptive management*
8: *Ensuring sustainability and mainstreaming*

Funding and Financing opportunities and options

What is the best options for financing or funding NbS and how to structure and deliver these.

Structuring the investment:

- *Scale , lifetime, location, rate of return.*
- *Rationale for financing on or off balance sheet.*
- *Nature of risks and availability of risk mitigation or transfer instruments.*
- *Availability of finance partners*

Co-benefits to society and the environment

- Climate change mitigation
- Climate adaption
- Water security
- Livelihoods
- Biodiversity protection and delivery on commitments

ACRONYMS AND ABBREVIATIONS

AfDB	African Development Bank
AFOLU	agriculture, forestry, or other land use
CBD	Convention on Biological Diversity
CBNRM	community-based natural resource management
CCB	Climate, Community, and Biodiversity
CDP	Carbon Disclosure Project
CDM	Clean Development Mechanism
CO2e	carbon dioxide equivalent
COP26	2021 UNFCCC Conference of the Parties in Glasgow
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
DFI	development finance institution
EIA	environmental impact assessment
ESG	environmental, social, and governance
ETS	Emissions Trading System
EU	European Union
FLR	forest landscape restoration
FPIC	free, prior, and informed consent
GBF	global biodiversity framework
GHG	greenhouse gas
Gt	gigatons
ICMM	International Council on Mining and Metals
IETA	International Emissions Trading Association
IFC	International Finance Corporation
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
Mt	megatons
NbS	nature-based solution(s)
NCS	natural climate solution(s)
NDC	Nationally Determined Contribution
NPI	net positive impact
NYDF	New York Declaration on Forests
PES	payment for ecosystem services
REDD+	Reduce Emissions from Deforestation and forest Degradation and sustainable management of forests and enhancement of forest carbon stocks
SBT	science-based target
SBTi	Science Based Targets Initiative
SBTN	Science Based Targets Network
SDG	Sustainable Development Goal
SPE	special purpose entity

TCFD	Task Force on Climate-related Financial Disclosures
TNFD	Taskforce on Nature-related Financial Disclosures
TNC	The Nature Conservancy
UN	United Nations
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
WBCSD	World Business Council for Sustainable Development
WEF	World Economic Forum
WWF	World Wide Fund for Nature
MRV	monitoring, reporting, and verification
NBSAP	National Biodiversity Strategies and Action Plans
NDC	Nationally Determined Contribution
NEEI	non-energy extractive industry
NNL	no net loss
NPI	net positive impact
OECD	Organisation for Economic Co-operation and Development
PA	protected area
PEFC	Programme for the Endorsement of Forest Certification
PPCP	public-private community partnership
PROFOR	Program on Forests
PS	Performance Standard (of the IFC)
REDD+	Reducing Emissions from Deforestation and Degradation and associated co-benefits
RMD	Raw Materials Database
RPPN	private natural heritage reserve (of the Vale company)
SDG	Sustainable Development Goal
SEA	strategic environmental assessment
SMFG	Société des Mines de Fer de Guinée
SuRe	Standard for Sustainable and Resilient Infrastructure
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
UNFCR	United Nations Framework Classification for Resources
WLNP	West Lunga National Park (Zambia)
WWF	World Wide Fund for Nature

All dollars are U.S. dollars unless otherwise indicated.

1. BACKGROUND

Source: © Pixabay, Mangle-camboya-kampong-agua-pueblo

Guidance

Nature-based solutions for Forest smart mining

Mining has a vital role to play in the development of a future, low-carbon economy. The COVID-19 pandemic has caused an urgent demand for both economic recovery and an acceleration of the transition to a low-carbon, sustainable economy as defined by delivery of the Sustainable Development Goals (SDGs). Mining, and the products of mining, play a vitally important role in both, supporting up to 45 percent of global economic activity and providing the minerals required for the delivery of technologies central to a low-carbon economy, from turbines and solar panels to improved energy storage (World Bank Group 2017).

The mining sector is one of the few sectors to have weathered the global pandemic relatively well. Indeed, sharp rises in commodity prices in expectation of post-pandemic economic recovery driven by major fiscal stimulus packages have led to the best conditions for mining in a decade and to huge dividend payments by some of the sector's largest players in early 2021.[1]

But the large-scale mining sector is not yet fit for purpose for a sustainable economy. The environmental and social costs associated with mining are well documented. In response, many mining operators have made substantial progress in addressing these impacts through improved commitments, performance, and reporting on environmental, social, and governance issues. Yet many challenges remain, for example, the disconnects between corporate level commitments and performance on the ground, and the alignment of project-level environmental and social impact assessments (ESIAs) with the need for larger-scale, strategic approaches. As such, significant gaps remain between even the best performing companies and

1 *Anglo American, Vale, BHP, and Rio Tinto announced record dividends in 2021.*

societal needs and expectations on multiple environmental and social criteria (RMF 2020).

The need for progress is particularly urgent on the challenge of addressing carbon emissions. According to the Responsible Mining Index Report 2020 (RMF 2020), less than a quarter of mining companies had publicly engaged in any form of climate scenario analysis. Reduction commitments, when they have been made, generally fall way short of the 40–70 percent reductions needed to meet the Paris Agreement goal of 2°C. Furthermore, they almost exclusively focus on direct (Scope 1) and some indirect (Scope 2) emissions (Delevingne et al. 2020).

Mining in forests represents a particular challenge that is both poorly understood and rapidly growing. In 2019, a World Bank report (2019a) showed mining in forests accounted for almost half of all large-scale mining, potentially influencing 10 percent of all forest, and was increasing quickly—particularly in response to demand for minerals essential for green technology, many of which are found in forested areas. The report highlighted that the impacts of mining on forests could be extensive, extending many kilometers outside the mine footprint through land use and behavior changes, but they often go largely unaddressed. Given that forests contain 80 percent of global biodiversity, provide 75 percent of fresh water, hold 20 percent of global carbon, and support over 2 billion people, the environmental and social implications of mining in forests are huge. As the pressure from mining on forests grows, the report called for a new "forest smart" approach to mining from companies, governments, and finance.

Nature-based solutions (NbS) represent an important tool for meeting environmental and social targets, particularly in forested landscapes. NbS are actions that use nature to address societal challenges through the conservation and protection, sustainable management, and/or restoration of natural or modified ecosystems. NbS approaches have been viewed with skepticism by some, either because they can be perceived as an excuse to maintain business as usual or because they can be complicated to implement. However, interest in NbS from a climate perspective has been growing in recent years following realization that NbS could represent a cost-effective approach to meet up to 40 percent of the Paris Agreement emission reduction goals while simultaneously contributing to biodiversity, water, and social development targets. This was realized during COP26, where the importance of protecting, conserving, and restoring nature and ecosystems to achieve the Paris Agreement temperature goal was officially acknowledged for the first time and included in the final decision text, published at the end of the summit. With the development of carbon markets also offering new opportunities for financing NbS, many companies now incorporate NbS offsets into their environmental and social policies (Griscom et al. 2017).

In parallel to the UN Climate Convention's "net zero" emissions goal there is a global call for the world to become nature positive.[2] This requires urgent and sustained action across all sectors to halt and reverse nature loss by increasing the health, abundance, diversity, and resilience of species, populations, and ecosystems. NbS have the potential to play a critical role in delivering nature-positive goals.

The uptake of NbS within mining projects has been limited to date, but this could be set to change. While some companies have made bold commitments to NbS, application of NbS in the mining sector remains relatively low. Mining projects often include "NbS-like" activities related to site-level infrastructure, reclamation, biodiversity conservation, or community development, but such activities are generally approached in a siloed and uncoordinated manner. This is despite mining being a land use–based, carbon-intensive industry for which NbS have high potential. This is particularly true for mining projects in forested landscapes, where forest-based NbS approaches could tie together various social and environmental approaches, bringing significant carbon, biodiversity, and community benefits.

Access to appropriate financing and funding for NbS is not yet obvious. Financial flows to conserve nature are hugely outbalanced by financing targeted to activities that are directly harmful to biodiversity. Financial institutions themselves have little direct impact on nature but are funding destructive activities in many sectors such as agribusiness and fisheries, extractive industry, infrastructure, and urban development, not to mention the harmful effects on ecosystems of human-induced climate change (WWF and The Biodiversity Consultancy 2021). Only a fraction of this global investment is being mobilized under appropriate conditions for environmental safeguarding and nature protection. Knowing where and how to tap into appropriate funding or project financing is key for enabling the delivery of NbS.

This guidance introduces the concept of NbS, explores the business case, financing, and funding for NbS on mining projects, and outlines the steps required to implement NbS. This guidance was developed by Fauna & Flora International (FFI) and Vivid

2 *"A Global Call for Nature," Nature Positive, accessed October 2021, https://www.naturepositive.org/; G7 2030 Nature Compact, Cornwall, UK, 2021, https://www.consilium.europa.eu/media/50363/g7-2030-nature-compact-pdf-120kb-4-pages-1.pdf.*

Economics under contract to the World Bank and under the supervision of an advisory committee comprising representatives from the mining, finance, academia, and conservation sectors. Aimed predominantly at an audience of mining project developers, but with relevance to financiers and regulators of mining projects, the guidance covers the following:

1. What are NbS and why are we talking about them now?
2. Why should NbS be relevant to mining projects?
3. How to develop the business model and identify the financing options for NbS on a mine site
4. How to design an NbS according to the NbS principles
5. Case studies for the development of NbS on mining projects in forested landscapes

The guidance is structured in five sections following this introduction:

Section 2 introduces NbS, what they are, the sorts of problems NbS can help address, and the challenges for application. The evolving business case for NbS is presented, particularly in relation to the role of NbS in mitigating climate change and the development of a carbon market, and consideration of how business, finance, governments, and civil society sectors are responding to NbS.

Section 3 considers the relevance and growing importance of NbS in mining projects and the potential for NbS to be part of the solution when addressing challenges common to mining projects.

Section 4 guides mining companies, and more specifically their project development, commercial, and finance teams, in understanding the wide range of financing and delivery options for implementing NbS, with a focus on third-party financing and funding. The section lays out how extractive industries currently finance and deliver their NbS projects, and then it discusses financial instruments and associated risk mitigation tools available to mining companies, as well as new sources of finance and funding.

Section 5 focuses on innovative financing solutions for NbS, considering the various objectives that different potential sources of finance might have, for example, donors, impact investors, multilateral lenders, and commercial investors. It explores options relevant to different stakeholders in a project and some of the different instruments available.

Section 6 looks at the integration of NbS into mining projects. Using the main criteria of the IUCN Global Standard for NbS, this section outlines the main considerations required to apply NbS associated with a mining project.

The guidelines have been piloted with four mining operations located in diverse sociopolitical, environmental, and geographical contexts. A supplementary report summarizes the case studies, providing practical examples of existing NbS already under implementation and the possible opportunities that may exist for NbS in the future.

2. AN INTRODUCTION TO NATURE-BASED SOLUTIONS

Source: © Pixabay, Atardecer-playa-tropical

What are NbS and why are we talking about them?

NbS is an umbrella term for a multitude of similar labels, including natural Climate Solutions (NCS) - NbS activities that focus on the challenge of climate change.

Nature-based Solutions involve working with and enhancing nature to address societal challenges. The concept is grounded in the knowledge that healthy, biodiverse and functioning ecosystems, are fundamental for human wellbeing and a wide range of services we rely on. Substantial benefits for climate, biodiversity and socioeconomic outcomes.

2.1. Key Messages

1. ***Nature-based solutions (NbS) are activities that work with natural systems to address societal challenges.*** *They are based on the principle that healthy natural systems generate a range of services that benefit people. The term "nature-based solutions" is an umbrella term for a multitude of similar labels, including natural climate solutions—NbS activities that focus on the challenge of climate change.*

2. ***NbS approaches are typically applied to issues related to climate, biodiversity, and water,*** *but they can equally be applied to issues of social development, health, poverty reduction, employment, and well-being. A well-designed NbS will address multiple challenges simultaneously.*

3. ***The range of activities that can be classified as NbS*** *is wide and includes activities to prevent the loss of natural systems, activities to manage natural systems better, and activities to restore or generate new natural systems.*

4. ***In theory, NbS approaches can be extremely cost-effective in delivering multiple benefits at scale.*** *But numerous barriers have prevented NbS from being applied at scale. First, the economic frameworks used to assess NbS often work against them. Second, if NbS are implemented poorly, that can lead to numerous valid criticisms, including facilitating "business as usual" or negatively impacting local communities. Third, the methods used to monitor, measure, and verify the results of NbS can be perceived as complex and limiting.*

5. ***NbS approaches have been used for millennia, but they have been gaining increased attention*** *for three key reasons:*

    - *Developments in the understanding of how NbS could contribute to mitigating climate change, particularly as the role of carbon sequestration becomes more important to hit "net zero" targets by 2050*

    - *Developments in the markets for services from NbS, specifically carbon but to some extent in other environmental services, too, making NbS a more financially viable option*

    - *Developments in the methods, tools, and technology for implementing NbS, making it easier to distinguish "good" NbS from "bad" and making implementation more practical*

6. ***NbS approaches deliver multiple values.*** *While climate contributions are one of the key benefits, NbS approaches that do not clearly contribute to climate change may still be very valuable for achieving multiple other environmental and social goals.*

7. ***The significant ramping up of ambition across all sectors is in response to the convergence of extraordinary environmental changes, with unprecedented engagement from the private and financial sectors.***

    - *In the private sector, there is recognition of financial risks and opportunities resulting from environmental change and of NbS as a potential response.*

    - *In the financial sector, the amount of money flowing toward NbS remains small, but significant movements to "green finance" and to "finance green" are under way. Climate risk remains the main focus of environmental interest, and interest is growing in treating natural capital as a new asset class.*

    - *NbS are increasingly well supported by governments through international agreements, notably the Paris Agreement and the Convention on Biological Diversity, and are being reflected at the national level as countries integrate NbS into climate strategies.*

    - *Many civil society groups recognize the potential for NbS to bring together climate, biodiversity, and sustainable development targets and to harness climate finance to drive cross-cutting change. However, there are also significant voices in opposition to NbS who focus on the role of NbS in combatting climate change and the ways it is implemented, monitored, and verified.*

2.2. What Are NbS?

In the modern world, many challenges are met by using an engineered or technological solution. NbS represent a complement, or an alternative, to such approaches. As defined by the International Union for Conservation of Nature (IUCN) they cover *"actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits"* (IUCN 2016). Alternative definitions are in use too—the European Community uses a broader definition including actions "inspired" by nature (Maes and Jacobs 2017)—but in essence NbS mean working with natural systems to provide solutions to societal problems. They are based on the principle that healthy natural systems provide a range of services that have value to society, and that maintaining or restoring these systems can be one of the most cost-effective and beneficial ways of generating or protecting these services (Box 2.1).

The term "NbS" is an umbrella phrase encompassing a variety of alternative phrases and acronyms that describe similar approaches. This includes, for example, ecosystem-based adaptation, ecosystem-based mitigation, eco-disaster risk reduction, and green infrastructure. Natural climate solutions (NCS) is another term commonly used to describe actions that use nature to address climate challenges. In this report, we use NbS as the general term referring to all approaches using nature to address specific problems.

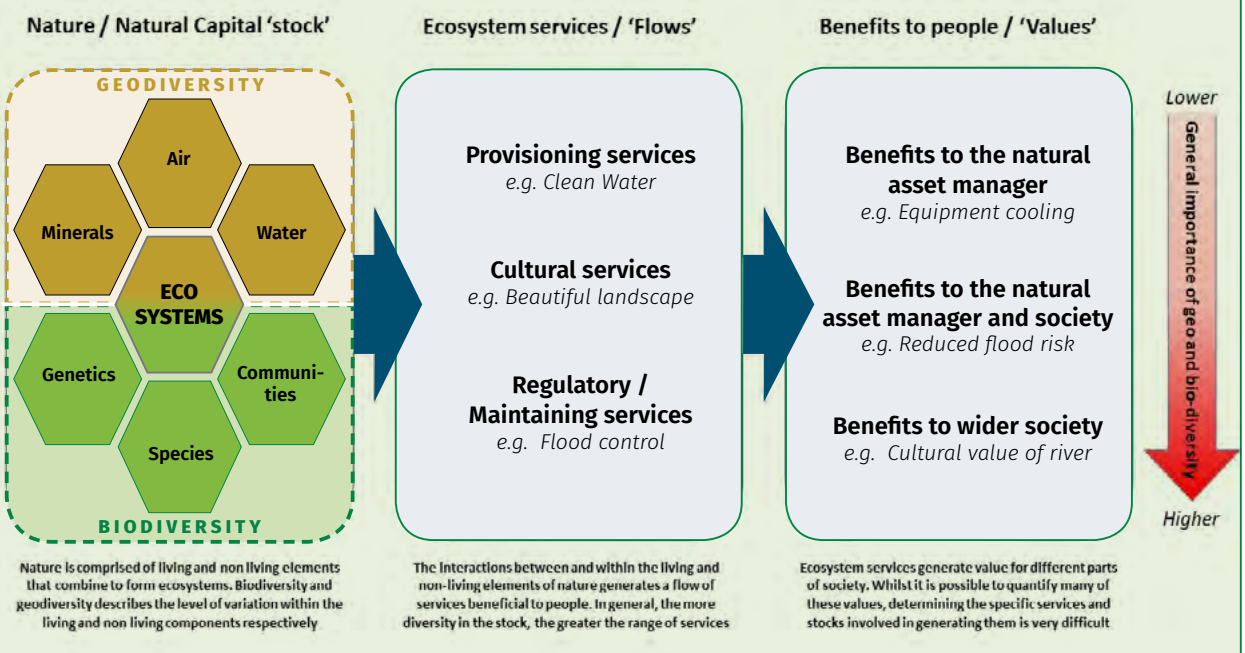
Box 2.1: The Underlying Ecological Principles of NbS

Nature-based solutions (NbS) are based on the principle that natural systems (or "natural capital") generate a range of goods and services ("ecosystem services") that can benefit society. These services range from direct provisioning goods (for example, fresh water, food, fibers) to indirect supporting services (for example, flood mitigation, climate regulation, pollution removal). The larger and the more biodiverse the natural capital that generates these goods and services, the greater the range of services generated and the more resilient they are to change.

Every aspect of human society depends on nature and the services it generates to some degree, and most human activities impact natural systems at some level. But the levels of dependency and impact, the degree of overlap between who is most dependent and who is most impactful, and the tolerance of natural systems to change, vary greatly.

Mining projects are one example of where the discrepancies between impact and dependency exist. For a sector that is land use based, most mining projects will have comparatively low direct dependence on living natural capital. There may be dependence on the continued provision of fresh water, or the capacity of local ecosystems to filter pollutants generated from the mine, and there may be longer term sensitivity to the impact of climate change on the feasibility of mining a given site. However, compared to an agribusiness project, dependence on natural capital is relatively low. Dependency of local communities on natural capital, on the other hand, is often high, particularly for projects in developing countries and those in forested landscapes. Dependency can rely on direct provisions—food, water, or fuel—or on the services natural systems provide.

The balance of impacts tips in the other direction. Mining projects generally have vast impacts on natural systems, both through the initial mine footprint and production waste, but also through secondary impacts of population influx or behavior change that can extend 70 kilometers or more across the landscape (World Bank 2019a; Sonter et al. 2017). The impacts of local communities without connection to the mine can also be significant, but they are generally far more insignificant in a landscape dominated by a major mining project. The result is a major mismatch in impacts and dependencies on the environment. NbS are one way mining projects can both address their own impacts and improve the situation of local communities.



Source: IUCN

2.3. What Sorts of Problems Can Nbs Help Address?

NbS approaches can be applied to a wide range of challenges, often contributing simultaneously to more than one. Society's top challenges are summarized by the 17 Sustainable Development Goals (SDGs). The World Wide Fund for Nature (WWF) published a report demonstrating evidence of nature-based projects contributing to every single one (Figure 2.1). For an overview of challenges more specific to mining projects, and the potential for NbS to play a role in the solution, see section 3.

Figure 2.1: How NbS Can Contribute to the Sustainable Development Goals

Source: Adapted from Osieyo 2020.

2.4. What Kinds of Activities Count as NbS?

When thinking about NbS, most people immediately think of planting trees or about approaches to reduce deforestation (such as REDD+[1]). However, the range of activities that could be classified as NbS is much wider (Somarakis, Stagakis, and Chrysoulakis 2019), with activities generally fitting into one or more of three approaches:

1. **Conservation and protection** of ecosystems (such as forest protection, conservation of mangroves)
2. **Improved and sustainable management** of ecosystems (such as sustainable forestry, community agroforestry, improved agricultural methods)
3. **Restoration of ecosystems** (such as rangeland rehabilitation, reforestation/afforestation)

Ultimately, determining whether an activity in each of these categories counts as an NbS or not depends on how it is approached (see also section 6). Table 2.1 illustrates example NbS activities and how they compare. The greenhouse gas (GHG) mitigation ranking refers to an analysis by Griscom et al. (2017) quantifying the potential for different NbS activities to contribute to climate change mitigation (either through avoided emissions or carbon sequestration). In the absence of more formal analysis for other impacts, activities are ranked by the authors. For a more extensive review, see the Nature-based Solutions Initiative Evidence Platform or the Nature4climate Atlas.

1 *REDD+ is a framework created by the UNFCCC to guide activities in the forest sector that Reduces Emissions from Deforestation and forest Degradation (REDD) and sustainable management of forests and enhancement of forest carbon stocks (indicated by the "+").*

Table 2.1: Activities That Could Be Defined as NbS and Their Relative Importance for Climate Change Mitigation

Category	Activity	GHG mitigation ranking[a]	Biodiversity impacts[b]	Water impacts[b]	Social impacts[b]
1. Protect	Avoided deforestation	2	XXX	XXX	X
1. Protect	Avoided grassland conversion	13	XXX	XX	X
1. Protect	Avoided mangrove impacts	11	XXX	X	X
1. Protect	Avoided peatland impacts	8	XX	XX	XX
2. Manage	Biochar	4	X	X	X
2. Manage	Grazing regimes	12	XX	X	XX
2. Manage	Improved forest management	3	XXX	XXX	X
2. Manage	Improved rice cultivation	12	XX	XX	X
2. Manage	Nutrient management	9	XX	XX	X
2. Manage	Trees in agricultural land	5	XXX	XX	XX
2. Manage	Wood fuel harvest	10	XX	X	XX
3. Restore	Coastal restoration	6	XXX	X	XX
3. Restore	Forest restoration	1	XXX	XXX	XX
3. Restore	Peatland restoration	7	XXX	XXX	X

Source: Based on the categories used by Nature4Climate, https://nature4climate.org/n4c-mapper/.
Note: Relative contribution to biodiversity, water, and social impacts indicated by X (lower), XX, and XXX (higher). GHG = greenhouse gas.
a. Based on estimates by Griscom et al. 2017.
b. Based on ranking by the authors.

2.5. What Are the Challenges to NbS?

NbS, if implemented well, have the potential to address a wide range of environmental, social, and development challenges. Yet in practice NbS face numerous challenges and criticisms. Key challenges are considered below, while Table 2.2 summarizes some of the pros and cons.

2.5.1. The Challenge of Establishing the Economic Case for NbS

The failure of our economic systems to adequately incorporate environmental values and the implications this has for the state of our environment are well recognized (Dasgupta 2021). The same challenges apply to the economics of NbS, particularly at a project level, and are the key reason NbS approaches are not more widespread. At a macro level, NbS should make clear economic sense: The total costs incurred when protecting or restoring natural systems are usually clearly outweighed by the benefits if the full range of benefits are considered (Seddon, Chausson, et al. 2020). These would include not only the specific benefit the project was set up to provide (such as flood prevention) but also the range of additional services generated for multiple beneficiaries, such as carbon sequestration (a benefit to the global community), biodiversity values (a benefit to the global/regional community), and clean water and local livelihood opportunities (benefits to the local community; see Box 2.2). However, this favorable cost-benefit balance often fails to materialize. Three reasons account for this:

1. Many of the benefits flowing from NbS may go unnoticed because of challenges in understanding, recognizing, and quantifying the multiple values generated from natural systems. For example, until recently the carbon sequestration benefits generated by peatlands were completely unrecognized. Often benefits are not noticed until they are gone.

2. Even when values are recognized, often no price is associated with them. Assigning prices to benefits is not the only way of recognizing their value, but an absence of a price and market to pay for them can lead to undervaluation. This is changing for carbon and to a much lesser level for some water and biodiversity values, but overall many of the benefits generated by NbS go unpriced.

3. The costs and benefits are often shared unequally. If it falls to one party to shoulder the full costs of an NbS project, while multiple parties share the benefits, then the implementing party might

rationally decide that a cheaper alternative with fewer broad benefits makes more economic sense from their perspective.

Box 2.2: Case Study: Business Supports Enterprises That Value Forests and Sustainable Land Use

The mining company Vale applies nature-based solutions (NbS) to meet legal and compliance objectives and corporate commitments for biodiversity and forest conservation and to generate positive social impact through job creation and collaboration with local communities and Indigenous People. Funding for NbS is sourced from both balance sheet and the Vale Fund. Vale created the Vale Fund 10 years ago as a voluntary investment action to act in critical biomes. Its strategy is based on strengthening businesses with a positive social and environmental impact and offering financial instruments to enterprises that value standing forests, forest restoration, and sustainable land use, with a focus on low-carbon production chains.

2.5.2. Challenges Arising from Inappropriately Implemented NbS

The most common criticisms of NbS stem from projects being inappropriately implemented—at the wrong time, in the wrong place, or in the wrong way. A key criticism is that NbS can be an excuse not to carry out more important or effective activities—in effect, greenwashing. For example, a government or a company might choose to invest in NbS as a high-profile, visible action while failing to address its own emissions or impacts on biodiversity. In other words, the NbS are not being implemented at the appropriate point of the mitigation hierarchy. The mitigation hierarchy is a framework for addressing impacts through avoidance, minimization, restoration, and compensation. It is a hierarchy of steps that prioritizes the avoidance of adverse impacts first and foremost, followed by the minimization and restoration of impacts. The steps of the mitigation hierarchy should be applied iteratively and often simultaneously.[1] NbS activities that focus on restoration or compensation should never be used in preference to avoidance and minimization.

This criticism is particularly relevant for NbS focused on tackling GHG emissions. To meet global targets on climate change, the overwhelming changes that need to be made focus on the reduction of current emissions. There are concerns that some companies are using NbS as a cheap way to sequester carbon while failing to address the far larger emissions resulting from the rest of their business (Perez-Cirera 2020). The use of NbS to continue within a business-as-usual model that fails to prioritize the avoidance and minimization of adverse impacts is a fundamentally flawed approach that further risks undermining the perceived value of NbS measures. NbS do have an increasingly important *complementary* role to play in climate strategy (see section 2.6.1), but they cannot be applied *in place* of emission reduction strategies.

NbS approaches that have taken a myopic approach to benefits, focusing on a single benefit at the unwitting cost to others, have also been criticized. Such projects miss the opportunity of having wider positive impact and can have serious unintended negative consequences. For example, a fast-growing, non-native, monoculture plantation forest might be one of the best seminatural solutions for fast carbon sequestration, but it can have strongly negative impacts on biodiversity, water provision, and cultural values (Seddon et al. 2019). Similar criticisms relate to the social impacts of NbS. Implemented well, in consultation and coordination with local stakeholders, NbS can contribute directly to many social goals, but poor implementation can lead to various negative results, particularly in the context of mining, given that NbS require land for implementation (Forest Peoples Programme 2020) and competition for land use could arise. This has been the case for a small number of REDD+ projects that were developed without due consideration for local communities (Hajjar, Enbring, and Kornhauser 2021). This can lead to negative impacts on other beneficial land uses, such as food production, or by infringing on the rights or livelihoods of people that live in the area (Griscom et al. 2017; WWF 2020b).

2.5.3. Challenges Related to the Complications of Implementation

Further concerns focus on the complexities of implementing NbS, some of which arise from unfamiliarity. For example, while NbS projects can be far simpler to implement than highly engineered alternatives, they often rely on completely different skill sets. They can also be harder to raise finance for, with finance systems better adapted to funding more familiar "gray infrastructure" projects (see Box 2.3 and section 4).

Additional complexities arise when attempting to quantify or verify the benefits generated. Some of the science underpinning NbS, such as calculations of how

2 *For more information, see Biodiversity Consultancy (2015).*

much carbon is sequestered by an activity, is evolving rapidly, but it often remains relatively inexact, and the data required can be difficult to obtain. Many projects face complications in addressing additionality (did the activity truly make a difference, or would the same results have happened anyway?), permanence (are the benefits permanent, or is there a risk they will disappear again?), and leakage (did the activities simply displace the problems elsewhere?) (see also section 6.15). Several methods have been developed for addressing these, but they can make the implementation of NbS complex (Seddon, Chausson, et al. 2020).

Finally, concerns exist around the philosophical, political, and moral ramifications of NbS, particularly if environmental markets are involved. It has been argued that the reframing and commodification of our relationship with nature and the offsetting of economic activity is a way of bending environmental concerns to fit with business-as-usual approaches when we should be focusing on changing our economic and political systems to fit with an environmental system that has finite limits (Damiens, Porter, and Gordon 2021; Apostolopoulou and Adams 2017).

Box 2.3: Green versus Gray Infrastructure

The relationship between nature-based solutions (NbS) and gray infrastructure, or engineered solutions used to build resilience, is an important one. Much of the argument in favor of NbS focuses on how efficiently natural systems can perform services that benefit people compared to engineered solutions providing the same function. In many cases this is true. There is consensus that NbS can offer protection from multiple hazards, provide co-benefits in addition to their climate mitigation capacity, can survive certain natural events, and have the ability to repair themselves at no cost. A study of coastal defense options in the United States showed natural systems were 2–5 times more cost-effective than engineered solutions (Narayan et al. 2016).

But NbS activities also have vulnerabilities. When adapted to local conditions, they can be very effective, and biodiverse systems in particular can be very resilient to change, but there is still need for an increased understanding of their ability to cope with extreme events, their performance under different conditions, or when conditions pass a tipping point. Their long-term economics are also still being worked out, and they generally require more time and space to become effective.

By comparison, gray infrastructure is a known quantity, with considerable expertise to deliver and a clear understanding of the economics and associated costs. They also offer defined and immediate benefits. However, they are not dynamic and only offer single solutions to single issues, with a lack of any co-benefits. They do not include or contribute to the natural systems or to the socioeconomic systems of the area. They require ongoing financial input and costs and will ultimately fail over time.

In many cases, the best solution may be a combination of NbS and engineered solutions, particularly in a multifunctional landscape where they can work together to form a hybrid approach that is effective over both the short and longer term, with each intervention having its own specific costs and benefits (Griscom et al. 2017; Seddon 2018).

Table 2.2: Pros and Cons of Nature-Based Solutions

Pros	Cons	Example
Often make clear economic sense at a macroscale in total benefits generated vs. total costs incurred	Often fail to make economic sense at the level of implementation due to limits of understanding, lack of environmental prices, and inequitable cost/benefit distribution	Large-scale REDD+ projects driven by jurisdictional objectives work if they meet local outcomes due to high transactional costs and project delays in implementation
Can form a key pillar of strategies to address environmental impacts if used in accordance with the mitigation hierarchy	Can undermine other efforts to address environmental impacts if not used in accordance with the mitigation hierarchy	Offsetting impacts to biodiversity as a final resort after the application of the mitigation hierarchy can result in positive outcomes for biodiversity; however, in the absence of the mitigation hierarchy, offsets result in perverse outcomes and license to trash
Can generate a lot of high-profile goodwill among stakeholders	Can be seen as greenwashing if used as an excuse to not address impacts elsewhere	Development of nature-based livelihoods for local communities provides co-benefits of NbS for biodiversity and ecosystem services; however, without adequate environmental impact mitigation, actions may be linear and unsustainable
Can generate multiple benefits simultaneously if implemented in a balanced way	Can cause unintended impacts if the focus is on a single service	Protection or restoration of ecologically rich biodiversity forest systems delivering ecosystem services versus delivery of a carbon sink with monoculture afforestation
Can provide livelihood and income options for local communities if implemented well	Can have negative impacts on local communities if implemented poorly	Forests in mountain ecosystems provide a diversity of services and goods. NbS ecological restoration protecting watersheds in mountain landscapes can improve soil stability and water provisioning services; however, it may subsequently require a loss of timber production and altered livelihoods for local communities.
Can make efficient use of previously unproductive land	Can compete with alternative land uses such as food production	Rangeland rehabilitation has multiple, sometimes conflicting goals, such as the re-establishment of the pre-disturbance vegetation, soil protection, carbon sequestration and forage production. Where poorly planned, this may compromise livestock farming (e.g., as in the Succulent Karoo biome, South Africa)
Generally simple to implement without access to specialist technologies	Often rely on different skill sets to those available and can be complex to verify and monitor the benefits in the short term	Habitat management to enhance carbon sequestration potential through destocking of livestock may be simple, whereas longer-term outcomes for nature may require specialist input to design complex ecosystem restoration to regenerate composition, structure, and function of an ecosystem to deliver ecosystem services that may be difficult to justify in the short term but demonstrably beneficial in the long term

Pros	Cons	Example
Can often provide an environmental service more efficiently and cheaper than engineered alternatives	Can be less reliable, predictable, or slower to implement	Wetland system water purification and attenuation or a natural forest watershed reinstatement and restoration that may take a decade to mature to full production capacity compared to a reverse osmosis water treatment facility
Can be much cheaper to implement than other alternatives	Can be harder to raise finance for than projects with which financiers are more familiar	Land purchase to protect threatened forest for biodiversity and ecosystem services, such as water provision, climate regulation, and non-timber forest products, compared to buying the land for timber harvesting and clearance for agricultural production
Can be financed by the growing environmental markets (e.g., carbon)	Finance derived from environmental markets distorts the motivations for environmental protection	Protection or restoration of ecologically rich biodiverse forest systems delivering ecosystem services vs. delivery of a carbon sink with monoculture afforestation. The price of carbon distorts the values of the ecosystem services and the value of protecting the natural capital in the first place

2.6. How Has the Application of NbS Evolved?

NbS are far from a new idea—arguably, people have been working with nature to address a variety of challenges for millennia. They have been an important component of policy and business responses to environmental challenges for several decades. Yet for a number of years, NbS have been stuck in a "chicken and egg" dilemma: Demand has been limited by the concerns outlined above, while supply is limited by the absence of clear demand (WEF 2021a). Recently, three important developments have people talking about the business case for NbS in a new way:

1. Understanding of the role for NbS in attempts to mitigate climate change
2. The development of carbon markets and their applicability to NbS
3. Development in the approaches, methods, tools, and data for implementing NbS

This reframes NbS as a key tool for addressing climate change, making NbS more economically attractive through access to climate finance and more practically feasible by providing clear guidelines on implementation supported by improved tools, data, and methodologies.

2.6.1. Changing Positions on the Role of NbS in Mitigating Climate Change

There has been reluctance to embrace NbS as a significant tool for tackling climate change given concerns that benefits can be difficult to verify and that NbS risk displacing activities focused on emission reductions. However, it is becoming increasingly clear that there is no clear path to deliver climate mitigation that does not include NbS at some level. The Paris Agreement targets a maximum temperature rise of "well below" 2°C and to "make efforts" to keep it below 1.5°C by 2050. Various pathways have been mapped for different sectors and all show an urgent need to drastically reduce emissions. At the same time, there is growing recognition of the need to complement the reduction of "positive emissions" with an increase in "negative emissions"—in other words, the removal of 7–8 billion tCO_2e per year from the atmosphere (WEF 2021a; ETC 2017).

A key focus of global climate discussions is on the achievement of "net zero," meaning any emissions emitted are balanced by emissions taken out of the atmosphere. The Intergovernmental Panel on Climate Change (IPCC) has calculated global emissions need to reach net zero by the middle of the century if we are to meet the 1.5°C target (IPCC 2018). Various countries have adopted net zero targets (see section 2.7.3), and numerous non-state actors, including companies, are following suit (see section 2.7.1).

NbS has a significant role to play in both reducing positive emissions and increasing the negative emissions required to reach net zero. About 25 percent of global emissions come from changes in land use (formerly referred to as emissions from agriculture, forestry, and other land use, or AFOLU). Therefore, NbS approaches such as REDD+ or improved and regenerative agriculture

have a major role to play in reducing emissions. For carbon removal, much of the focus up to now has been on two technological solutions: bioenergy with carbon capture and storage, and direct air carbon capture and storage. Both approaches attract significant controversy and debate. Yet NbS approaches such as reforestation, particularly in the tropics, have the potential to sequester vast volumes of carbon (see Figure 2.2) (Griscom et al. 2017), with some estimates identifying potential for "a trillion trees" to be planted globally (although calculations of how much carbon this would sequester remain hotly debated) (Veldman et al. 2019; Skidmore et al. 2019; Bastin et al. 2019; Cook-Patton et al. 2020).

It has been calculated that NbS activities have the potential, through a combination of avoided emissions and carbon sequestration, to abate emissions by 7–10 $GtCO_2e$ per year, which represents at least a third of the 23 $GtCO_2e$ net emission reductions required to get on a pathway to 2°C/1.5°C by 2030. About 60 percent of this would come from reduced emissions and 40 percent from carbon sequestration, with the highest potential for activities lying in the global south. Most could be delivered at a relatively attractive price point of $10–$40/tCO_2e (Griscom et al. 2017; WEF 2021a).

Figure 2.2: Potential for NbS (NCS) to Deliver a Third of the Emission Reductions Required by 2030

2.6.2. The Impact of Carbon Market Development on NbS

Rapid development in the market for carbon has made NbS activities incorporating climate targets increasingly financially viable. The carbon market is now worth in excess of $275 billion, with some projecting it will become the largest commodity market in the world (Mace 2021). Compliance or regulatory markets—those defined by laws regulating carbon emissions, such as the Clean Development Mechanism (CDM) or the European Union (EU) Emissions Trading System (ETS)—now exist in 39 countries and are by far the largest markets for carbon, worth in excess of $200 billion (Box 2.4).

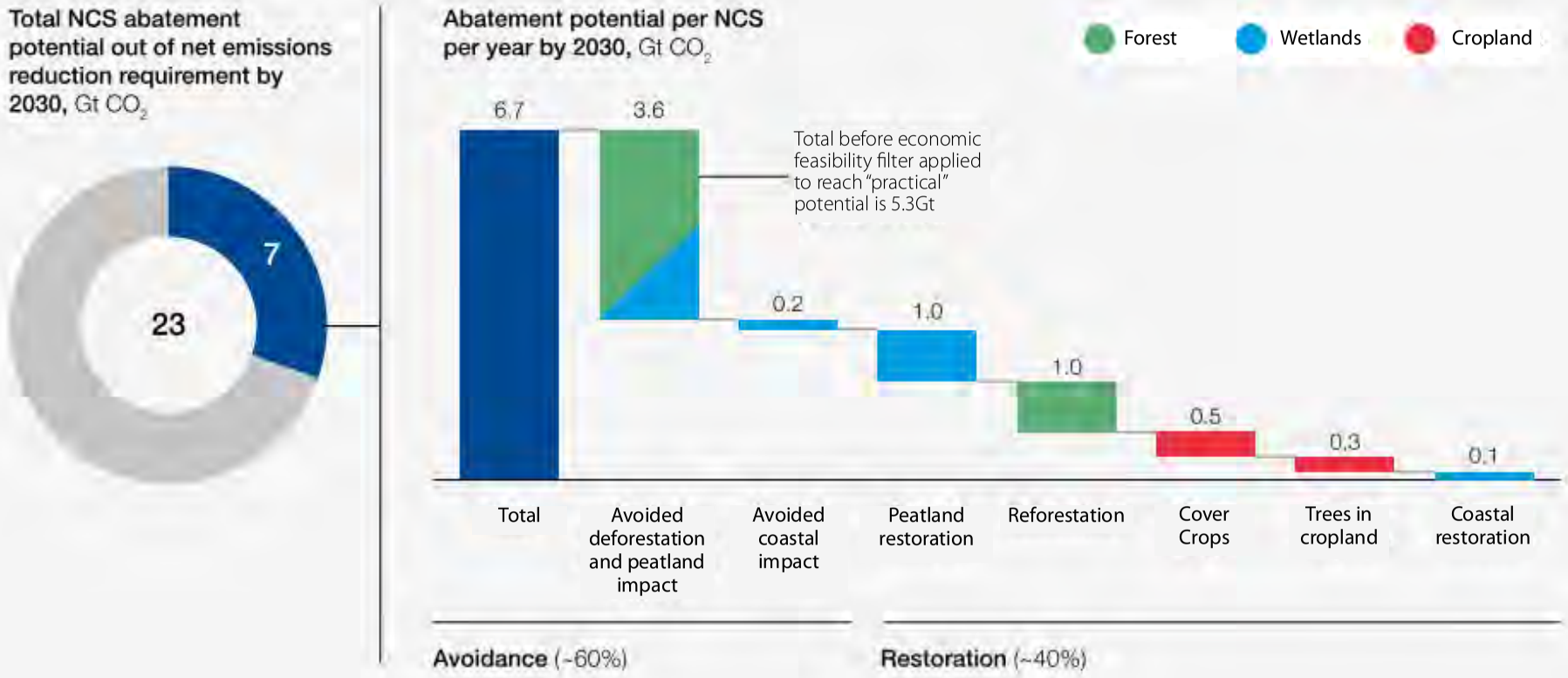
Voluntary markets—where traders voluntarily trade carbon credits to meet self-imposed targets and commitments—are a fraction of the size of the compliance market ($0.6 billion/0.01 percent), but they have grown markedly in recent years. This growth is expected to continue, particularly following the recommendations of the Taskforce on Scaling Voluntary Carbon Markets (TSVCM 2020). The interaction between both forms of market is key—the compliance markets are where the scale required to correct market failures and drive global change can be found, but the voluntary markets allow the testing of new ideas, unregulated sectors to be reached, and businesses to demonstrate leadership (WEF 2021a; WBCSD 2019).

Currently, most of the market potential for carbon credits generated by NbS lies in the voluntary market, serving companies seeking to meet voluntary commitments. Increased demand for such credits has led to significant growth in the voluntary market, with credits generated from NbS rising from 5 percent of the market in 2010 to 40 percent in 2019 (Forest Trends' Ecosystem Marketplace 2020; HSBC Centre of Sustainable Finance 2020). Where there used to be a lack of demand for carbon credits generated by NbS, now it is the supply of quality, verified credits that is increasingly lacking.

NbS currently remain ineligible for most compliance markets because of concerns over permanence, leakage, and accounting issues (Seymour and Langer 2021) (see also section 6.15). However, there are signs that NbS will be increasingly integrated into compliance carbon markets.

Some compliance markets already allow limited credits from NbS, including in Australia, California, China, Colombia, and New Zealand. Furthermore, NbS activities have just been approved for limited use in the regulated airline offset scheme—Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)—which legally obliges airlines to offset emissions above a 2020 reference level. This is expected to create additional

Figure 2.2: Potential for NbS (NCS) to Deliver a Third of the Emission Reductions Required by 2030



Notes: [1] The "practical" potential is a portion of the total NCS abatement potential in recognition of the fact that it becomes progressively more difficulty to secure carbon credits as the total potential of each source is approached. It filters out low-feasibility lands, which are more likely to be accessed by mechanisms other than voluntary carbon markets, such as philanthropic or governmental grants. The practical potential sized here is 6.7Gt CO^2 per year by 2030, which excludes 3,5Gt C02 that is low feasibility according to our filter. The total potential is therefore 10.2Gt $C0^2$. There are many economic, potential and social lenses that can be used to determine feasibility. In reality, these lenses would not draw a neat boundary between lands that are "practical" or not for the voluntary carbon market; however, this analysis classifies low-feasibility lands, assessing their agricultural rent as an economic barrier and proxy for feasibility.

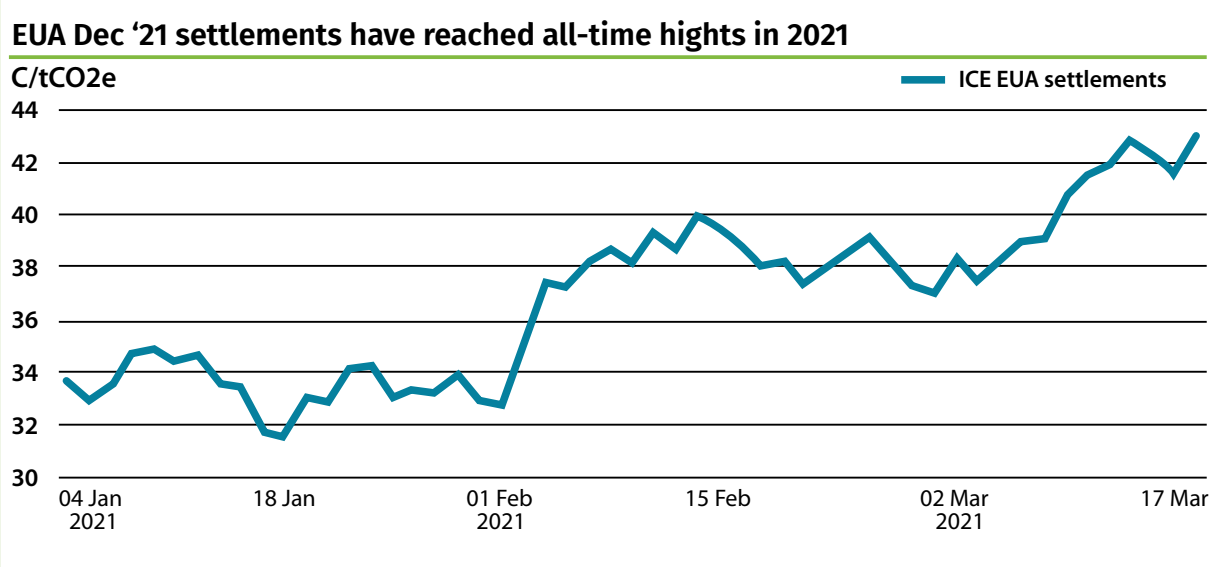
Source: McKinsey Nature Analytics

demand for 2.5 billion tCO_2e over the next 15 years.

The most significant development was the decision on Article 6 of the Paris Agreement, which was finalized at COP26 in Glasgow in 2021. *The agreed Article 6 rules, while not perfect, give countries the tools they need for environmental integrity, to avoid double counting, and ultimately to clear a path to get private capital flowing to developing countries.* Article 6 sets the rules for the Sustainable Development Mechanism (SDM) to replace the CDM as a way for countries to voluntarily cooperate on reaching their climate targets while supporting sustainable development. It is expected that high-integrity NbS will be expected to play a greater role in the new mechanism than allowed under the CDM (see also section 2.7.3). If designed well, the Sustainable Development Mechanism could lead to much greater incentives and finance to implement NbS (HSBC Centre of Sustainable Finance 2020; CI, TNC, and EDF 2019).

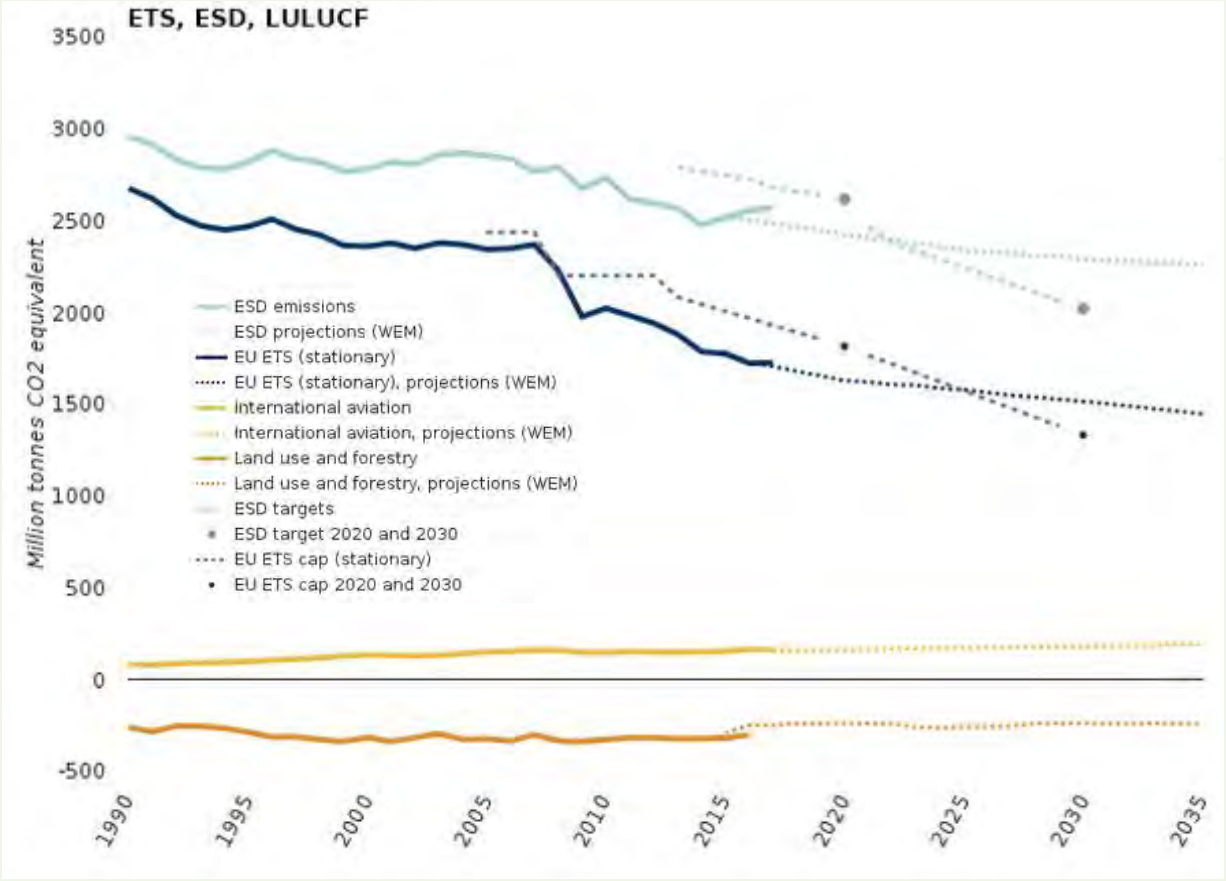
Box 2.4: Case Study: The Rise of the EU Carbon Credit Market

Oil has regained its pre-pandemic highs, lumber has more than doubled in price from last year, and precious metals like platinum and copper are multiplying investors' fortunes many fold. But there's another, more obscure commodity at the beginning of a bull market that could dwarf all the above: carbon credits. The price of a one-metric-ton carbon dioxide emission permit within the EU's ETS has more than doubled from its pre-pandemic levels in 2021.



Source: https://www.icis.com/explore/resources/news/2021/03/18/10619064/energy-markets-align-amid-carbon-volatility.

The EU cap and trade scheme is by far the largest cap-and-trade system in the world, accounting for more than 90 percent of the global carbon credit market and sporting a market capitalization of more than $250 billion. In a meeting of the European Council, the bloc announced plans to cut its carbon emissions by 55 percent by 2030 and by 100 percent (to net zero) by 2050. As demonstrated in the graph below, that would involve a significant reduction in the supply of EU ETS carbon credits.



Source: https://www.eea.europa.eu/data-and-maps/indicators/greenhouse-gas-emission-trends-6/assessment-2.

This supply-side pressure has pushed the price of EU credits past EUR 50 in early May 2021, a key milestone many analysts were waiting for. Fund inflows then sharply quickened. The EU's faith in its own ETS is also being buoyed by similar proposals elsewhere. In the United States the Business Roundtable and the Commodity Futures Trading Commission have both called for the United States to adopt an EU ETS-style national cap-and-trade system. In summary, a combination of fundamental and technical factors is pushing EU carbon credits into a bull market that is likely to continue.

Source: "Ride the Carbon Credit Rally," Energy & Capital, accessed December 15, 2021, https://secure.energyandcapital.com/327656?device=c&gclid=CjwKCAjwndCKBhAkEiwAgSDKQVB1N_uzQCsVmFBOALKVWzG98_g3_38fFrfEHzW6OYZu4MDCmLx2UxoC31gQAvD_BwE.

2.6.3. Developments in the Principles, Methods, and Data Availability for Implementing NbS

The third development that is promoting the uptake of NbS is the development of frameworks, methods, tools, and data supporting the implementation of good-practice NbS. Groups such as Together With Nature, Nature4Climate, and the Nature-based Solutions Initiative have developed a set of overarching principles for what a NbS project should and should not look like (WBCSD 2019; Seddon et al. 2021; Cohen-Shacham et al. 2019). These vary in their wording but can be summarized as follows:

1. NbS should not be used as a substitute for other actions to mitigate environmental impacts, particularly the reduction of fossil fuel use.

2. NbS should always prioritize the protection of existing ecosystems over the generation of new systems.

3. NbS should be socially responsible, respecting local and Indigenous rights.

4. NbS should always be able to demonstrate measurable benefits to biodiversity.

Building on these, the IUCN has now published a comprehensive Global Standard for Nature-based Standards, based on consultations with over 800 experts. Covering eight criteria and 28 indicators, the standard provides a globally accepted set of rules for defining when an activity counts as an acceptable NbS and when it does not (see section 6 for further details).

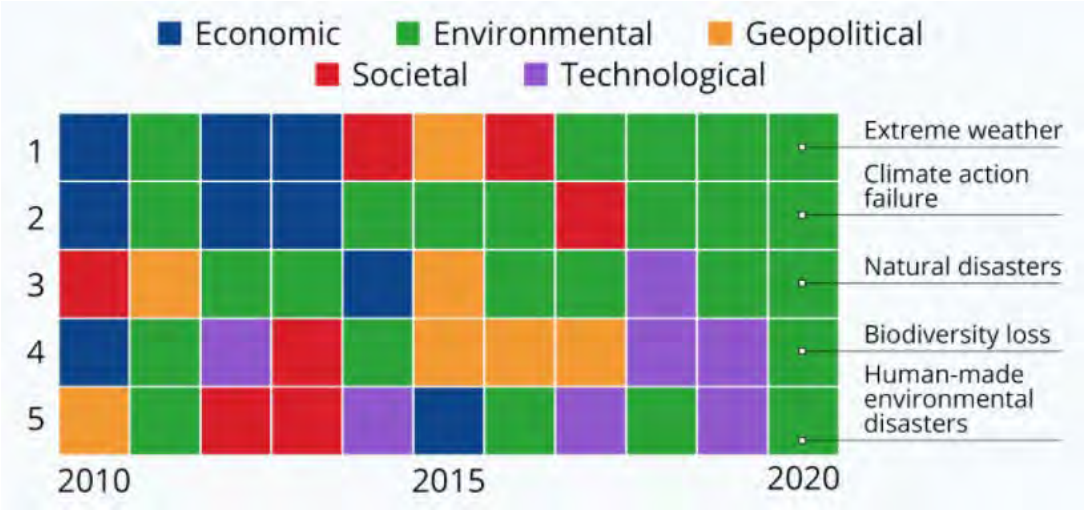
This has been complemented by improvements in the tools and data available to implement NbS. Developments in remote sensing technology and spatial data processing have transformed the cost, quality, and availability of monitoring and verification, while access to data has also been improving. Sites like Global Forest Watch have been providing access to free, high-quality global forest data, and the Norwegian Climate and Forests Initiative has made high-resolution satellite data for the tropics freely available since late 2020. RESTOR, an open source data platform supporting ecological restoration developed by ETH Zurich and Google, is due to come online in the final quarter of 2021.

Academic and environmental institutions are also providing resources to support NbS implementation, presenting the evidence supporting different NbS approaches, the policy context for NbS in different countries across the world, or case studies showing NbS in action (see section 2.7). At the same time, developments in methodologies and verification procedures have progressed for a growing number of activities, addressing various concerns about how NbS might be applied. For example, there are numerous standards for carbon-based activities (Verified Carbon Standard and the Gold Standard, among others), for projects delivering multiple benefits (Climate, Community, and Biodiversity Standards and Plan Vivo, among others), and for projects delivering at different geographical scales (for example, LandScale).[3]

2.7. How Are Key Societal Sectors Responding to NbS?

The rise of environmental risks to society have been well documented. In 2021, four out of five of the top global risks by likelihood were environmental, and the only exception—infectious disease—is widely accepted to have environmental roots (Figure 2.3). While not a silver bullet, when used at the right time, in the right place, in the right way, and in conjunction with the right complementary activities, NbS activities can be an extremely cost-effective, cross-cutting tool that can generate multiple benefits within a wider environmental and social policy. As the business case for NbS application has evolved, private sector, government, and civil society are embracing NbS like never before (Figure 2.4).

Figure 2.3: The Rise of the Likelihood of Environmental Risks over Time



Source: Taken from Statista.com and derived from the World Economic Forum (WEF) Global Risks Reports 2010–2020.

3 *See Verra, https://verra.org/; Gold Standard, https://www.goldstandard.org/; Plan Vivo, https://www.planvivo.org/; and LandScale, https://www.landscale.org/.*

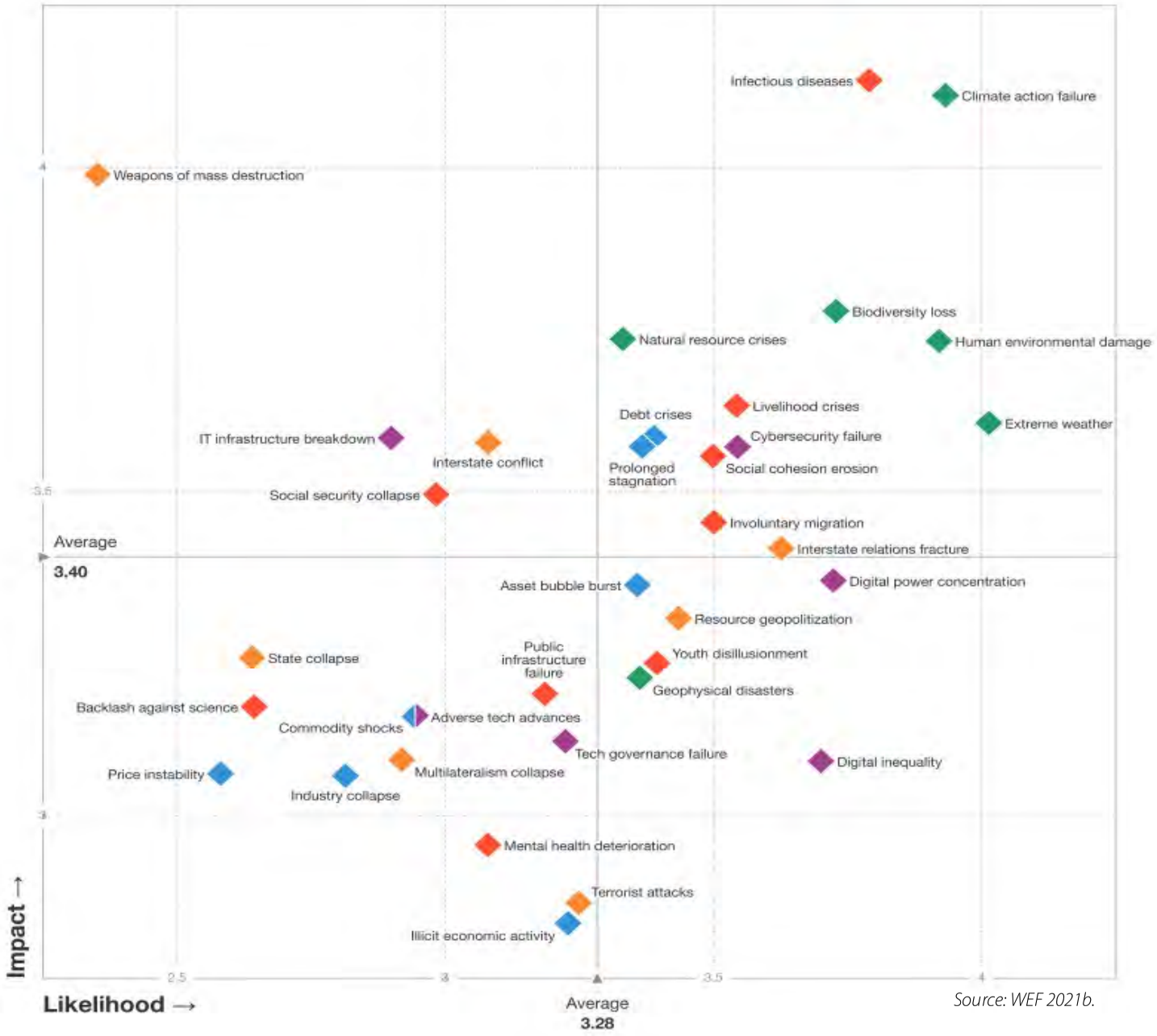
NbS are a fundamental part of the pathway to nature positive and need to become part of a new business as usual. As emphasized in the previous section, NbS and the objective of nature positive must first and foremost be designed around a mitigation hierarchy. As such, NbS should not be used as a substitute for other actions to mitigate environmental impacts and NbS should always prioritize the protection of existing ecosystems over the generation of new systems. Crucially, NbS must address the relationship nature has with all sustainable development issues and goals.

NbS can be nested within an overall "nature positive" framing, where net positive impact (NPI) is delivered at a site and operational level and nature is addressed in the relationship the company has with all sustainable development issues and goals. Nature should be woven into all aspects of society and business, and businesses need to assess and then respond to the protection and recovery of nature in all senses.

Nature positive must be about raw material supply chains, chains of custody, and value chains, and the footprints these chains have on nature in addition to the direct impacts of a project that should be delivering net positive impact on nature. It is about nature-centric decision-making and holistic integrated management approaches that fully apply environmental, social, and governance (ESG) considerations to the role of nature in all aspects of business activities and in the impact these activities have on nature: dependencies and impacts. They are mutually exclusive and cannot be considered or dealt with independently. Herein lies the opportunity for the mining sector to grasp the NbS and innovative financing and funding options to tackle the climate, biodiversity, and water crises.

Figure 2.4: Estimated Likelihood and Impact of Global Risks, 2021

Figure 2.4: Estimated Likelihood and Impact of Global Risks, 2021



Source: WEF 2021b.

Top Risks
by likelihood

1. Extreme weather
2. Climate action failure
3. Human environmental damage
4. Infectious diseases
5. Biodiversity loss
6. Digital power concentration
7. Digital inequality
8. Interstate relations fracture
9. Cybersecurity failure
10. Livelihood crises

Top Risks
by impact

1. Infectious diseases
2. Climate action failure
3. Weapons of mass destruction
4. Biodiversity loss
5. Natural resource crises
6. Human environmental damage
7. Livelihood crises
8. Extreme weather
9. Debt crises
10. IT infrastructure breakdown

2.7.1. Business

Businesses are recognizing both risk and opportunity from the rise in environmental threats and NbS have the potential to play a role in responses to both. It is estimated that $44 trillion of economic value—over half of global gross domestic product (GDP)—is moderately or very dependent on nature and its services (WEF 2020b).

The risks derived from unaddressed impacts and dependencies are numerous: disrupted supply chains, raw material prices, impacts of extreme weather, regulatory and reputational risks, access to resources, access to capital. But where there is risk, there is also opportunity. The estimated benefits that could be derived from positioning a company for a future, low-carbon economy through new customers, new markets, and new sources of capital are huge. The World Economic Forum (WEF) estimates a $3.5 trillion opportunity from business opportunities in just six key system transition areas, of which $2 trillion of opportunities lie within NbS approaches of regenerative agriculture, sustainable management of forests and oceans, and ecosystem restoration and avoiding expansion of land and ocean use (Figure 2.5) (WEF 2020a).

Economic actors have a crucial role to play in shifting their business models "from nature-negative to nature-positive" and in identifying and disclosing their dependencies on nature,[4] and a new economic model and investment in nature has been called for to bridge the financing gap.[5]

The question of how to increase the mobilization and allocation of financial resources from the international financial system and the private sector for global biodiversity framework (GBF) implementation has been debated (IISD 2021). At the IUCN World Conservation Congress 2020, business signed up to nature positive and NbS to the tune of $1.3 trillion capitalization and banks promised billions of dollars to finance nature through nature-based economies.

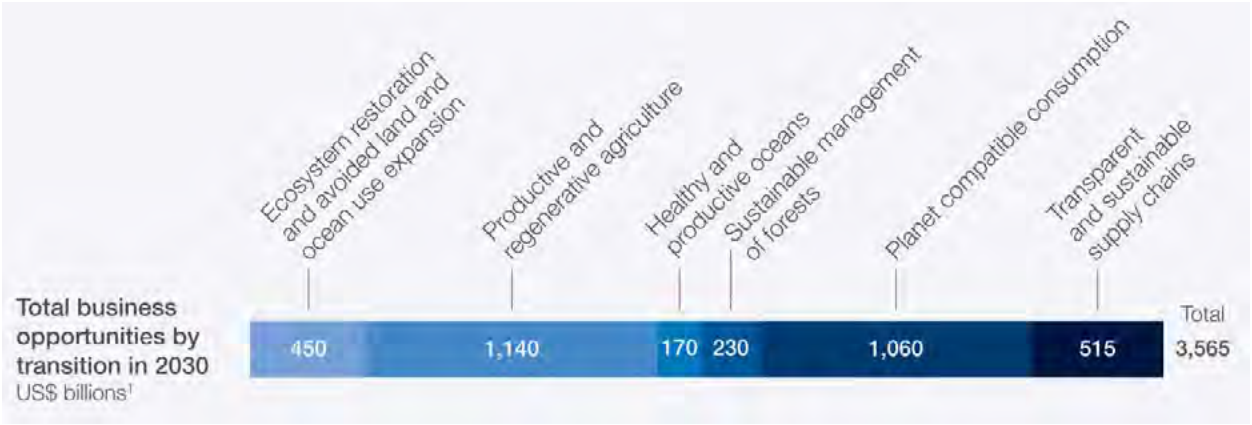
Figure 2.5: Potential Business Opportunities from Six Key System Transitions

Customers are demanding greener products, investors are shifting to greener investments, and governments are introducing greener legislation. Companies are therefore transforming the way they are approaching environmental issues. "Sustainability" is becoming mainstream, ESG scores are becoming a key metric, environmental pledges and commitments are proliferating, and all the actors are looking for how this value can be translated into real economic value, particularly at the local level.

With climate the most visible and urgent of the environmental risks, the primary response focuses on decarbonization. Some of the commitments are simply to improve on past performance. Others focus on reaching their "fair share" of emissions, with over 1,000 companies now working to reduce emissions to "science-based targets" (SBTs). Signatories to the UN Global Compact are encouraged to set SBTs aligned with 1.5°C and so far over 100 companies have done so. But increasingly, the focus is on the target of "net zero by 2050"—the relatively easy to understand target being adopted by companies and governments alike that aligns with the global target identified by the IPCC (WEF 2021a; WBCSD 2019).

Corporate commitments to net zero doubled between 2019 and 2020, totaling over 1,500, representing over $11 trillion in revenue, or 12 percent of the global economy.

Figure 2.5: Potential Business Opportunities from Six Key System Transitions



Source: WEF 2020a.

4 *Executive Secretary Elizabeth Maruma Mrema, speaking at the IUCN World Conservation Congress 2020, Marseille, September 2021.*

5 *Klaus Schwab, Executive Chairman of the World Economic Forum, speaking at the IUCN's World Conservation Congress 2020, Marseille, September 2021.*

Companies in the consumer goods sector made the most commitments, followed by those in the industrial sector; the commitments range from net zero by 2050 to becoming net negative, that is, taking more emissions out of the atmosphere than they contribute (Race to Zero 2021; Data-Driven EnviroLab and NewClimate Institute 2020; Vivid Economics 2020). Table 2.3 presents some companies' commitments and how NbS are playing a role. So far, the mining sector response to climate has been relatively cautious, though a number of industry and company commitments to various net zero targets have been made (see section 3.3.2).

However, what net zero commitments mean in practice can vary. There is currently no single definition for what a corporate commitment to net zero means, although various organizations define what they see as an acceptable approach (Kachi, Mooldijk, and Warnecke 2020; Allen et al. 2020; University of Oxford 2020). The result is that individual commitments can vary greatly, sometimes only covering a limited scope of the company's full emissions.

One of the key net zero initiatives is the United Nations Race to Zero campaign, which focuses on promoting and endorsing commitments from companies, cities, and regions. Commitments made through Race to Zero now total nearly 1,500 companies (Race to Zero 2021; Data-Driven EnviroLab and NewClimate Institute 2020). Signatories do not only include large companies—the SME Climate Hub supports small and medium enterprises in setting net zero strategies.

There is also a question around how these corporate commitments interact with their compliance obligations under governments. In other words, are governments recognizing these as representing compliance with their GHG emissions mitigation targets? This can vary from one jurisdiction to another and is often a source of conflict in the incentives that drive companies to deliver locally (that is, in the landscapes of nations where their impacts occur) on their climate commitments, or more broadly on their NbS objectives. Nesting corporate commitments within Nationally Determined Contributions (NDCs), for example, only occurs in special circumstance when taxation and incentives are clearly driving broader mitigation requirements as part of "packages" of delivery. South Africa is such a case. Most often, corporate effort can only be accounted for by reporting on the financial contribution to carbon in the national climate mitigation efforts rather than accounting for the carbon on their own corporate carbon neutrality program.

Table 2.3: Corporate Net Zero and Net Negative Commitments and the Role Nbs Are Expected to Play

Company	Ambition	Year	NbS
AstraZeneca	Carbon negative	2030	50 million tree reforestation program
Drax	Carbon negative	2030	-
IKEA	Carbon negative	2030	$200 million invested in joint renewable energy / NbS program
Microsoft[a]	Carbon negative	2030	Procured 1.3 $MtCO_2e$ in 2020, primarily through NbS
Nespresso	Net zero	2022	Reforestation on coffee farms
Apple	Net zero	2030	Carbon Solutions Fund to remove 1–2 million tCO_2e/yr, including management of 400,000 ha land through NGOs
Facebook (value chain)	Net zero	2030	100,000 tCO_2e purchased in 2019
PwC	Net zero	2030	Statement of intent to invest in NCS
Tesco	Net zero	2035	-
Unilever	Net zero	2039	€1 billion invested in Climate & Nature Fund
Amazon	Net zero	2040	Restoring 1.6 million ha
Aviva (real estate)	Net zero	2040	-
Walmart	Net zero	2040	20 million ha land, 1 million sq. miles sea
BT	Net zero	2045	-
BP	Net zero	2050	"Strongly support NCS as a key part of the energy transition"
HSBC (investments)	Net zero	2050	Establishment of Pollination JV for investment into NbS

Company	Ambition	Year	NbS
LafargeHolcim	Net zero	2050	-
Nestle	Net zero	2050	Regenerative agriculture and planting 200 million trees
Shell	Net zero	2050	Investing $300 million in NbS
Tetrapak (whole value chain)	Net zero	2050	-
Total	Net zero	2050	$100 million invested in Total Nature Based Solutions unit
Eni	Net zero (Scopes 1, 2, and 3)	2040	Sequester 30 million tCO_2e through REDD+ by 2050
Airlines (CORSIA agreement)[b]	Offset all emissions above 2020 reference levels		Verified NbS an approved option. Potentially 2.5 billion tCO_2e will need to be offset

Note: *Climate commitments by mining companies are covered in Table 3.2 and so are not repeated here. NCS = natural climate solution(s).*

a. *Microsoft's full commitment is by 2050 to have removed enough emissions from the atmosphere to account for all its Scope 1 and 2 emissions since it was founded in 1975.*

b. *The 13 airlines forming Oneworld have also committed to net zero by 2050.*

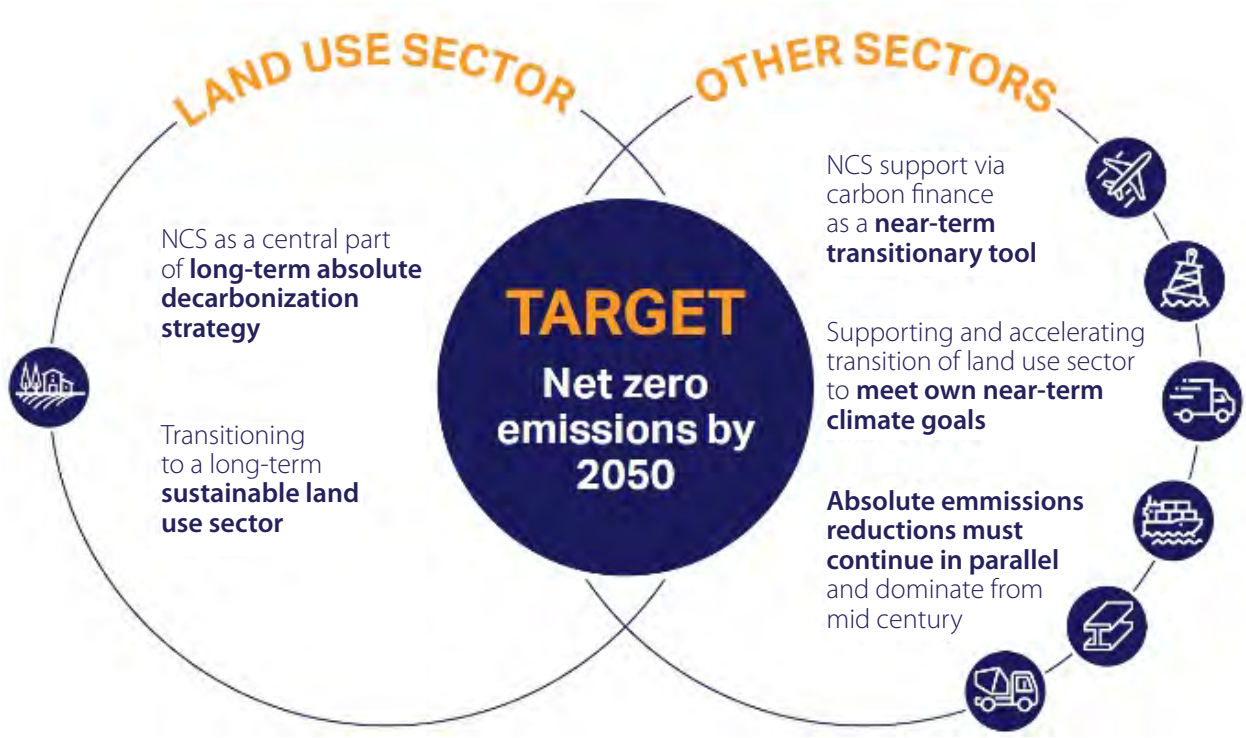
NbS form a fundamental component of many of these responses, not only as one of the most cost-effective ways for generating the carbon credits needed to reach climate commitments but also as a source of a range of co-benefits that can contribute to additional corporate goals or potentially benefit other company stakeholders, boosting relations with local communities and governments alike.

Most interest is coming from sectors with high land use that have a strong influence on GHG emissions from AFOLU activities (for which NbS represents one of the most cost-efficient and multibeneficial ways of reducing emissions). In addition, sectors with significant carbon footprints are making commitments on carbon as well as biodiversity, water, and other environmental targets (Figure 2.6) (WBCSD 2019). Land use–reliant companies already investing in NbS as part of corporate climate, deforestation, or biodiversity commitments include Amazon (restoring 1.6 million hectares), Nestle (focusing on NbS in West Africa in particular), and Walmart (restoring or managing 20 million hectares of land and 1 million square miles of ocean) (see also section 3.3).

Companies making commitments to NbS include American Airlines, Shell, Eni, and BP, which have all made net zero commitments that they expect to meet, at least in part, through the purchase of credits from NbS (WEF 2021a). BA and Air France have also committed to make all domestic flights carbon neutral by 2021 (Forest Trends' Ecosystem Marketplace 2020). Shell is specifically working to generate its own credits to work toward its 2050 net zero commitment through NbS, with commitments to spend $300 million on NbS, including planting 5 million trees in the Netherlands and 1 million in the United Kingdom (Shell Global 2020). Other companies have gone further and made net positive commitments. Microsoft, for example, has made a "moon shot" commitment to remove enough emissions to account for all those the company made since they were founded in 1975, with forest protection and reforestation forming a key part of the strategy (Schwartz 2020), and IKEA has committed to becoming climate positive by 2030 by reducing more GHG emissions than the IKEA value chain emits while still growing the IKEA business.[6]

6 *"What Does Being Climate Positive Mean for IKEA?," Sustainability, IKEA.com, accessed September 28, 2021, https://about.ikea.com/en/sustainability/becoming-climate-positive/what-is-climate-positive.*

Figure 2.6: The Role Different Private Sector Actors Can Play in Delivering NbS



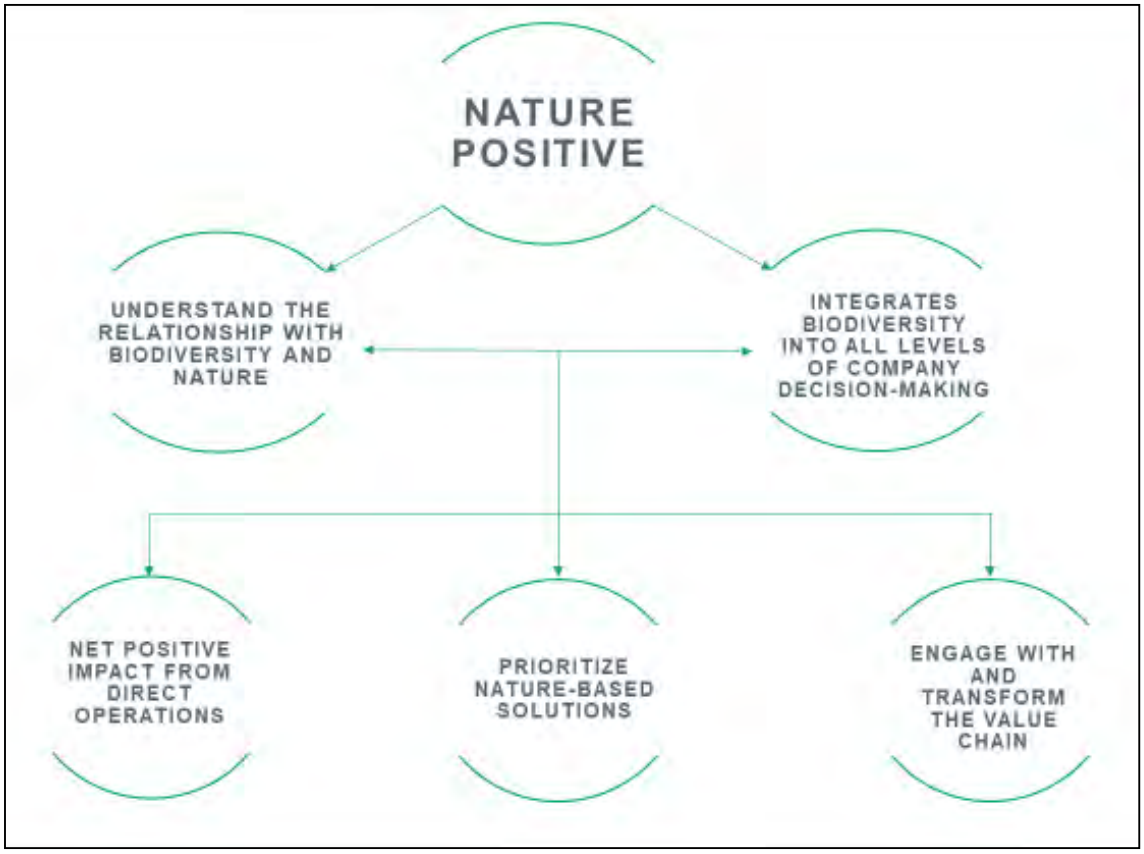
Source: WBCSD 2019.

While adoption of NbS in the private sector is growing, it is coming from a relatively low base. In 2019, the Carbon Disclosure Project (CDP) showed that only about 15 percent of over 540 companies responding to their Forests Questionnaire were implementing NbS. Of those employing NbS, most were companies producing material goods (such as timber or mining) and most were based in Asia, with reforestation and forest conservation the most popular NbS choices (CDP 2020b).

No net loss / net zero, and net positive impact / net gain goals for biodiversity are also being employed by leading companies (see Box 2.5). No net loss may be set at a site, project, or corporate level, or for part of the value chain, and means that the impacts on biodiversity that it causes are balanced or outweighed by measures taken to avoid and minimize the impacts, to restore affected areas, and finally to offset the residual impacts so that no loss remains.[7] Where the gain exceeds the loss, the term "NPI" or "net gain" may be used instead. NPI is nested within the overarching goal of achieving nature positive (Figure 2.7). NbS constitute one element or approach that can be applied to deliver NPI where this forms part of corporate or site-level commitments for biodiversity.

7 *"'No Net Loss' and 'Net Gain' of Biodiversity," Business and Biodiversity Offsets Programme, Forest Trends, accessed September 21, 2021, https://www.forest-trends.org/bbop/bbop-key-concepts/no-net-loss-and-net-gain-of-biodiversity/.*

Figure 2.7: The Concept of Nature Positive



Note: *"Nature positive" is a composite term for a number of key elements needed to deliver positive outcomes for biodiversity. This would include net positive impact/net gain, prioritizing nature-based solutions, transforming raw material supply chains so that they are contributing positively to nature, and integrating nature into decision-making throughout a company's activities so that impacts and dependencies are acknowledged and addressed as a strategic business imperative.*

Box 2.5: The Role of Nbs in Delivering Net Zero and Net Positive Commitments

Corporate commitments to mitigate climate impacts have proliferated in recent years, and commitments to reach net zero particularly so, including a handful committed to net positive, meaning they intend to sequester more carbon than they produce (Kachi, Mooldijk, and Warnecke 2020). Many of the commitments rely heavily on nature-based solutions (NbS) within their strategies to deliver. But with no global consensus on what net zero means for a company, these commitments encompass a range of approaches that vary in scope, measurement, and their use of NbS.

Commitment level	Ambition	NbS appropriate?
Meet legal requirements	Laggard	No / rarely
Reduce emissions beyond legal compliance		No / rarely
Low/zero carbon products or sites		No /rarely
Reduce emissions to an agreed "fair share" (science-based target) level	Minimum acceptable?	No
Reduce emissions to net zero after 2050		Yes
Reduce emissions to net zero by 2050 or before		Yes
Reduce emissions to a net positive carbon outcome	Leader	Yes

The Science Based Targets Initiative (SBTi), part of the Science Based Targets Network (SBTN), represents one of the most established approaches for companies looking to set climate targets and provides clear guidelines on how and when NbS can play a role in delivering such targets.

As an "entry level" target, the SBTi describes how to set a **science-based target** (SBT), defined as a target that is *"in line with what the latest climate science deems necessary to meet the goals of the Paris Agreement."* SBTs have been set for a range of sectors and companies, and there are a variety of options for calculating targets for new areas. SBTs are not the same as net zero targets—they describe a "fair share" level of emissions but will generally still result in some level of emissions being released. **NbS approaches cannot contribute to SBTs.** SBTs are set according to what is known to be feasible within the sector, and allowing NbS would be seen as an opportunity for companies to neglect priority areas for emission reduction.

For companies looking to go beyond SBTs, the SBTi has now produced guidelines for reaching net zero (CDP 2020a). The guidelines outline a mitigation hierarchy approach to avoid, reduce, and restore impacts on emissions to reach the lowest impact possible (roughly equivalent to the SBT) but then offsetting the residual impact to reach net zero or net positive impact. **NbS approaches can contribute to net zero or net positive targets at three points in the process:**

- Abatement – Land use–intensive companies can use NbS to reduce emissions from existing activities.
- Neutralization – Activities inside and outside the value chain to offset the residual emissions that cannot be abated.
- Compensation – Activities outside the value chain that reduce emissions *while transitioning to the net zero target.*

SBTs and net zero targets are not only relevant for carbon. **Net zero/no net loss or net positive/net gain approaches to biodiversity** are also being employed by some countries and companies. Like carbon, there is no single accepted way of approaching these targets, but there are established guidelines available. The most comprehensive guide for companies is the **BBOP Standard on Biodiversity Offsets**, while the SBTN is also in the process of producing a guide for companies wishing to set **science-based targets for nature.** However, unlike carbon, there is as yet no agreed global target for nature equivalent to 1.5°C, nor is there a single measurable unit of nature or biodiversity equivalent to CO2e. However, many companies are setting nature positive, net positive, and no net loss targets for biodiversity, and the metrics and indicators are developing alongside these.a NbS are one element or approach that can be applied to support delivery of net positive/net gain objectives for biodiversity, where this forms part of corporate or site-level commitments relating biodiversity.

a. See "A Global Goal for Nature," https://www.naturepositive.org/.

2.7.2. Finance

Investment is generally agreed to be a fraction of what is required to meet global environmental goals. Furthermore, investment in climate targets and broader biodiversity and nature-based targets are largely separate and siloed.

Estimates of the levels of climate finance required to meet the 1.5°C target range from $1.6 to $3.8 trillion per year (IPCC 2018). Actual levels of finance total closer to $600 billion, 15–40 percent of the requirement (Buchner et al. 2019). The proportion of this expenditure that is invested in projects that could qualify as NbS is minimal, with just 2–3 percent spent on such activities (Buchner et al. 2015).

The gap between required and actual finance for meeting global biodiversity goals are even greater: Required finance is estimated to range around $720–$960 billion, while actual investment is just 15 percent of this at around $120–$140 billion (Deutz et al. 2020; OECD 2020).

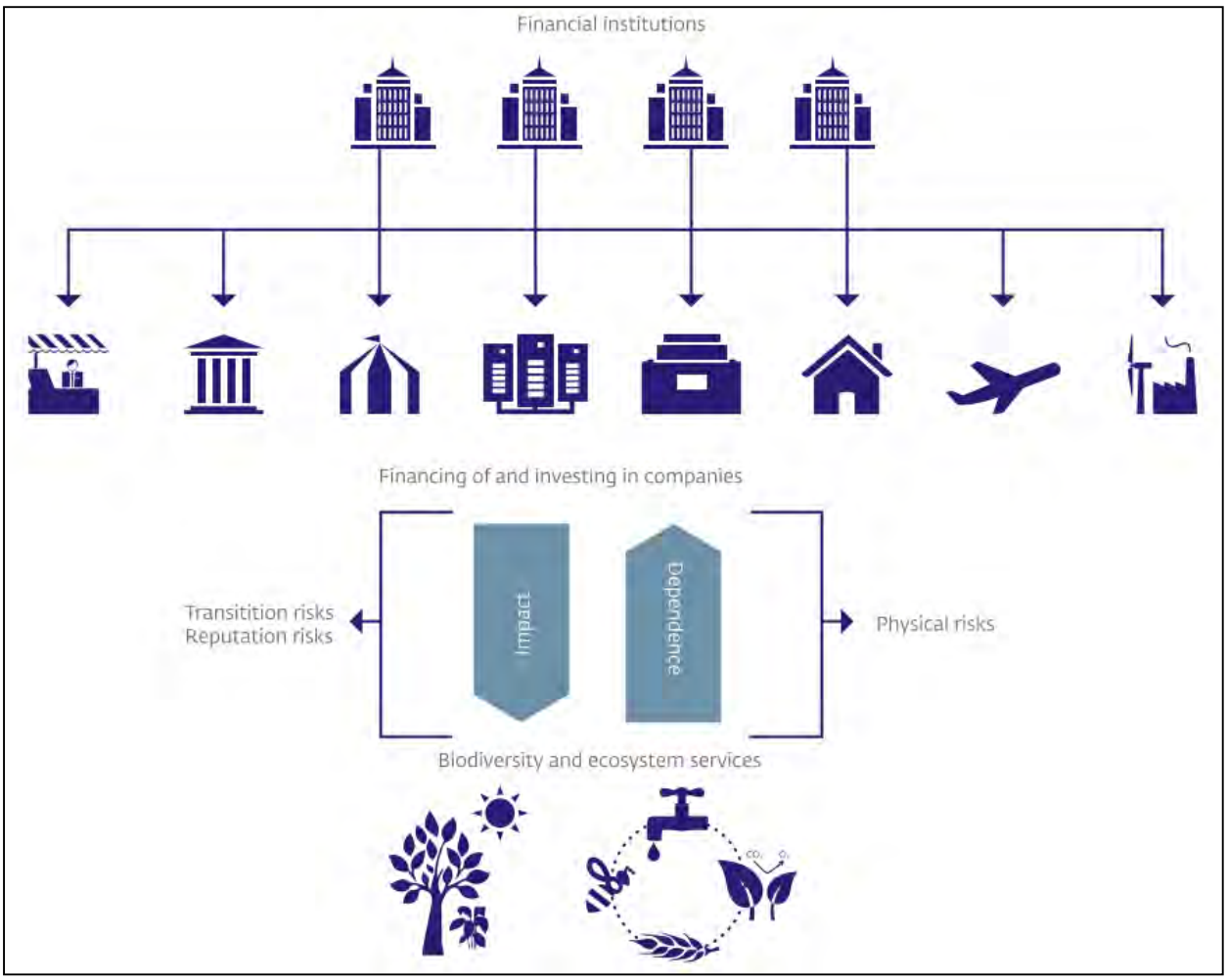
The role of the private sector varies. For climate finance, the private sector provides over half of all investment (Buchner et al. 2019). For biodiversity, 70–90 percent of finance comes from the public sector, with investment from the private sector typically hindered by perverse economic incentives, lack of cash flows, lack of data, complex methods of verification, and the challenges of early-stage business models and scope for scaling (Deutz et al. 2020; World Bank 2020). NbS activities are therefore largely publicly funded.

However, efforts to "green finance" (redirecting finance from projects that cause environmental harm) and to "finance green" (promoting investment in environmentally positive projects) are increasingly being promoted (Deutz et al. 2020). Climate-based risk (see Figure 2.8 for risk typologies) is rapidly gaining widespread

acceptance, with groups such as the International Monetary Fund and the Bank of England espousing its importance and over 500 investors with more than $50 trillion in assets signing up to the Climate Action 100+ initiative, set up to drive a set of focus companies toward net zero emissions. The most recent signatories include Blackrock and its $7 trillion in assets under management, which began 2021 with a commitment to reshape investment strategy around climate. Understanding of the risks based on biodiversity is far less developed (van Toor et al. 2020; ShareAction 2020).[8] The world's largest banks still have close to $3 trillion invested in the sectors driving biodiversity losses (Portfolio Earth 2020).

At the same time as recognizing the risks, investors are being urged to approach biodiversity losses as an "asset management problem" (Dasgupta 2021). One group taking up this challenge is the HSBC Pollination Climate Asset Management joint venture, which has the stated ambition to become the largest dedicated natural capital asset management company in the world. Describing a new investment thematic of natural capital as an "uncorrelated asset class that offers diversification in the shift to decarbonize the economy and still derive a healthy return," they are focusing on investment themes including biodiversity and wildlife protection and restoration and natural capital assets that generate carbon credits. The first fund, for which HSBC will be a cornerstone investor, is looking to raise $1 billion from sovereign wealth funds, pensions, and insurers. A second fund, aiming to raise $2 billion, will focus on carbon credits (Wilder 2020).

Figure 2.8: The Relationship between the Financial Sector, Biodiversity, and Ecosystem Services



Source: van Toor et al. 2020.

8 *One of the few exceptions is the Dutch bank ASN, which has issued special investment criteria for biodiversity (ASN Bank 2010).*

This doesn't, however, close the financing gap and deliver project funding to where it is really needed. A fundamental shift is needed, from the financing of nature-based economies to the funding of impact investment in NbS. This requires appropriate scale and impact and the necessary time frames and de-risking to ensure sustainability and endurance in the flow of funds to those that are implementing projects on the ground and delivering the co-benefits. This may be a shift in paradigm, but it is genuinely required for sustainable nature positive outcomes.

2.7.3. Government

Support for NbS from governments and international institutions is rapidly gaining momentum. At the international level, a number of agreements and treaties are directly relevant to NbS, including the following:

- Sustainable Development Goals (SDGs)
- UN Framework Convention on Climate Change (UNFCCC)
- UN Convention on Biological Diversity (CBD)
- UN Convention to Combat Desertification (UNCCD)
- UN Decade on Ecosystem Restoration 2021–2030
- Bonn Challenge
- New York Declaration on Forests (NYDF)
- Great Green Wall Initiative

The focus here is on the UNFCCC given notable advances at COP26 in recognizing the importance of nature for reducing emissions and building resilience to the impacts of climate change and implications for the enabling environment for NbS moving forward.

The UNFCCC and the Paris Agreement on Climate

The UNFCCC is the international mechanism for tackling climate change. The Paris Agreement was adopted at COP21 of the UNFCCC. Of the 197 Parties to the Convention, 191 are Parties to the agreement, which targets holding *"the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C."* Countries set their commitments and actions to contribute to these targets in NDCs—plans that are meant to be updated every five years with increasing ambition (see below). A key response to the agreement has been a focus on net zero, which the IPCC says we need to reach by the middle of the century if we are to hit the 1.5°C target.

Commitments to net zero have doubled in the last year and now cover over 65 percent of global emissions. The United Kingdom was the first to enshrine net zero by 2050 in law, and net zero targets have also been enshrined into law by Denmark, France, Norway (2050), and Sweden (2045). Austria, Canada, Costa Rica, Chile, the EU, Germany, Iceland, Italy, Japan, Mexico, New Zealand, Portugal, Spain, Switzerland (2040), Finland (2025), China (2060), and now the United States (2050 have all made political commitments to net zero.

The Paris Agreement specifically recognizes the role of NbS in several sections, including *"the importance of the conservation and enhancement, as appropriate, of sinks and reservoirs of the greenhouse gases referred to in the Convention,"* and notes *"the importance of ensuring the integrity of all ecosystems, including oceans, and the protection of biodiversity, recognized by some cultures as Mother Earth"* (Seddon, Sengupta, et al. 2020).

Interest in NbS has also accelerated among the Parties in recent years. A subset of members under the Climate Ambition Alliance recently called for a greater focus on NbS in NDCs, and at the 2019 UN Climate Action Summit an NbS Coalition—a group of 30 countries led by China and New Zealand—launched their Climate Manifesto, specifically calling for increased support for NbS and establishing the NBS Contributions Platform where parties can share examples of experience. The UN Secretary General declared NbS a priority at COP26 (Glasgow, 2021; see Box 2.6). The focus for NbS within the UNFCCC comes down to country-level application and Article 6 and the eligibility of NbS in future carbon trading frameworks (see section 2.6.2).

At the national level, support for NbS is more variable but growing. One of the most important indications of support is through each country's NDC, outlining its commitment to the Paris Agreement. NDCs are produced every five years and are meant to increase in ambition; most countries' NDCs are now due for updating. NbS approaches do appear in the majority (66 percent) of original NDCs, particularly in NDCs from less developed countries, and are mainly focused on forest actions. However, the levels of commitment to NbS are vague, with very few set quantified targets and very few using NbS in a strategic way to address mitigation and adaptation. Furthermore, most commitments are based on a presumption of external support and finance. In the run-up to COP26, in the wake of new research highlighting the importance of NbS in meeting climate targets, many institutions and programs focused on strengthening representation of NbS in the next iteration of NDCs (Seddon, Sengupta, et al. 2020; UNDP 2019; Beasley et al. 2019; WWF 2020a; Seddon, Daniels, et al. 2020), so the new NDCs will have a significantly greater and more robust focus on NbS as a key component of national climate strategies.

A second indication of the likely growing importance of NbS is the number of countries committing to national net zero targets. Today, 65 percent of global emissions come from countries with a net zero commitment in place, with all but China committing to reach net zero before or by 2050 (China has a current ambition to reach net zero by 2060).

Box 2.6: Summary of Outcomes from COP26, Glasgow, 2021

By the end of COP26 held in Glasgow during November 2021, 151 countries had submitted new climate plans (NDCs) to slash their emissions by 2030. To keep the goal of limiting temperature rise to 1.5°C within reach, we need to cut global emissions in half by the end of this decade. In contrast, the United Nations calculates that these plans, as they stand, put the world on track for 2.5°C of warming by the end of the century.

The Glasgow decision calls on countries to "revisit and strengthen" their 2030 targets by the end of 2022 to align them with the Paris Agreement's temperature goals, and this ratcheting-up process was seen as a real breakthrough. It also asks all countries that have not yet done so to submit long-term strategies to 2050, aiming for a just transition to net-zero emissions around mid-century. Together, stronger NDCs and long-term strategies should help align the net-zero and 2030 targets, as well as ramping up ambition.

In addition, the "Glasgow Climate Pact" asks nations to consider further actions to curb potent non-CO2 gases, such as methane, and includes language emphasizing the need to "phase down unabated coal" and "phase-out fossil fuel subsidies." This marked the first time, negotiators have explicitly referenced shifting away from coal and phasing out fossil fuel subsidies in COP decision text.

It is disappointing that Glasgow could not deliver on developing countries' calls for a settlement on loss and damage and climate adaptation finance. A call to double adaptation finance from 2019 levels by 2025 and the beginning of a "dialogue" on funding for loss and damage, together with some mitigation transactions channelled into adaptation are welcome, but overall this lacks the ambition many had hoped for.

The Glasgow COP finally recognized the importance of nature for both reducing emissions and building resilience to the impacts of climate change, both in the formal text and also through a raft of initiatives announced on the sidelines. The final decision text *"emphasises the importance of protecting, conserving and restoring nature and ecosystems to achieve the Paris Agreement temperature goal, including through forests and other terrestrial and marine ecosystems acting as sinks and reservoirs of greenhouse gases and by protecting biodiversity, while ensuring social and environmental safeguards."* This is a promising development as for decades, those in power have failed to appreciate that the crises of climate change and biodiversity loss are not separate issues to be dealt with one by one—but deeply intertwined problems that must be tackled together. **Now those linkages and the power of NbS are well understood.**

Here's what negotiators decided on three important topics:

- **International Carbon Markets.** After five years of negotiations, the world's governments settled on the rules for the global carbon market under the Paris Agreement's Article 6. One of the most contentious issues in recent years and one of the final pieces to be resolved in Glasgow, the negotiations tried to balance finally reaching agreement on the rules while ensuring they didn't undermine climate ambition, but instead maintained environmental and social integrity. This part of the overall agreement is critical for private finance to be able to fund large parts of climate action. Of particular importance is the agreement on corresponding adjustments, to prevent double counting of emission reductions by two different countries, in which more than one country could claim the same emissions reductions as counting toward their own climate commitments. This is critical to make real progress on reducing real emissions, however; the exact carbon accounting rules for the Voluntary Carbon Market and potential for double counting remain unregulated and therefore a gray area that will require continued scrutiny.

  Countries also decided that 5 percent of proceeds must go toward funding adaptation under traditional market mechanisms (Article 6.4), though under bilateral trading of credits between countries (Article 6.2) contributing funds toward adaptation was only "strongly encouraged," which may reduce this potentially secure source of finance for adaptation.

  Unfortunately, countries decided they would allow the carry-over of old carbon credits generated

since 2013 under the clean development mechanism of the Kyoto Protocol to help meet climate commitments of the Paris Agreement. At COP27, it is crucial that negotiators put stringent guidelines in place to ensure any of these older credits that are allowed to be used represent real emissions reductions, not just "hot air."

- **Common Time Frames.** In Glasgow, countries were encouraged to use common timeframes for their national climate commitments. This means that new NDCs that countries put forward in 2025 should have an end-date of 2035, in 2030 they will put forward commitments with a 2040 end-date, and so on. Aligning NDC targets' dates around five-year cycles will hopefully help spur ambition and action in the near term, facilitate better understanding of global progress, ensure countries take action over the same time period, and keep pace with the Paris Agreement's five-year cycle to strengthen their plans. The use of the term "encouraged," rather than stronger language, may however weaken the impact of this decision.

- **Transparency.** In Glasgow, all countries agreed to submit information about their emissions and financial, technological and capacity-building support using a common and standardized set of formats and tables. This will make reporting more transparent, consistent and comparable. This is a boon for the global community to better hold countries accountable for what they say they will do.

What Developments Outside the Negotiations Relate to Application of NbS?

Many significant announcements were made outside the negotiations throughout the two-week long summit. The first two days featured over 100 high-level announcements during the "World Leaders Summit" including a bold commitment from India to reach net-zero emissions by 2070 that is backed up with near-term targets (including ambitious renewable energy targets for 2030), 109 countries signing up to the Global Methane Pledge to slash emissions by 30 percent by 2030, and a pledge by 141 countries (as of November 10) to halt and reverse forest loss and land degradation by 2030 (backed by $18 billion in funding, including $1.7 billion dedicated to support indigenous peoples).

A group of 46 countries, including the U.K., Canada, Poland and Vietnam made commitments to phase out domestic coal, while a further 29 countries including the U.K., Canada, Germany and Italy committed to end new direct international public support for unabated fossil fuels by the end of 2022 and redirect this investment to clean energy. The Beyond Oil and Gas Alliance, led by Costa Rica and Denmark—with core members France, Greenland, Ireland, Quebec, Sweden and Wales—pledged to end new licensing rounds for oil and gas exploration and production and set an end date that is aligned with Paris Agreement objectives.

To help hold businesses and others accountable for achieving their net-zero goals, UN Secretary-General António Guterres announced he is creating a high-level expert group that will establish clear standards to measure and assess these commitments.

The recognition of human rights in the climate transition and in particular the explicit recognition of Indigenous People and Local Communities is a step forward.a The voices from the most vulnerable parts of the world were loud and clear right across Glasgow, but their lack of influence within the negotiating rooms was called into question. Local communities have the specialist, on-the-ground, place-specific knowledge that will drive success, and funding for NbS must reach the grassroots. The launch of initiatives at COP26 such as IIED's Principles of Locally Led Adaptation and Forest People Partnership, were a much needed addition.

For companies, the implications of COP26 are still materialising. Uncertainty regarding the timeline, speed and unpredictability of future policy developments presents a significant risk for companies, creating challenges for those looking to plan ahead. Amid this uncertainty, three developments from COP26 reflect how the attitudes of key stakeholder groups—namely regulators, investors and civil society—are evolving, and the implications these developments will have for companies.

Standardising sustainability disclosures will continue to be an investor priority

Greater clarity on the development of standardised sustainability disclosures was a priority for the finance and investment community at COP26. The Glasgow announcement of the establishing of the International Sustainability Standards Board (ISSB), which is to be tasked with creating consistent global standards for sustainability disclosures. The ISSB will aim to build upon the recommendations of the Taskforce on Climate-related Financial Disclosures (TCFD), which has been successful in driving

voluntary disclosures by business and investors and is providing the basis for mandatory climate-related disclosures in a number of jurisdictions, notably Europe and North America.

Against this background, investors are likely to demand more of companies on disclosure and reporting about their plans and policies in respect of climate and the energy transition. However, in doing so, companies should be mindful that the TCFD is not simply designed around disclosure, but requires companies to carefully consider how climate-related risks and opportunities impact broader business strategy.

Source: "FFI's Response to COP26 and the Glasgow Climate Pact," November 17, 2021, https://www.fauna-flora.org/news/ffis-response-to-cop26-and-the-glasgow-climate-pact/.

a. *Mountford et al. 2021.*

2.7.4. 2.7.4 Civil Society

Responses by nongovernmental organizations (NGOs) and other civil society groups to NbS have largely been positive, although some retain significant concerns (see also section 2.5). Most focus on the potential for NbS for bringing multiple environmental, social, and development concerns together, and on the growing opportunity for carbon markets to help drive the implementation of NbS and address the $600 billion annual underspend on the environment that is desperately needed if global conservation targets are to be reached (Deutz et al. 2020).

In response, there has been a proliferation of departments, institutions, and collaborations and associated reports based around maximizing the potential from NbS. Some key groupings are highlighted in Table 2.4.

Table 2.4: Some Key NGO Partnerships and Academic Institutions Working on NbS

Name	Led by	Structure	Focal areas
Natural Climate Solutions Alliance	World Business Council for Sustainable Development (WBCSD) / WEF	Partnership of multiple companies and NGOs	Unlocking finance for NbS, developing voluntary markets
Nature4Climate	The Nature Conservancy (TNC)	Partnership of 16 organizations, including multiple UN entitiesa	Guidance for governments, atlas of examples
Trillion Trees	WWF/Wildlife Conservation Society/ BirdLife	Campaigning group	To regrow/save 1 trillion trees by 2050, focusing on cocoa, timber, and rubber sectors
Natural Climate Solutions	George Monbiot	Campaigning group	Raising awareness of NCS
Nature-based Solutions Initiative	University of Oxford	Research department	Research, policy database, case study atlas
Center for Nature-based Climate Solutions	National University of Singapore	Research department	Research, informing policy
Crowther Lab	ETH Zurich	Research department	Research on reforestation and monitoring
Conservation International	Conservation International		
International Union for Conservation of Nature (IUCN)	Commission on Ecosystem Management	IUCN Specialist Group	Global Standard on NbS

Note: NbS = nature-based solutions; NCS = natural climate solutions; NGO = nongovernmental organization; UN = United Nations; WEF = World Economic Forum.

a. *Conservation International, Convention on Biological Diversity, Environmental Defense Fund, Food and Land Use Coalition, International Union for Conservation of Nature, The Nature Conservancy, United Nations Development Programme, United Nations Environment Programme, United Nations Program on Reducing Emissions from Deforestation and Forest Degradation, We Mean Business, Wildlife Conservation Society, Woods Hole Research Center, World Business Council for Sustainable Development, World Resources Institute, World Wide Fund for Nature, Youth4Nature.*

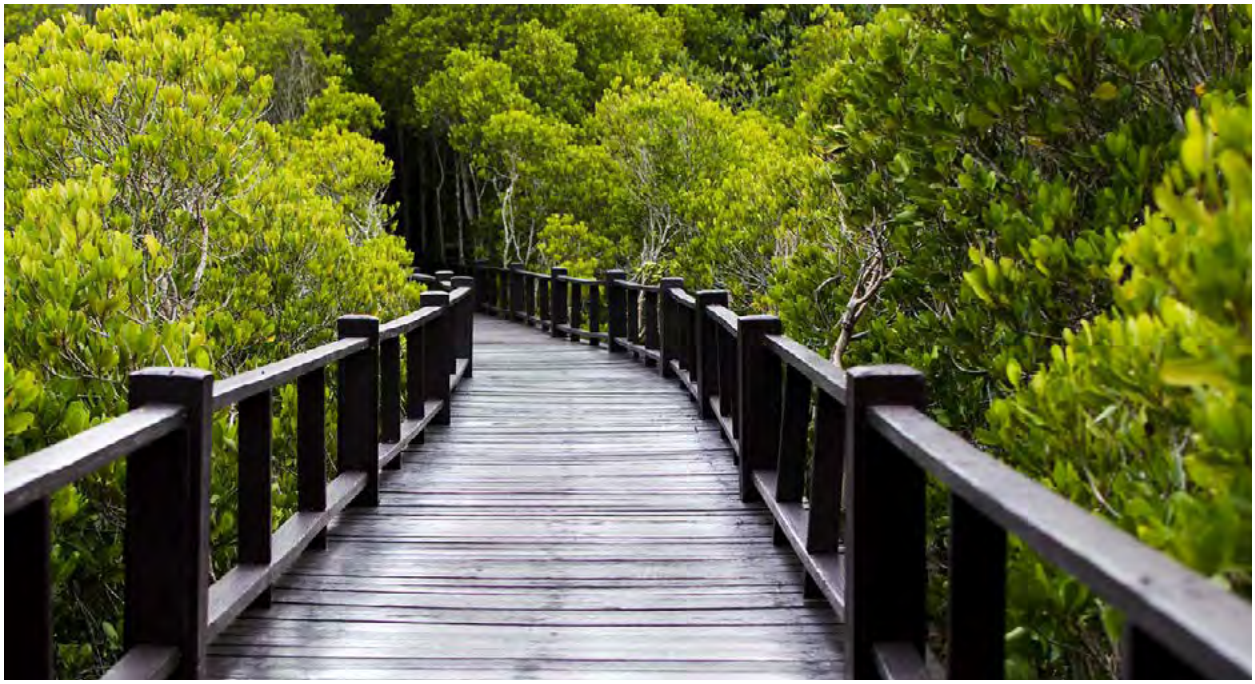
Not all civil society groups are supportive of NbS. Historical objections to the misuse of offsetting, to the approaches of avoided deforestation, and to the application of markets to environmental values are all equally valid to NbS, as are examples of when NbS can conflict with social interests. Most of the objections focus not on the concept itself but on NbS implemented poorly.

Greenpeace has published reports highlighting the danger of corporate offsetting programs being used by high-emitting sectors such as oil and gas and aviation, the dangers of a focus on carbon leading to the establishment of biodiversity-poor plantations, and the potential for NbS to displace Indigenous Peoples or infringe on their rights (Greenpeace 2020). While they acknowledge CO2 removal is a necessary part of the climate strategy, they argue it is a relatively minor component of mitigation and must not be allowed to reduce the focus on emission reductions. They highlight variation in the way different companies are applying and relying on NbS and other CO2 removal approaches in their climate policies (Greenpeace UK 2021). Friends of the Earth's concerns focus on "financialization of nature" and the way that companies can turn concepts such as NbS to their own advantage without generating the intended benefits, particularly the way some companies can use concepts such as offsetting to gain access to areas they might not otherwise have been able to access (FOEI 2019, 2020). Other concerns come from groups focusing on the application of environmental markets to finance NbS (Green Finance Observatory 2019).

All of these concerns are valid and indeed can be demonstrated as serious issues in various examples. It was to address such concerns that the principles and subsequently the IUCN Global Standard for NbS were developed and if these are followed, they should address many of the concerns that some civil society groups retain with NbS (see section 6 for more details).

3. RELEVANCE OF NATURE-BASED SOLUTIONS IN MINING PROJECTS

3.1. Key Messages



Source: © Pixabay, Puente-de-madera-bosque-de-manglar

Why are NbS relevant to mining projects?

Mine operations: *NbS activities that might facilitate normal mine operations and adherence to licencing requirement.* ***Managing externalities:*** *NbS activities that could be employed to mitigate mine impacts but are not necessarily mandated by the terms of the lincense.* ***Going beyong no net loss:*** *NbS activities that are entirely additional to normal mining operations.*

NbS help to mitigate impacts of mining, including rehabilitation of disturbed land, delivering sustainable development commitments such as livelihoods for local communities, water security and climate mitigation and adaptation.

1. ***The mining sector is experiencing its best conditions for a decade but remains heavily exposed to the environmental risks faced by business****. It is important that this time of prosperity is used to manage these and align the industry with societal expectations for a low-carbon future that is likely to look substantially different to today.*

2. ***Nature-based solutions (NbS) approaches tend to be affordable and can offer a wide spectrum of benefits in ecosystem services, climate risks minimization, and protection against multiple associated impacts****. In contrast, pure engineering alternatives can be effective in the short term, but they are expensive and deliver few if any co-benefits.*

3. ***NbS have notable potential for high-carbon, high land use sectors****. The mining sector meets both these criteria, meaning NbS approaches have a potentially strong and important role to play in this transition, particularly in the following broad areas:*

a. ***Increased and better application of existing NbS-like activities***. *Mining projects face a range of environmental, social, and financial challenges across the mining cycle that NbS can play a role in addressing. NbS-like activities are already being used to some extent, particularly for land reclamation, yet they tend to be applied in a siloed, unstrategic manner and often fail to meet NbS principles. There is huge scope for scaling existing infrastructure and experience to enable NbS in a more strategic and coordinated way.*

b. ***Establishing NbS as a key component of mining climate strategies***. *While the mining sector response to climate change has been relatively slow, companies are increasingly committing to ambitious targets. NbS are frequently listed as having a potential role in delivering these targets, but there is clear caution of overcommitting. As the rules and guidelines on NbS become clearer, NbS should become a more viable and positive component of climate responses.*

c. ***Reimagining mining land banks, associated infrastructure, and areas of influence for NbS***. *Mining companies often directly or indirectly control vast areas of land outside the mine footprint and may influence much larger areas beyond the direct licensed area. Employing NbS in the management of these lands could contribute to multiple environmental and social targets.*

4. ***The business case for NbS as part of a mining project is evolving rapidly:***

   a. ***Currently, interest in NbS is primarily risk based***. *NbS activities are used to a limited degree as an environmental management tool; they are used a little more widely as a way of meeting regulation on biodiversity or for reputational purposes and corporate commitments. Plans to use NbS as part of climate strategies are just starting to develop. Any activities undertaken tend to be financed by the mine and are often siloed and unidimensional.*

   b. ***Increasingly, NbS have the potential to play a clear and significant role in net zero climate strategies***, *particularly as insets to offset remedial emissions. Approached strategically, NbS incentivized and catalyzed by climate targets could simultaneously address environmental management, biodiversity, and social targets and/or feed into regional or national targets.*

   c. ***In the future, mining projects could be deploying NbS across large areas of land, simultaneously tackling multiple challenges and generating benefits*** *that are sufficient not only to meet company net zero targets but even to generate surplus that can be "donated" to regional or national government targets or traded as new revenue streams on growing voluntary and/or compliance markets.*

5. ***In support of the arguments for using NbS in their own right, various factors promote the use of NbS in mining***. *Beyond the climate agreement, many international frameworks relevant to mining now support the implementation of NbS, including the United Nations (UN) Race to Zero, the Sustainable Development Goals (SDGs), the Bonn Challenge, and the New York Declaration on Forests (NYDF). National-level support for NbS in mining can be found in national Reduce Emissions for Deforestation and forest Degradation (REDD+) strategies, and various voluntary standards can support the implementation of NbS.*

3.2. Why Should Mining Companies Think about NbS Now?

The mining sector is one of the few sectors to have weathered the global COVID-19 pandemic relatively well. However, the pandemic also highlighted and accelerated issues around environmental, social, and governance (ESG) performance and reporting that have been growing for some time. The next 30 years are likely to see *either* great changes resulting from the impacts of climate change, biodiversity losses, and resulting social upheaval *or* great changes in the way we run our economies as we make the huge transitions needed to avoid such impacts. Mining companies remain heavily exposed to many risks from either scenario and would be wise to use their current position of financial stability to align their businesses with the likely demands of a post-2020 economy (PwC 2020; Hume 2021a, 2021b).

3.3. Why Do NbS Make Sense for the Mining Sector?

The primary sectors adopting NbS are those that recognize NbS as an important tool for addressing climate impacts (such as the oil and gas industry) and sectors with a strong land use component in their value chain (such as agribusiness or forestry). The mining sector meets both criteria as well as has a long history of application of NbS-like activities, notably for mine reclamation. NbS approaches therefore have a strong potential to be a significant component of any mining company, or project, looking to position itself as a positive actor in a post-2020 economy (see Box 3.1 for examples from Teck Limited). There are three broad areas where the application of NbS makes sense for mining projects:

1. Through the better application of existing NbS-like activities

2. Through integration of NbS into burgeoning mining climate mitigation strategies

3. Through better use of the land where mining projects directly and indirectly influence

Box 3.1: Teck Application of NbS in Elk Valley, Canada

A range of nature-based solutions (NbS) are already implemented across Teck's operations in the Elk Valley of British Columbia, with a variety of environmental management objectives. Historically, the foremost driver has been mine rehabilitation to achieve post-closure stipulated end land uses. However, Teck has increasingly been employing a more holistic and collaborative view, evaluating the potential for NbS opportunities with local First Nations, governments, and other partners that could make a significant contribution toward Teck's strategic goals to work toward securing a net positive impact on biodiversity, and being a carbon neutral operator by 2050.

Within the Elk Valley, Teck contributes to the delivery of NbS that mitigate impacts at a landscape scale. Three examples include:

1. NbS for water treatment—harnessing natural processes through applying saturated rock fill technology

2. NbS approach to mine rehabilitation

3. Protection of conservation lands to contribute to multiple objectives

3.3.1. Improving Existing Application of NbS on Mining Projects

NbS could play a part in addressing many of the challenges mining projects face across the mining cycle (Table 3.1). Working with nature to restore and rehabilitate mined areas, or to stabilize mining waste, is a well-established practice in the sector. Green infrastructure instead of, or in conjunction with, gray infrastructure is becoming a recognized response to challenges such as water runoff, flood attenuation, erosion control, shading, or noise. Various activities are also employed to meet licensing requirements, to meet voluntary corporate commitments or standards, or to improve local stakeholder relations. Conservation work or biodiversity or carbon offsetting are common examples. Many mines have extensive social development programs that may include "NbS-like" activities, from tree planting to support local forestry programs to projects promoting eco-agriculture, soil management, beekeeping enterprises, and so on (see Table 3.1).

However, such activities are rarely conducted in a strategic, coordinated way that follow the principles of "good" NbS outlined in section 1. Differences between "NbS-like" activities and well-implemented NbS include the following:

- **Design and deployment of activities with a single function in mind rather than co-benefits**. For example, if the purpose is the reclamation of a mine site, or of mine waste, then often an approach is chosen that serves this but fails to do much else (see Box 3.2). Climate-focused NbS-like projects often focus on fast-growing, monoculture reforestation, which maximizes carbon sequestration at the cost of a range of other potential co-benefits. While this may be the fastest approach to sequester carbon, the restoration or establishment of a biodiverse, natural forest will generate a wider set of benefits while being more resilient to pests, fire, or climate change.

- **Siloed approach to NbS activities** without coordination, leading to inefficiency at best and counterproductivity at worst. Efforts to address land reclamation and stabilization can often occur without consideration of the potential biodiversity implications, and efforts to promote local enterprise can sometimes directly conflict with biodiversity or carbon objectives. This lack of coordination can also extend to the landscape level. Many NbS activities operate at a wide geographical level, and unless there is coordination and collaboration with other landscape actors, they risk being undermined by a lack of cooperation elsewhere.

- **Implementation of NbS as a reactive measure rather than a proactive design**. A strict condition of well-implemented NbS is that it is the "final piece of the puzzle." Well-designed NbS should focus initially on issues caused by the mine and should be implemented following the mitigation hierarchy, coming in after all efforts have been made to avoid and mitigate the issues the NbS activity is addressing. Often this is not the case. Conservation programs, for example, may be implemented in geographically separate areas from the mining project and thus not address the problems the mine is causing. Well-designed NbS for mining projects ideally need to be planned into the project from the outset. The full range of mine impacts and dependencies need to be mapped and understood (including those occurring outside the mine's direct area of influence), and these need to be avoided and

mitigated as far as possible. NbS can be considered either to enhance the mitigation plan to deliver additional and ecologically valuable benefits or to provide the most sustainable, nature-derived management options. The challenge is to recognize where NbS can play a role and to ensure that each activity maximizes the range of benefits achievable.

Looking across the sector, NbS is still a relatively unused approach. Mining is an industrial activity and mechanical, civil, or chemical solutions dominate thinking around mine design problem solving. Risks from the kinds of issues NbS are best positioned to address are still largely unappreciated (PwC 2020; Gillespy 2019).

Box 3.2: Reclamation in the Appalachian Mountains

Coal mining sites in the United States used to be restored by packing the substrate as much as possible and planting with grass species, often non-native, as the best way to bind the soil. Such approaches achieved the primary function desired but failed to bring many other biological or social benefits. Now restoration is being rethought. In one site in Kentucky, a mine is being re-restored with a much wider suite of benefits in mind: Invasive species are being removed and native grasslands are being created, suitable for a wider range of species, tied in with plans for multiple sources of revenue for people living in the area. Elsewhere, grassland restoration is being replaced with reforestation, resulting in a much wider range of benefits (Popkin 2020; Nemo 2018). Similarly, conservation projects or biodiversity offsetting programs might be effective for the target species, but they often have little awareness of the climate or social implications (many of which might be positive). Social management programs might focus on the desired social outcome, with little thought to the climate or biodiversity implications.

3.3.2. Integrating NbS into Mining Climate Strategies

The mining sector is a highly carbon-intensive sector, generating some 1.9–5.1 $GtCO_2e$ each year based on Scope 1 (direct operations) and Scope 2 (energy use) emissions. This translates into 4–7 percent of global greenhouse gas (GHG) emissions. A further 4.2 $GtCO_2e$ are generated by Scope 3 emissions by metals processing—primarily steel and aluminum—and another 10 $GtCO_2e$ are added if considering coal combustion, taking the sector's total share of global emissions to closer to 30 percent of global emissions (Delevingne et al. 2020). Decarbonization is technically and economically possible, but it will require emission reductions of 30–45 percent by 2030 and net zero emissions by 2050 (Marrakech Partnership and Global Climate Action 2020). The relevant outcomes from COP26 held in November 2021 are explored in more detail in section 2.7.3.

A number of risks and opportunities arise from this exposure:

1. Shift in relative demand for different minerals (for example, fall in demand for coal and platinum group metals while demand for metals with a clear role in a lower carbon economy, such as lithium, cobalt, nickel, copper, and aluminum, are likely to rise [Delevingne et al. 2020; Bour et al. 2020; Sovacool et al. 2020])
2. Increased reputational risk resulting from being a sector with a high-profile, high-visibility impact
3. Regulatory risk resulting from increasing pressure on states to meet their Paris Agreement climate targets leading to restrictions on the most polluting operations, or the introduction of carbon taxes (Whiteside 2020)
4. Risks from extreme weather events leading to flooding and/or drought, identified as particular risks for miners of bauxite, copper, and nickel (Delevingne et al. 2020; Rüttinger et al. 2020; Rüttinger and Sharma 2016)

So far, the mining sector's response to climate has been relatively cautious. According to the Responsible Mining Foundation, less than a quarter of mining companies were publicly engaged in any form of climate scenario analysis prior to COP26 (RMF 2020). In early 2020, both McKinsey and Boston Consulting group were urgently advising faster action from mining companies on climate, pointing out that emission reductions of at least 50–85 percent would be required to get the sector on track for the Paris Agreement, while almost no commitments on this scale had been made (Delevingne et al. 2020; Bour et al. 2020). Since then, additional commitments have been made.

The International Council on Mining and Metals (ICMM)[1] position on climate change commits members to consider climate risks and opportunities in business decision-making, to advance adaptation and mitigation and to set targets and report on Scopes 1 and 2 emissions annually. In October 2021, ICMM members committed to a goal of net zero Scopes 1 and 2 GHG emissions by 2050 or sooner (ICMM 2021),[2] with some individual company decarbonization targets going beyond this.

1 *The ICMM represents 27 of the world's largest mining companies who abide by a set of agreed principles on environmental, social, and governance issues.*

2 *See also "Our Commitment to a Goal of Net Zero by 2050 or Sooner," Environmental Stewardship, icmm.com, https://www.icmm.com/netzero.*

Seven of the top 10 largest mining companies have now committed to net zero targets in some form (see Table 3.2). The Minerals Council of Australia (2021) has also confirmed the industry's ambition to achieve net zero emissions by 2050 in support of the Paris Agreement goals.

There remains considerable debate over whether mining companies are in line with global climate targets (Marrakech Partnership and Global Climate Action 2020; Dietz et al. 2020). Furthermore, there remains a significant disjuncture between public commitments at the top and tangible actions on the ground (RMF 2020).

NbS are unlikely to lead a mining decarbonization strategy, but they do have a valid role to play in both a climate mitigation strategy and a climate adaptation strategy and will be crucial in, for example, water security, social impact programs, and nature-positive strategies essential to sustainability. The accounting methodologies applied for determining the carbon footprint of a company vary, as do expectations of sectoral contributions among countries. For example, in South Africa, the mining sector is expected to contribute to the National Climate Change Adaptation Strategy alongside the agriculture, forestry, fisheries, energy, and transport sectors. In general, however, the mining sector has yet to have clear options to integrate sectoral measures into future Nationally Determined Contributions (NDCs).[3]

The mining sector is also exposed to climate change impacts, where unpredicted flooding and storms, droughts, and spontaneous landslides, among other extreme effects, can affect mining design and operational planning, imposing substantial economic costs. In such cases, NbS can contribute toward improved climate resilience of current operations and mine rehabilitation efforts, responses to climate-related risks, and sustainable production of commodities.

ICMM members recognize "the role of natural climate solutions and offsets in providing low-cost options to address global GHG" (ICMM 2019). Strategies for decarbonization vary but tend to focus on the following (Marrakech Partnership and Global Climate Action 2020; Whiteside 2020; Azadi et al. 2020):

1. Reducing fugitive emissions
2. Reducing materials and energy usage
3. Improving productivity of resource and energy use
4. Decarbonizing production approaches
5. Carbon sequestration through natural or engineered processes

At present, NbS play an unclear role in the climate strategies of the major companies. Most companies mention some level of NbS activity, but there is clear caution over any reliance on NbS, with no company giving any firm indication of what proportion NbS are expected to play in reaching net zero. BHP is the only company with significant history of using NbS within a climate context. For most companies, the approach appears to be similar to Glencore, whose climate strategy simply states they are "working to deepen understanding of offsets" (Glencore 2020). The Transition Pathway Initiative recognizes the use of NbS to offset emissions as a legitimate path to decarbonization,[4] but recognizing that not all offsets are equally valid, they recommend that companies publish figures on the extent to which offsets are relied upon (Dietz et al. 2020).

3.3.3. Integrating NbS into Land Asset Management Strategies

Many mining companies own, manage, or lease vast land areas, with varying proportions currently permitted or available for mining. As managers or influencers of significant areas of land, the mining sector has the potential both to influence negative impacts and to promote positive impacts. This is clearest for climate—mining projects can influence emissions from AFOLU or use land to sequester carbon—but the potential is equally true for impacts on biodiversity, water, and other environmental factors. Mining licenses vary from country to country, but most incorporate large areas of land, only a proportion of which is taken up by the mine footprint and associated facilities and infrastructure. Many companies also hold legacy assets—land that has been bonded for rehabilitation, sold on, and often "orphaned" with unclear responsibility.

3 *For more information, see the GIZ's series of briefs on the sectoral implementation of NDCs, available on the Partnership on Transparency in the Paris Agreement website: https://www.transparency-partnership.net/documents-tools/briefing-series-sectoral-implementation-nationally-determined-contributions-ndcs.*

4 *The Transition Pathway Initiative (TPI) is supported by 90 investors with more than $23.6 trillion in assets under management and advice.*

Using such assets for NbS activities could represent a significant opportunity (see Box 3.3 for an example at the Los Bronces mine, Chile). Demand for good quality carbon credits (meaning credits from verified, trusted projects, ideally associated with multiple co-benefits) is fast outstripping supply, and several companies that are already committed to buying large quantities of credits (such as Shell) are already directly investing in NbS development in anticipation of significant price rises in the voluntary market. Any mining companies integrating NbS into their climate strategies would be wise to focus on developing inset projects on land they control as part of an integrated approach to biodiversity, water, and community development projects.[5]

Furthermore, mining projects have indirect influence over far greater areas of land. Mining project activities have been shown to indirectly affect landscapes for 70 kilometers or more from the mine site itself (Sonter et al. 2017). With nearly half of all large-scale mining occurring in forested landscapes, mines potentially influence some 10–30 percent of all forests (World Bank 2019a). While mining companies may not have direct control over such areas, they can affect what happens, negatively or positively, both through their own actions and through influence with local decision-makers, particularly in less economically developed areas.

5 *"Insetting" refers to a company offsetting its emissions through a carbon offset project within its own value chain. In contrast to a typical carbon offset project, emissions are avoided, reduced, or sequestered upstream or downstream within the company's own value chain. Smallholder farmers who practice agroforestry, or reforestation, can lock atmospheric carbon in the soil or in trees. This leads to carbon sequestration and a reduction in GHG emissions. In return, the farmers receive payments that allow them to provide raw materials to the investing organization, as well as produce measurable environmental and social impacts within their communities. It is about businesses investing in the ecosystems their suppliers depend on to increase their resiliency and provide significant, measurable benefits to communities surrounding the value chain.*

Box 3.3: An NbS Strategy for Land Management Practices at Anglo American's Los Bronces Mine, Chile

For the Los Bronces Integrado (and the whole Los Bronces operation), proposed nature-based solutions include the following:

- Ecological restoration of disturbed lands
- Habitat restoration with carbon sequestration benefits
- Erosion control
- Increased water attenuation
- Carbon neutrality
- Restoration of riverine habitat and hydrological flows
- Protection of aquifers and borehole water supplies through the protection of habitats and improvement of water attenuation and ingress (recharge)
- Green infrastructure and water harvesting managing important water sources
- Sustainable livestock farming to stop soil degradation

In response to community relations and addressing water scarcity, Anglo American is working on restoration in priority water bodies and aquatic ecosystems, applying the principles and techniques of process-based restoration including restoration of ecosystem hydrological functions and erosion control.

Changes in the water flow regime in the Yerba Loca estuary (the highest part of the natural sanctuary) because of potential glacier ablations resulting from project operation gases and particulate matter emissions. The Los Bronces operation has been supporting management actions in five nature sanctuaries. Anglo American is considering providing support for one or two more conservation areas. Proposed underground operations projected in the open pit as well as in the underground phase in the Yerba Loca estuary could also alter the phreatic levels and the underground waterflows. To mitigate such outcomes, NbS of habitat restoration can help increase the ingress and attenuation of water in the ecosystem and reduce runoff with recharge of the aquifer.

3.4. How the Business Case for NbS in Mining Is Evolving over Time

When NbS approaches are employed in mining projects, they are largely risk based, motivated by the need to secure a license to operate or establish reputational credentials, and are financed from the mine balance sheet as part of planned operating expenses.

As support for NbS grows across sectors, governments, and civil society groups and enabling guidance, methods, and data become clearer (see section 2), companies should feel increasingly confident to list appropriately planned NbS as an integral component to climate strategies. Approached in an integrated and strategy way, NbS can be the framework for bringing together disparate climate, biodiversity, water, and social development activities, increasing efficiency and impact and decreasing costs. Projects will still largely be financed through the balance sheet, but increasingly supplementary finance through grants or blended finance become options (see section 4 and Box 3.4).

If voluntary and compliance markets for carbon continue to develop as expected, along with markets for other environmental values, NbS activities have the potential to be scaled to large-scale projects, addressing multiple objectives supported by off-balance-sheet financial mechanisms as public and private funds are directed to support climate and related goals.

Mining companies with significant land banks have the option to make far better use of these assets, using NbS to generate multiple benefits, including carbon credits to support their own climate strategies. Potential surplus generation can be used to support national or international commitments or generate additional revenue for the company. NbS projects "beyond the fence" should be self-financing and completely independent of the company balance sheet (see Figure 3.1) and involve collaborators across sectors.

Box 3.4: The Role of External Finance

It is in pursuing a programmatic approach in the future that external financing solutions become relevant.

The investment scales of tens of millions and possibly hundreds of millions of dollars, with extended project life and ongoing revenue streams, particularly where those revenues are from compliance markets established in statute, could have the right characteristics to attract mainstream investors and intermediaries to structure the finance. Those characteristics might even be achieved in early projects presented to the capital markets if some of the novel, sovereign, and market risks were to be sufficiently mitigated by credit enhancement provided, for example, by a development finance institution. One can imagine the loan or other financial assets sold on the capital market being labeled "green" and easily attracting the attention of investors with a strong appetite to take up green investment opportunities in their ESG or Paris-aligned portfolios.

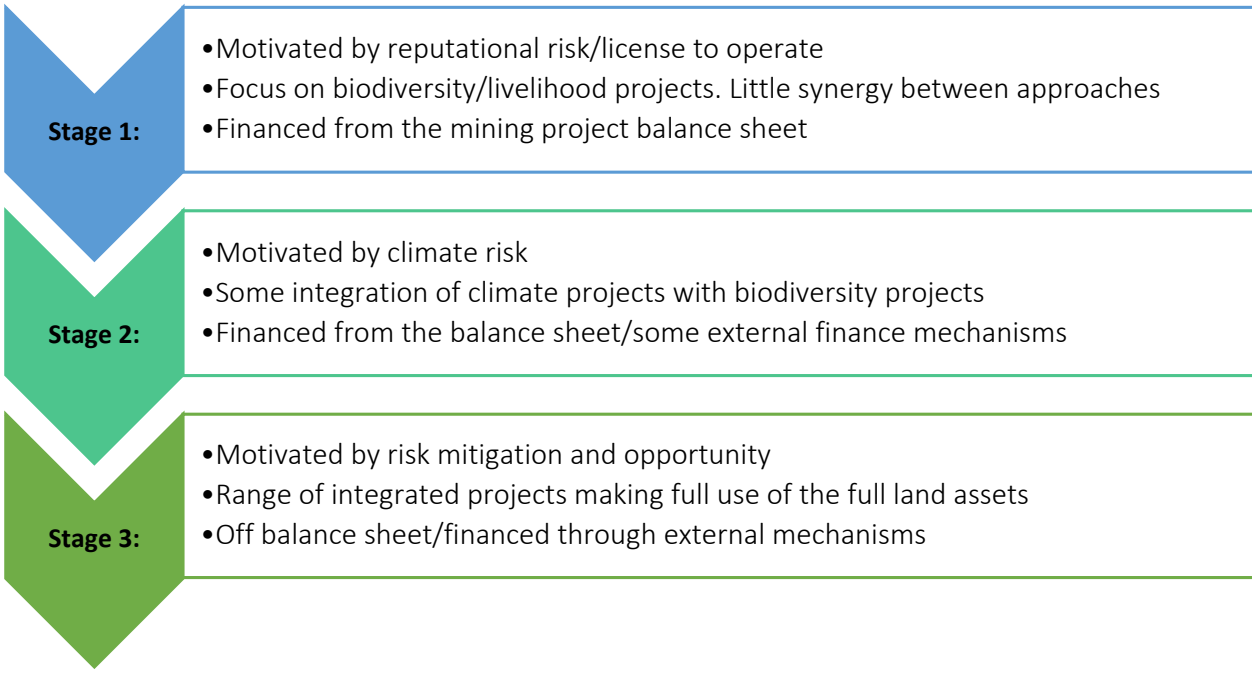
For a mining company, this scale of program and financial structure could only be created at a group rather than a site level and would fit into a strategic plan that integrates both climate and nature ambitions and takes advantage of carbon and nature markets, when they are mature enough to make NbS commercially attractive. Large mining companies have the access to land, local relationships with landowners and managers, technical execution expertise, and government and capital market relationships to bring about scale NbS programs such as these. They may find that it becomes a cost-effective way of achieving their environmental objectives, and at the same time, it might be expected—though it has yet to be proven—that value could be created by selling pure NbS securities to capital markets separately from traditional mining securities. That is because capital markets might find it easier to understand and value pure play securities than composite ones. For some of the leading mining companies, the scale that an NbS program could play helping to satisfy Scope 1 or 2 targets and achieving nature positive mining is such that it would lend itself to its own financing arrangement. In some cases, companies may even have sufficient landholding already, or through further expansion, and have potential to build requisite NbS capacity and partnerships, to offer credits to third parties on a merchant basis, generating carbon and biodiversity or nature credits beyond what the firms need for themselves.

Motivations for NbS vary among companies:

- NbS are an investment in securing future resources for the company.
- NbS are one of the approaches that will be needed to meet climate targets.
- NbS can demonstrate a company's positive contribution to the society it operates in, run in parallel to efforts to reduce impacts elsewhere (Boxes 3.5 and 3.6).

NbS can contribute to the management of legacy impacts, post-mining land use, long-term sustainable development in the landscape, and national socio-economic and environmental objectives. They will contribute to weaning the company of both socioeconomic and environmental management dependencies while enhancing environmental and social governance in the landscape.

Figure 3.1: The Potential Evolution of NbS in Mining



Box 3.5: Vale's NbS: Delivering Environmental Compliance in the Landscape

Throughout the business chain, Vale applies NbS to achieve long-term and shared value with Indigenous Peoples and traditional communities. An example of this is the NbS bioconstruction project developed in compliance with the environmental conditions of the expansion work on the Carajás Railway, within the scope of the Basic Environmental Plan for the Indigenous Component of the Awá and Guajajara peoples of the Caru and Indigenous Lands Pindaré River, in the state of Maranhão in Brazil. Bioconstruction is based on concepts consistent with ecological thinking, seeking low environmental impact techniques and solutions for the preservation of natural resources and health. In this case, building materials are manufactured using natural materials, which improves traditional methods used by the communities.

Source: "Indigenous Peoples and Traditional Community," Vale, accessed September 2021, http://www.vale.com/esg/en/Pages/IndigenousPeoplesAndTraditionalCommunity.aspx.

Box 3.6: Case Study: Vale, Brazil – NbS for Legal Compliance and Delivery of Multiple Co-benefits

Vale, Brazil

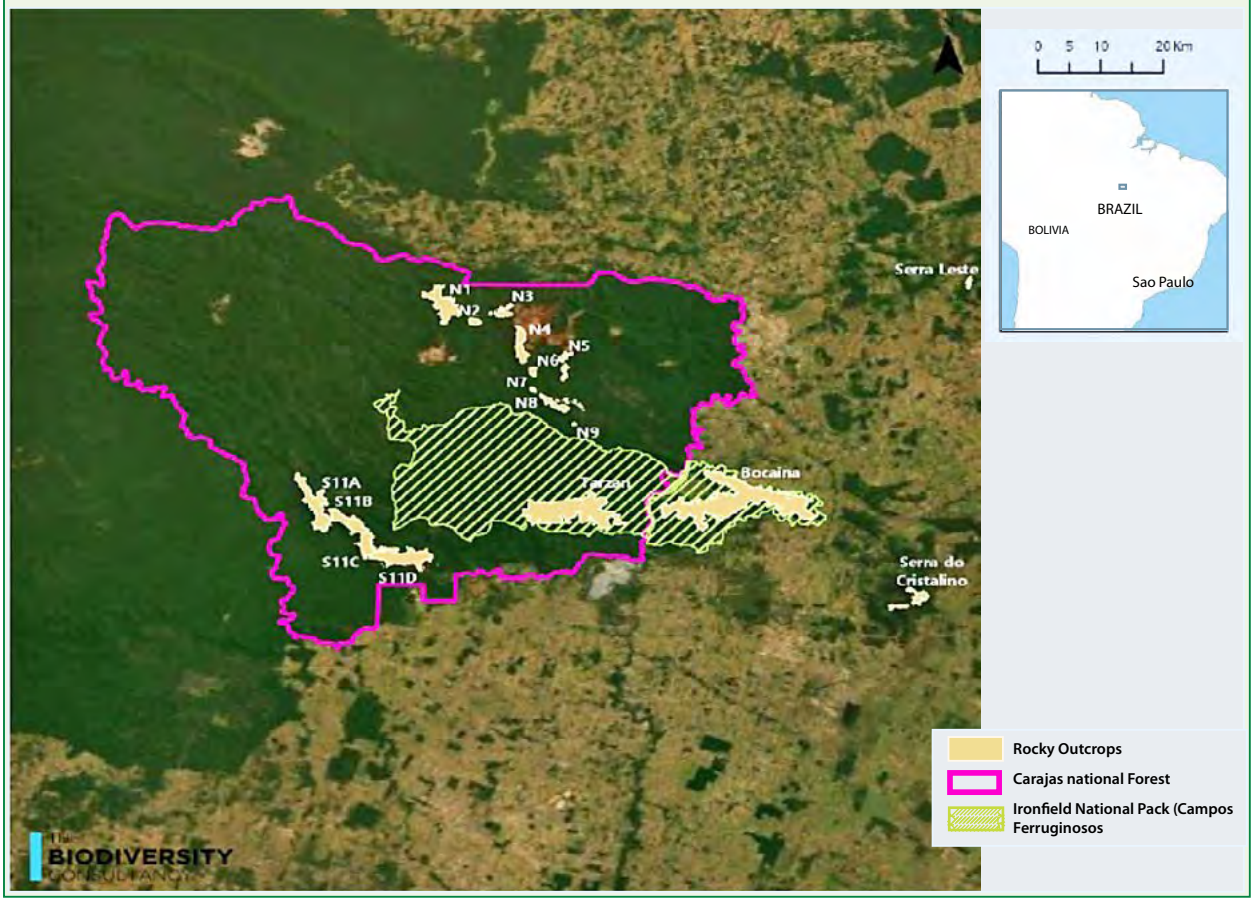
The Program for the Creation of a Conservation Unit NbS initiative provides compliance with Art. 36 of the Federal Law 9.985/2000 and is provided for in the Basic Environmental Plan Carajás Iron Ore Project.

The project is delivered in the remnants of forest and canga of the Serra da Bocaina. This area of high biodiversity value expands the conservation and connection between patches of the Carajás Forest. Since 2013, Vale, in partnership with DIMAN/ICMBIO, has been preparing and implementing the creation of the Campos Ferruginosos (iron ore outcrops) National Park (PARNA), which is part of the legal requirement for compensation and protection of areas of speleological interest. In this context, on July 5, 2017, the PARNA Campos Ferruginosos de Carajás was officially declared.

NbS are deployed to deliver on legal requirements for the restoration of legal reserve (80 percent of the properties need to be ecologically restored) and permanent preservation areas have been established to protect endangered and legally protected species.

Vale has established ecological corridors through forest restoration in Permanent Preservations Areas, Legal Reserves and properties located in the area of influence of the S11D Complex, as well as through educational actions that encourage forest restoration in neighboring properties. The forest habitat restoration program has been undergoing implementation since 2016 within Vale properties around the mine site (see map, above). The goal for these areas is to recover degraded areas previously used for agriculture and pasture into forest habitat that will support the formation of wildlife corridors. The program aims to restore more than 5,000 hectares.

The forest restoration in already degraded areas around the Carajás conservation units (Pará state) increases the native vegetation cover, contributes to carbon sequestration, neutralizes impacts of projects that could not be avoided and/or mitigated, restores forest connectivity and environmental services, and generates income for the local community.



Campos Ferruginosos National Park and rocky outcrops within Carajás National Forest

3.5. Which Frameworks Support the Implementation of NbS in Mining?

Natural climate solutions (NCS) present a range of co-benefits. While sequestering carbon, they can also increase climate resilience and food security, benefit biodiversity, and improve rural livelihoods and economic development (among other positive impacts). The need for these solutions is clear—but we lack the finance and policies needed to enable nature to deliver them. In fact, only an estimated 3 percent of climate finance is used in this way, and only a handful of regions and countries have policies in place that direct private sector finance to NCS at scale.

So, what can the mining sector do and what policies are needed to support implementation of NbS in mining?

3.5.1. Enabling Policy

Environmental and social policy focused on nature-positive outcomes and enabling nature-inclusive or nature-centric decision-making is needed. This requires coordination across multiple ministries and government departments and is not limited to portfolios dealing with environmental or climate issues. In fact, frameworks that support NbS would be inclusive of all land use typologies and would focus on integrated development planning at landscape scale.

Objectives-led frameworks are particularly important to achieve positive or no-harm outcomes, including net zero carbon targets. Such frameworks require the application of the mitigation hierarchy to avoid, minimize, and restore environmental and social impacts, and they may require additional compensation or offsetting to achieve the objective. For biodiversity, water, climate, livelihoods, land use integrity, and productivity, nature-positive objectives enable and recognize co-benefits from NbS.

The policy frameworks pertinent to the mining sector, both for compliance and voluntary NbS application, include environmental and social conditionalities and management plans that form part of license/permit agreements and social contracts with local communities and other stakeholders. NbS application and opportunities abound within these frameworks, particularly using green infrastructure and in the delivery of sustainable post-mine land uses and social impact.

National and international frameworks are also driving the NbS and NCS agenda, with an increasingly urgent call for mining companies to contribute to the delivery of the post-2020 biodiversity agenda (nature positive), land degradation neutrality targets, ocean stewardship, and the Paris Agreement.

3.5.2. Climate Change and Natural Climate Solutions

There are two important drivers for investment in NCS, namely purchasing carbon credits for voluntary action and regulatory compliance; how a mining company engages with these opportunities will depend on the regulatory environment of their operations and where the company is registered. However, numerous opportunities and models enable mining companies to engage in the delivery of NCS and in the stimulation of NCS to address the Paris Agreement—which established a new international framework to addressing climate change rooted in a bottom-up process that relies on national action. Examples are illustrated in Boxes 3.7–3.10.

Box 3.7: Mining and REDD+

The potential for synergy between mining projects and the reduction of emissions from deforestation and degradation has been noted by several sources, including the World Bank (2019a), Schure (2015), Hund, Schure, and van der Goes (2017), and Chatham House (2019). According to the World Bank, of the 47 countries engaged in REDD+, 57 percent considered the mining sector to be a direct or indirect driver of deforestation in their REDD Readiness Preparation Plans. For Africa more than 72 percent of the countries involved in REDD+ establish this link with the mining sector (World Bank 2019a). Yet, despite over 10 years of research-related activities that have posited that the mining industry would be well served in participating in the voluntary and regulatory carbon offsets market, the uptake of this industry (and the private sector in general) in land-based offsets, including those associated with REDD+ has so far been limited. The tracking of disclosures related to both the forest impacts of operations and support for REDD+ and other forms of forest finance may help draw companies into REDD+ schemes, including jurisdictional schemes and jurisdictional nested approaches, with the potential to strengthen existing REDD+ schemes in the host country as well as further forest finance and higher climate ambition. There may also be opportunities to apply REDD+ and innovative finance mechanisms to mining operations or regions to help address the direct and indirect footprint of mining, for example, through land reclamation, rehabilitation, and restoration.

Box 3.8: BHP's Finance for Forests Initiative

In 2014, BHP was among the first resource sector companies to integrate support for REDD+ investment into its climate change strategy. The strategy broadened in FY2020 to include investments in reforestation, afforestation and "blue" carbon—the carbon stored in coastal and marine ecosystems (e.g. mangroves, tidal marshes and seagrasses). The company focuses on project support, governance and market stimulation for carbon credits generated by these projects.

In 2017, BHP launched the Finance for Forests initiative (a joint ongoing initiative with Conservation International and Pollination), which aims to encourage replication of BHP's REDD+ investments, and the exploration of other innovative private finance tools to conserve forests and further advance natural climate solutions. To date, investments in REDD+ have contributed to the conservation of 382,000 hectares (ha) of land in areas of national or international conservation significance, comprising 182,000 ha from investment in the Alto Mayo REDD+ project in Peru and 200,000 ha from investment to support the Kasigau Corridor REDD+ project in Kenya. To put these numbers in perspective, the total area conserved to date is approximately 2.5 times BHP's land disturbance footprint in 2019 (148,800 ha, as reported in BHP's FY2019 Sustainability Report).

Under the Finance for Forests initiative, BHP issued a request for proposals for natural climate solutions projects/concepts, to be supported by market innovations. The aim is to support the development of another innovative financing mechanism to support a portfolio of natural climate solution projects.

BHP's Carbon Offset strategy does not outline an allowable contribution of offsets toward emission reduction commitments, for example, limiting the use of offsets to a certain percentage of its emissions footprint. In lieu of this approach, BHP is developing a quantitative investment metric that proposes to weigh operational emissions medium-term target and long-term goal against an offset price forecast and an internal abatement project cost curve. This metric would be designed to help decision-makers evaluate the trade-off between reducing emissions internally and offsetting externally. This would differ from their carbon price forecasts, which track regional compliance carbon markets and regulatory pricing schemes to assess observed and projected levels of decarbonisation ambition.

BHP is in the process of acquiring voluntary offsets in the form of Verified Carbon Units (VCUs) from two projects that have been certified against the Verified Carbon Standard Program, administered by Verra. Both of these projects have been validated and verified to the Climate, Community and Biodiversity (CCB) Standards, also administered by Verra. The CCB Standards identify projects that simultaneously address climate change, support local communities and smallholders, and conserve biodiversity.

Source: BHP 2020.

Box 3.9: International Finance Corporation Forests Bond

The International Finance Corporation (IFC) developed the innovative finance mechanism Forests Bond as a means to unlock private sector finance for reducing deforestation. The Forests Bond allows investors to take investment returns in the form of carbon credits generated. One example of a Forests Bond is the one IFC issued in 2016 for the Kasigau Corridor REDD Project in Kenya; the bond raised $152 million from the private sector, including $12 million from BHP (BHP 2020). The IFC issued the Forests Bond in October 2016, raising $152 million.

Box 3.10: International Emissions Trading Association Markets for National Climate Solutions Initiative

IETA's Markets for NCS Initiative was founded in December 2019 (IETA 2019), with BHP a founding member alongside oil majors Shell, BP, Chevron, and Woodside Energy. This initiative aims to support development of global markets for carbon credits generated from NCS, enabling private sector investment at scale. Companies can take action to reduce emissions from deforestation and degradation by investing in carbon projects and purchasing emission reduction or removal units from established programs such as Verified Carbon Standard, American Carbon Registry, and Climate Action Reserve. Action can be catalyzed through carbon markets to preserve or enhance existing carbon stocks as part of an effort for organizations to compensate emissions as they transition toward a state of net zero emissions.

The following models are suggested:

1. Public-Private NCS Funds – A nation could create a public-private fund to purchase international NCS credits in larger volumes. The fund could be capitalized with a mixture of public and private finance.

2. Carbon Market Portal – This would help ensure environmental integrity, provide disclosure surrounding the role of NCS credits in delivering companies' net zero targets, and reward developing country hosts with a path to early investment by the private sector.

3. Carbon Tax or Market Evolution – Nations with a carbon tax or emissions trading systems could accept offsets from neighbors in a region, or elsewhere in the world, as compliance instruments in their system.

4. Article 6 Projects – To start to build a supply of international carbon credits, willing nations could develop a number of Article 6 NCS projects. Credits generated from a variety of emissions reduction and removal projects would be used toward the NDCs of the developer and the host countries.

Source: IETA.

3.6. Governments' Role and Recommendations

NbS have an important role at the national level, with economic growth in many countries highly dependent on the mining sector and governments needing to balance a sound economy and a healthy natural heritage (see also section 2.7.3).

NbS are an instrument based on economic principles; therefore, the transaction costs are a key determinant of success. Governments have a critical role in establishing the policy, legislative, institutional, and technical frameworks to enable these initiatives and resources to flow efficiently in support of national/jurisdictional environmental goals, international commitments, integrated landscape planning, and scaling up and/or aggregating NbS opportunities.

Governments can establish the conditions under which NbS can be designed, delivered, and monitored toward nature-positive and net zero outcomes. For this potential to be realized, policy and institutional changes must be accompanied by capacity building across the different national agencies involved in relevant sectors (mining, environment, climate, water, agriculture, and so on).

The following recommendations for government are provided:

- Develop the enabling policy environment. Set and align national and jurisdictional targets for the mining sector consistent with global agreements/ frameworks.

- Comply with the mitigation hierarchy. Governments should require full application of the mitigation hierarchy by the mining industry and other sectors, with NbS considered as a relevant alternative to address residual impacts. To enable application, this may require legal, institutional, and technical advances and should promote decision-making processes supportive of jurisdictional and landscape objectives.

- Establish appropriate institutional arrangements and build capacity among public authorities, national agencies, and other stakeholders to enable the design, implementation, and monitoring of NbS activities in mining and other sectors.

- Enable best-practice stakeholder engagement processes to increase NbS knowledge and awareness, optimize NbS design to maximize delivery of co-benefits, and allow for the early identification and avoidance or mitigation of potential trade-offs.

- Promote the scale-up of NbS initiatives by linking them with international commitments and national strategies and goals (for example, national climate strategies, land use planning, national biodiversity strategies, REDD+ strategies, land degradation neutrality targets), establishing incentive mechanisms for appropriate NbS application by mining operations both at site and in the wider landscape and creating the conditions necessary to aggregate NbS at the landscape level.

Credit: Roel Slootweg

4. FINANCING AND FUNDING NATURE-BASED SOLUTIONS

4.1. Key Messages

Source: © Pixabay, Bote-barquero-paisaje-agua

Identifying the Business case for NbS activities

Setting up the business case for NbS investment: *The value proposition - benefits to whom, revenue streams. The operating/delivery model - owner, manager. The value capture - what will it cost and who will pay for it?*

What is the financial feasibility and how can NbS be delivered and integrated into business objectives and wider landscape objectives?

1. ***Despite a substantial gap in financing the protection and restoration of nature, especially from the private sector, momentum is growing.*** *New players are entering the space to unlock financing of nature-based solutions (NbS). However, private financial institutions face several problems, including financier aversion to the novelty of the assets and the sparsity of revenues for NbS.*

2. *In the context of NbS needing to be implemented,* ***large-scale mining companies can make the most of this momentum to explore new investment models for their NbS projects.*** *Companies may wish to weigh some considerations before assessing the sustainability of their project's investment model. The first step before structuring the investment is to identify the business model of the selected project. The business model combines the project's social and environmental objectives with its costs and risks, governance, and the company's in-house capabilities. Having chosen a design of project business model, companies can go on to access a range of financing options.*

3. ***A mining company has a choice between delivering and financing NbS internally, with its own resources, and contracting it out to a third party.*** *It may hold the project close, on balance sheet, or at arm's length, in a special purpose vehicle, with a*

corresponding choice of financing on or off balance sheet, drawing on the general corporate finance available to the firm, ring-fencing funds with specific use of proceeds, or drawing wholly on external finance.

4. ***A mining company may then be clear about the scope for public and private financing through the life of its project.*** *The source of finance determines the types of financial instruments that may be available and identifies who might be willing to act as financial investor. To identify suitable investors, one must first understand the range of investors and their respective preferences, including their preferred exit.*

5. ***Risk mitigation instruments may become part of the investment model,*** *where they could lower the cost of finance, allow a more highly leveraged structure to be adopted, or increase the range of financiers who are willing to participate, or some combination of all these.*

6. ***In the move to go beyond the business-as-usual approach to climate finance, there are requirements to better factor in climate risks and build ecosystems' resilience to climate change while embracing a more transformative approach to financing options.*** *This will require significant collaboration across the private sector, civil society, and governments. Aligning climate and nature finance with particular Sustainable Development Goals (SDGs) and other wider goals for biodiversity and social outcomes while also identifying the business models and opportunities that can best enable this approach, at scale, will be critical to success. There is a need to create new opportunities for companies to explore how to invest, and to combine multiple benefits through the most appropriate investment models. Companies are generally buying carbon credits as a small piece of their corporate net zero strategy, but the combined value of those deals is becoming a serious source of finance for green projects around the world that contribute to the SDGs. Of course, not all are good quality carbon projects, nor are they all delivering the SDGs.*

7. ***The "holy grail" of making NbS investable is to find positive cash flows that emerge from protecting and/or restoring nature, providing a return on an investment.*** *There are now opportunities for new types of investment models, where there is high potential for NbS, with private finance, to meet increasing future demand for carbon credits and ecosystem services such as water provision, flood controls, and food, among others (WEF 2021a).*

4.2. State and Trends of NbS Finance

The United Nations Environment Programme (UNEP) estimates that meeting climate change, biodiversity, and land degradation neutrality targets will require an investment of $8.1 trillion in nature by 2050. Governments are under growing pressure to increase funding to meet these targets and are increasingly aware that public finance alone will not be sufficient to achieve these goals—much less to act on a planetary scale.

Public financing institutions, such as development finance institutions (DFIs), donors, as well as philanthropic foundations, are therefore increasingly interested in ways to use their balance sheets to attract private investors or to build the capacity of conservation projects to leverage private capital (Earth Security 2021a).

Recent analysis shows that between $0.8 and $1.4 billion is spent annually on NbS—a small proportion, 1 percent, of the annual flows of global biodiversity conservation finance. The total current annual financial flow into biodiversity conservation is estimated at $124–$143 billion per year (in 2019) (Deutz et al. 2020). Earth Security (2021a) provides a practical road map for public finance institutions (DFIs, donors, foundations) and long-term investors to use blended finance strategically to unlock investments in nature. Nature may be our ultimate asset, but the markets that will enable investors to invest in precious ecosystem services are still nascent and Earth Security states that only 5 percent of blended finance transactions over the past 15 years have focused on nature.

The private sector plays a small role in the financing of conservation. Biodiversity conservation funding continues to be principally the domain of the public sector, with direct domestic government spending and fiscal policies alone representing 54–60 percent of total annual biodiversity conservation flows (Deutz et al. 2020).

Research indicates that the gap between NbS investment needed and investment delivered reached between $500 and $711 billion per year in 2019. To continue protecting biodiversity and meet conservation targets, the Paulson Institute recommends that biodiversity conservation receive between $722 billion and $967 billion per year by 2030. UNEP (2021) estimates a $400 billion per year requirement in forests, mangroves, peatland, and silvopasture.

Together, forestry and protected areas conservation represent a quarter—$168 billion and $224 billion, respectively—of the global biodiversity conservation financing needs.

Despite a substantial gap in biodiversity financing, especially from the private sector, momentum is growing. Large companies are increasingly committing to climate action and drawing on private sources of finance. With net zero commitments from more than 700 of the world's largest companies, there is high potential

for NbS, with private finance, to meet increasing future demand for carbon credits (WEF 2021a). In addition, companies are showing increasing willingness to invest directly in nature. For example, Amazon is contributing $10 million to the restoration of 1.6 million hectares of forest in the United States; Nestlé is investing in avoiding deforestation and supporting forest restoration in Ghana and Côte d'Ivoire; and Shell is planting 5 million trees in the Netherlands, among other climate commitments. Walmart has pledged to become net zero in operations by 2040 and to manage or restore 50 million acres of land (WEF 2021a). Ørsted aims to achieve net positive for biodiversity for projects commissioned from 2030.

The private finance sector is increasingly aware of the crisis in nature and the likelihood of future government action. The gradual increase in regulations conferring duty of disclosure in supply chains, with rare extensions to supply chain financiers, such as the Loi de Vigilance in France, has increased awareness among financial institutions. Regionwide, the European Union is considering future rules on mandatory due diligence and the Taskforce on Nature-related Financial Disclosures (TNFD) is working on reporting of both current and future risk, with the latter having the potential to encompass impact. Furthermore, there are signs that investors and asset managers may wish to improve the understanding of the environmental, social, and governance (ESG) performance of the land-based components of their portfolios.[1] Commentaries such as the Dasgupta Review suggest that investors should better understand and internalize the risks and impacts associated with deforestation and nature loss, that they should equip themselves with tools that make these risks visible and quantified, pointing out that groups such as the TNFD have an important role to play as will initiatives such as Trase Finance, Forest 500, Planet Tracker, and Orbitas, among others.[2] In due course, one might speculate that investors will wish to "defund deforestation" and align their portfolios with both a Paris Agreement–compliant 1.5°C pathway and a nature-positive or similar principle. In the past years, mining companies' shareholders have started demanding regular, transparent reporting on the impact of projects that mitigate the consequences of mining on land and Indigenous communities.

New players are entering the space to unlock financing of NbS. Asset managers and banks are increasingly willing to consider innovative strategies for their portfolios. For example, the Pollination Group has formed a partnership with HSBC to raise $1 billion for NbS in 2021. The Timberland Investment Group has launched a new division, Landscape Capital, with ambitions of a similar scale (Landscape Capital 2020). Other groups, such as Emergent, are making strides in mobilizing support to tackle deforestation at the jurisdictional level, which could unlock significant new funding for NbS, creating a high-quality supply of forest carbon credits to meet rising corporate demand.[3] Some concessional financiers have also made commitments to help bridge the NbS private funding gap. For example, by 2030 the IUCN's Nature+ Accelerator Fund expects to have a portfolio of up to 70 projects, attracting additional co-investment of up to $160 million.[4]

Private financial institutions face several problems, including novelty and the sparsity of revenues for NbS. A common perception among the finance sector is that revenues from NbS are high risk or inadequate, and this discourages investments by private financial institutions. In this immature market, projects in search of finance can be relatively small and location specific. A lack of track record of NbS performance at scale and a limited forward pipeline result in low willingness to invest in expertise to handle transactions.

In the context of emerging NbS momentum, demonstrated need, and potential for future revenue streams, large-scale mining companies may be looking to build and test investment models for their NbS.

The current approach by the banking sector to biodiversity financing is premised on returns on investment within time frames that may or may not be feasible to deliver NbS project requirements. More important, they may be of a scale that is poorly aligned to the needs or functionality of those implementing the project. Noting that NbS need to deliver co-benefits to society and biodiversity, and should be scalable, the financing options need to be tailored to the size, scale, timing, and focus of the NbS.

We present a range of nonconventional financing instruments and funding options more typically applied to the nature conservation and development sectors in the form of impact investment, micro-enterprise, and blended financing, as well as tapping into grant and public financing facilities.

As such, this chapter offers four typologies, each addressing financing and funding options appropriate to the

1 *See chapter 20 in Dasgupta (2021).*

2 *For more information, see TNFD, https://tnfd.info/; Trase Finance, https://trase.finance/; Forest 500, https://forest500.org/; Planet Tracker, https://planet-tracker.org/purpose/mission/#gallery-1; and Orbitas, https://orbitas.finance/.*

3 *For more information, see Emergent, https://www.emergentclimate.com/.*

4 *"Nature + Accelerator Fund," Nature-based Solutions, IUCN, accessed May 26, 2021, https://www.iucn.org/theme/nature-based-solutions/initiatives/nbs-finance-mechanisms-and-funds/nature-accelerator-fund.*

need of the NbS project and the delivery agency/ies responsible for implementation.

1. Traditional financing
2. Landscape and climate financing
3. Financing facilities
4. Conservation financing

4.3. Building the Business Case

Companies will, of course, appraise the economic viability of candidate projects against alternatives before deciding which to proceed with and how to finance them. This appraisal and due diligence, where done comprehensively, will cover the economic, environmental, and social performance of a project.

The objective of this section is to describe the due diligence steps companies would carry out before drawing conclusions on the sustainability of their project's investment model.

The business model to support the finance option of a project is a critical part, combining the project's social and environmental objectives with project costs and risks, governance, and the company's own in-house capabilities. An example process for developing the business model for NbS is shown in Figure 4.1 and can be adapted to the specific context of the project.

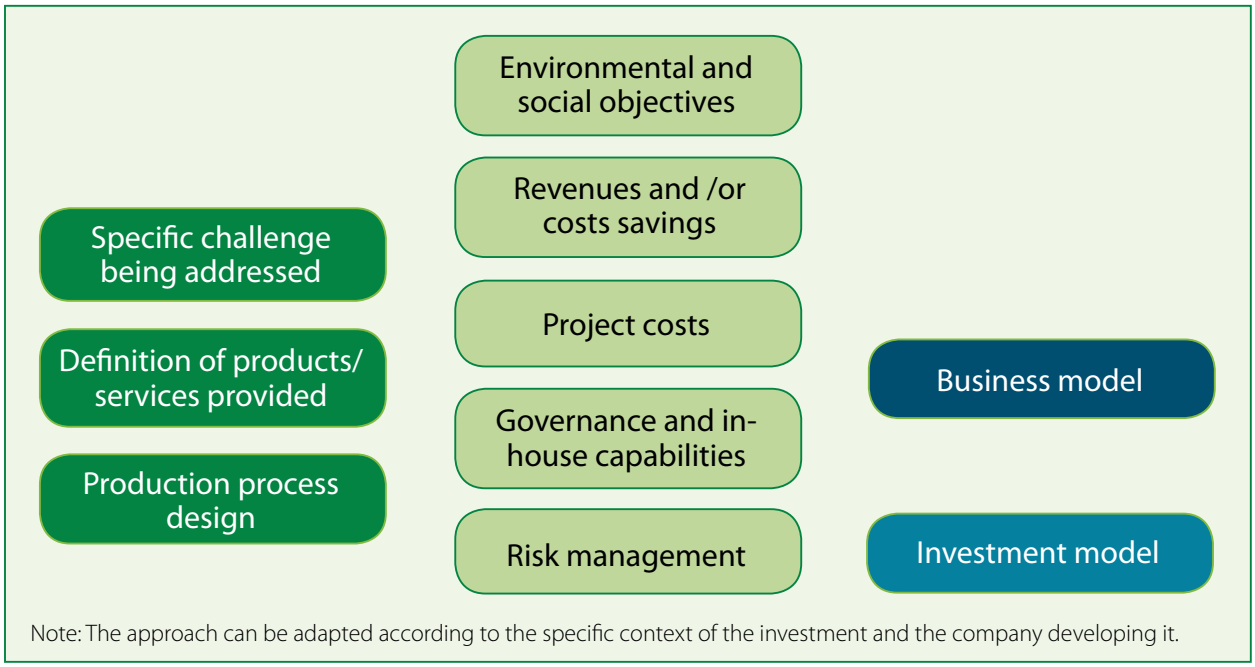
Consideration should be given to the development of innovative financing solutions, which might include the following:

- Cofinancing (for example, for clearing of alien species and converting alien plant biomass into a commercial by-product to sell and finance the ongoing removal of this vegetation)
- Strengthening the regulatory framework to incentivize innovative financing (for example, hydroelectric power sold and returns reinvested in water infrastructure)
- Exploring innovative and off-budget financing mechanisms
- Supporting microfinancing for smallholders
- Drawing on successes and lessons learned from financing models adopted internationally to fund infrastructure in the water sector
- Exploring opportunities to invest in ecological infrastructure through blue or green bonds issued by government, municipalities, or multinational banks

4.3.1. Revenues and/or Cost Savings Resulting from the Project

The financial return on an NbS project is the key indicator of commercial viability. Revenues increase the viability of the project and its attractiveness to investors, but there can be trade-offs with other dimensions of performance. Landowners or rights holders who could sell carbon credits, water credits, and/or biodiversity credits from a sustainably managed forest typically would compare this with an alternative, such as farming cash crops, to

Figure 4.1: Suggested Process for Developing the Business Model



Note: The approach can be adapted according to the specific context of the investment and the company developing it.

see which is financially more attractive. Sources of NbS revenue include the sale of goods and services, carbon credits, biodiversity credits, and subsidies. Opportunities exist across a wide range of investments, not only in forestry but also in, for example, restorative agriculture, peatland restoration, and mangrove restoration. The demand for carbon and biodiversity credits is still relatively small today, but it is predicted to grow rapidly and have a transformative effect. Sources of cost saving include reduced impacts from extreme weather, lower input costs for sustainable agriculture, reduced royalties, and/or reduced time to obtain exploration or extraction licenses.

There is also potential for financing from providing biodiversity offsets within a regulatory environment (including protected area financing) with co-benefits accruing to carbon, water, livelihoods, and other key environmental services, delivered through land restoration for both carbon and biodiversity offsets.

Key issues relating to NbS revenues and typical for any project include the following:

- The timing when the project will commence, reach full scale, reach maturity, and come to the end of its life
- The amount and timing of revenues and uncertainty in both price and quantity of outputs
- The revenue and cash waterfall, determining how proceeds will be distributed across parties to the project
- The demonstration of "additionality" as part of the framing of the project (required by some models)

The accounting problem of additionality links the cause and effect of a potential donation and conservation effort. That means making sure that an acre of rainforest or a stretch of coastal wetlands is preserved as a direct result of a given funding effort. If a credit, grant, or investment goes to secure an ecosystem that wasn't under threat to begin with, it isn't leading to an additional reduction in emissions. The same is true for purchasing credits for restoration efforts that were already under way within a country.

However, establishing that a program is additional requires evaluating a counterfactual—that a particular nature preserve or restoration effort would not have happened were it not for the intervention—and many initiatives have struggled to demonstrate that this is true for their interventions.

4.3.2. Project Costs

The project costs and cash flow profile determine the financing need. They will also influence the source of finance. The sponsor will estimate the amount, timing, and type of finance required, usually relying on experience or market practice as a guide.

Key issues relating to the appraisal of costs include the following:

- The estimated amount and timing of costs and contingency to achieve the project's aims
- The amount and timing of free cash that will be used to repay debt or will be distributable to equity investors
- The credit enhancements that will reduce uncertainty for investors
- A comparison of the project with the sponsor's preferred project financial characteristics, including threshold key financial performance criteria such as hurdle internal rate of return or maximum payback period

4.3.3. Social and Environmental Objectives

The company should provide an articulation of tangible, quantifiable objectives and supporting metrics for social and environmental outcomes (see Boxes 4.1–4.3 for examples of the business case for NbS). Ideally, these objectives and metrics will allow the comparison of the project's expected outputs with those of past and alternative projects. In choosing objectives and metrics, it may be possible to align around SDG goals and recognized principles and standards. NbS projects would expect to deliver against metrics related to conservation/protection, restoration, new asset creation or improved land management practices, and preserved carbon value of preserved soils/forests. The project proposal would identify the potential of the NbS investment to address needs and opportunities.

Key issues relating to nature investment include the following:

- The needs and opportunities addressed by the NbS project and the project's fit within broader sponsor strategy, including where appropriate having regard to corporate policy, sectoral plans, national public policy and local public policy across nature, biodiversity, water, land, livelihoods, environmental justice, and social SDGs.
- The context of the project in terms of the scale of the need (for example, to reduce deforestation rates) and opportunity taking account of existing conservation/protection, restoration, and habitat creation efforts, as well as unmet need. The project's expected contribution to meeting that need, expressed, for example, as hectarage of an ecosystem type, species numbers and populations under threat or requiring restoration.

Box 4.1: Vale's Business Case for NbS

Vale has incorporated NbS into its corporate targets. Vale has a Forestry Goal, to restore 100,000 hectares and to protect a further 400,000 hectares of forest beyond its borders, by 2030.a Local to its Carajás site, the forest habitat restoration program aims to restore more than 5,000 hectares. This program will convert degraded agricultural land into forest habitat to offset direct mining impacts on forest habitats.

NbS projects can contribute to the fulfillment of Vale's emission reduction targets. Vale has incorporated NbS initiatives into its climate planning and broader climate-related goals, which include a 33 percent reduction in Scope 1 and 2 emissions by 2030, progressing to carbon neutrality by 2050. This is a voluntary corporate policy, as Vale does not licensing limits or liabilities for CO2 emissions. NbS investments are accompanied by other decarbonization activities which are placed higher in the mitigation hierarchy. Thus, NbS projects are primarily favored for their complementary benefits to biodiversity and nature, rather than as an initial decarbonization measure.

a. By 2020, Vale had achieved the recovery of 1,053 hectares and protection of 52,846 hectares.

Box 4.2: Anglo American's Business Case for NbS at Los Bronces Mine, Chile

Anglo American has identified protected land areas wherein nature-based solution (NbS) projects can demonstrate commercial and environmental benefits. Anglo American has two private protected areas in Los Bronces (7,000 hectares) and El Soldado (4,000 hectares) under first stage evaluations for potential NbS investment. Anglo American is already developing a forest rehabilitation plan on a 240-hectare site in Las Tórtolas, where it aims to plant between 72,000 and 120,000 trees. Furthermore, the national sanctuaries of Yerba Loca and Los Nogales have great potential for NbS and are already supported by Anglo American as part of the company's Biodiversity Action Program. Prospective and existing projects are small but of sufficient scale to evidence a business case for NbS adoption.

Anglo American has a set of environmental targets and standards that NbS could help to meet, particularly its emission reduction target, and is targeting a company-wide 30 percent reduction in net greenhouse gas emissions by 2030, compared with 2016 levels. To achieve this target, the company is looking to offset all Scope 1 emissions for three copper production sites in Chile, using regional offsets with a biodiversity focus, presenting a clear opportunity for NbS. Anglo American has made initial evaluations to understand the scale of this task and modeling by ENGIE estimates that Anglo American's offset demand will be of a scale of several hundred thousand tons of carbon dioxide per annum. Furthermore, Anglo American hopes to achieve a net positive impact on Biodiversity by 2030. Anglo American recognizes the benefits to nature from implementing NbS in its protected areas.

Licensing and permitting requirements for mining at Los Bronces do not demand significant conservation or emission reduction activities, although this could change in the future. Instead, Anglo American's corporate standards require mining operations to achieve greater environmental protection than is mandated by local compliance rules. Anglo American does not currently face an emissions trading scheme or carbon pricing mechanism in Chile. However, it is possible that Chile will implement an emissions trading scheme in the medium term. The Chilean government is currently working on developing an offset regulation, expected to be operational in 2023 (ICAP 2021).

The sale of emissions credits could create a source of revenue and a commercial incentive for expansion of NbS on Anglo American's protected lands. If a carbon pricing mechanism commences in Chile, Anglo American could be rewarded for NbS via carbon credit sales. This might significantly strengthen the business case for NbS.

The level of offset demand to satisfy Anglo American's emission reduction targets might require additional land purchase (or carbon credits from other sources). Anglo American has two protected areas in Los Bronces and Soldado, covering 11,000 hectares. However, its current landholdings might be insufficient to meet future offset demand, so the firm is considering land beyond its ownership for its suitability for NbS conservation and carbon sequestration.

Box 4.3: Responding to Shortfalls in Funding for Effective Management of a Protected Area in Liberia

ArcelorMittal Liberia developed its Biodiversity Conservation Program to compensate for residual impacts of mining operations on biodiversity in the Nimba Range landscape in northern Liberia, with a goal of achieving net positive impact through a multifaceted program of environmental and social activities.

A core component of the program was to improve the management of the East Nimba Nature Reserve that extends across 11,553 hectares of the Nimba Range. The reserve was gazetted in 2003 but did not have a formal management system in place until 2014, agreed through a consensual process supported by the Biodiversity Conservation Program. The financial contribution of the program has also helped address a critical shortfall in state funding for the management of the reserve. The program is also working to enhance management of community forests in the landscape in order to reduce illegal agricultural clearance and tree cutting, avert the loss of forest cover, and protect plant species, including those that are of economic use to communities, and maximize species diversity. This example highlights the potential role that mining companies can play in responding to unmet needs for forest protection and sustainable management in a landscape while delivering on its own environmental and social objectives.

The Biodiversity Conservation Program does not currently generate revenue or create cost savings directly from the project activities; however, through improved management and reduction of deforestation, the opportunity for carbon credits, payments for ecosystem services, and biodiversity offsets might create potential options to bolster financial viability and revenue generation in the future. Currently, the real strength of the program lies in its ability to help enable company social and environmental objectives within its operating landscape.

4.3.4. Project Governance and Company In-house Capabilities

When structuring a viable NbS, it is necessary, as with any project, to identify capabilities and roles for project implementation. This exercise will (a) clarify the governance of the project, (b) assess the capabilities of the sponsor and contractors and their fitness to carry out the project, and (c) estimate the financial requirements. In this assessment, the leadership and management, technical expertise, and financial and commercial capabilities of the participants will be assessed. While these might all reside in house in the project sponsor, they might instead be found between the sponsor and a variety of contractors. It is also possible for the project to be developed by one party or parties before being transferred to others for its operational phase and to a final set of parties at the end of its operational life.

Key issues relating to governance and capabilities include the following:

- The types of capability required. A wide range of capabilities might be involved, covering land and conservation management, carbon credit trading, monitoring and evaluation, assurance, commercial, finance, government, and community relations. These capabilities could be spread across a range of organizational types, such as cooperatives, small and medium enterprises, large corporations, nongovernmental organizations, academic institutions, DFIs, and commercial banks.
- The definition and allocation of roles, responsibilities, risk, and reward.
- The strength and reliability of each party and availability of substitutes.

4.3.5. Financial Risk Management

NbS may involve a range of risks, all of which have to be identified and considered within the financial arrangements. Some of these are general risks for any project and some are specific to NbS.

Key issues relating to NbS project risks include the following:

- The general risks for any project, including technical risks in construction and operations, commercial risks, risks around legal title and licensing, public policy and reputational risks.
- The specific risks are around novelty (lack of track record). These include uncertainty in the costs and performance of NBS assets, uncertainty in the prices and buyer availability for voluntary or compliance carbon market credits (or other revenue sources), and the risk of public policy changes in the long-term licensing or permitting arrangements for NbS.

It is possible to transfer some of these risks to a third party, in the form of insurance, or credit enhancements, for example, via a first loss contribution of subordinated debt, but it is too early to say which risk mitigation mechanisms will become available or be most popular.

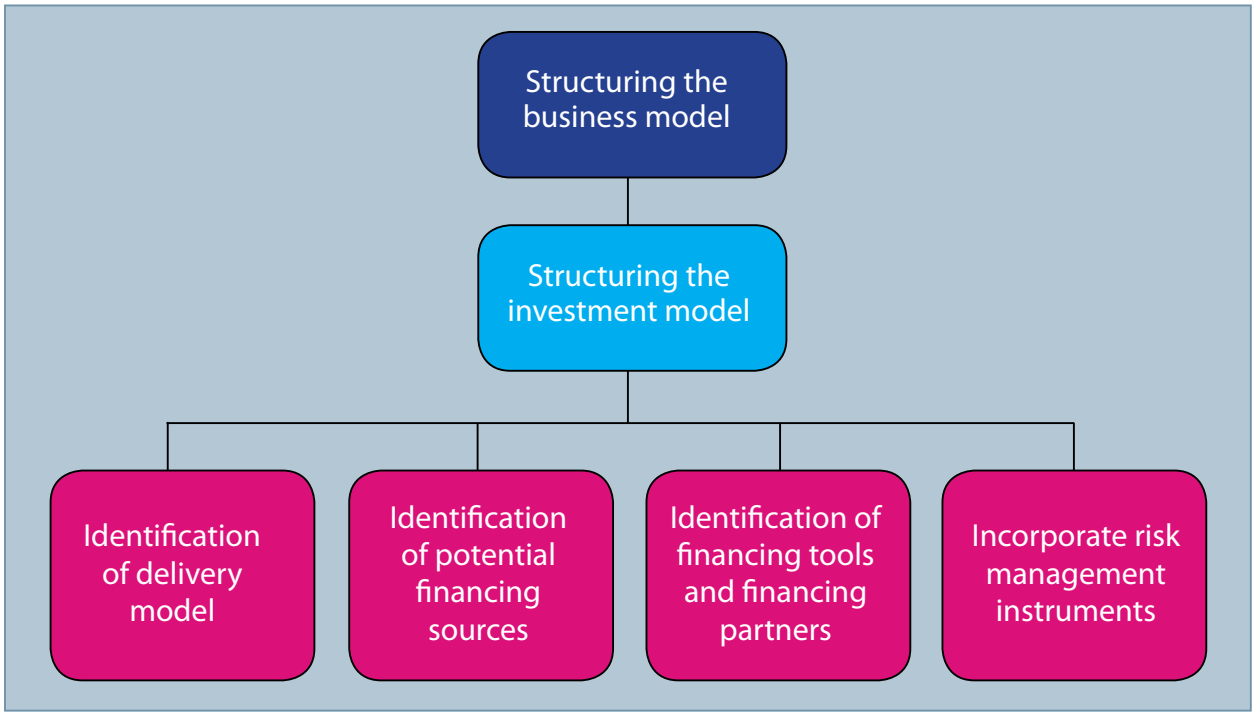
4.4. Designing Financing Techniques for NbS

4.4.1. Building the Investment Model

In building their NbS investment model (Figure 4.2), mining companies face four overlapping decisions:

1. Delivery mode
2. Financing sources
3. Financing instruments and finance partners
4. Risk mitigation instruments

Figure 4.2: Suggested Process for Developing the Investment Model



Currently, large-scale mining companies typically record their conservation and nature-based activities on their balance sheet and finance them using their own cash flow. The following sections discuss the key issues relevant to each stage of the investment modeling process for this and alternative investment models.

4.4.2. Delivery Models

Mining companies have a choice to make between delivering and financing NbS internally—either through their own divisions, by contracting it out to a third party, or by setting up in a special purpose vehicle, with a corresponding choice of financing on their balance sheet—or externally, off balance sheet. The factors in the choice span the following:

- Operational resources of the firm
- Scale and transaction costs associated with the option, with only the largest projects able to accommodate the higher transaction costs of setting up and maintaining new legal structures such as special purpose vehicles
- Scope to drive economies of scale by servicing demand for NbS from a range of customers
- Advantages of close control of activities, especially if compliance with NbS provision is a license requirement for the core activity
- Availability of capital and degree of competition for capital budget from core activities
- Fit of the financial profile, in cash generation from capital deployed, of NbS with the rest of the firm's activities

At present, most NbS are financed on balance sheet as the projects are relatively small, being associated with offsetting the biodiversity or land footprint of mining projects (rather than the carbon footprint and typically focused on just the mining site and not the broader area of impact), and sources of NbS demand from third parties have yet to scale, which means there is not yet a vibrant community of independent, financially strong, low-cost project developers and operators to which to outsource. This situation might change and might change rapidly if and when an NbS market emerges, in turn driven by the timing and scale of demand for carbon and/or biodiversity credits (see Box 4.4 for examples of financing options at the Los Bronces mine, Chile).

Box 4.4: Anglo American's NbS Financing Options at Los Bronces Mine, Chile

Anglo American's existing nature-based solution (NbS) reforestation at Las Tórtolas (240 hectares) is a small-scale venture, financed on balance sheet and treated like any other capital expenditure. Additional land acquisition is unlikely to raise financial affordability questions to a firm of Anglo American's size and strength.

NbS projects have the potential to generate revenues in the long term. Anglo American is looking to generate regional offsets through restoration of land in hand and purchased land. If the land purchases generate surplus emission reductions beyond insetting (using land owned or controlled as "internal offsets") its own emissions, Anglo American could verify and sell these emission reductions into carbon markets.

In Anglo American's current context, revenues from carbon offsets or credits are uncertain. The absence of a forward carbon market and a national or regional carbon pricing mechanism means that the company would have to rely on the voluntary markets as a source of revenue. A formal compliance scheme such as an emissions trading scheme or carbon tax would be likely to lift the value of credits.

Similar to the other large mining firms who have adopted long-term corporate policies to decarbonize or become nature positive, Anglo American's scale of investment in NbS could be relatively large and could further expand into the development of assets beyond their own requirements, allowing the merchant sale of credits to third parties. This scale is amenable to the sale of securities on capital markets and to blended finance models in which development finance institutions offtake those risks that make financial market participants feel uncomfortable.

Aggregating projects can deliver greater returns to scale. Anglo American's ambitions might suit a wider program of activities approach to NbS investment. Emission reductions at Las Tórtolas, for example, could be bundled into a wider program of activities alongside potential NbS implementation at Los Bronces and encourage expansion of Anglo American's existing NbS pilot projects.

4.4.3. Financing Sources

The source of capital financing varies depending on both the ecological domain and the scale of financing required. The majority (around 86 percent) of finance flowing directly into NbS today across all sectors comes from public sources, though within mining it is likely that it all or mostly comes from the private purses of miners themselves. The large international financiers and donors are intent on substantially increasing their flow of funds into NbS over the next five years. At the same time, private financiers are paying more attention to NbS as a potential future class of assets, as a possible prelude to making funds available. That means, as of today, there is public and on-balance sheet finance available. In the future, more of these and third-party private finance may become much more available, likely in response to demand rather than anticipating it.

Key issues relevant to financing sources for nature-based projects include the following:

- The impact the financing needs might have on profits and the ability to achieve the break-even point
- The role of grant and concessionary finance to mitigate risk and leverage private sector investment at later stages

The next section introduces the elements of finance that may become available to NbS in the short and medium term, by showing the range of financial instruments and their role in capital structures, discussing ways to assign risk to third parties through risk mitigation instruments, and introducing aspects of the choice of financial partner (sources of finance).

4.4.4. Financing Instruments

NbS projects are potentially hugely diverse, even within mining alone, in underlying assets, in geographical setting and sovereign risk, in scale, and in ancillary public benefits to society and the local economy. Thus, a wide range of financial instruments could be applicable. Table 4.1 provides an overview of available financing instruments according to their source and the rationale behind their use.

At the present time, a large proportion of NbS finance globally is from public funds, with the objective of developing experience and the market for NbS, as well as directly procuring (via subsidy) public goods and services. In particular, the mandate of this public finance is to support economic development, environmental improvement, and social justice. Thus, public funders are more willing to provide finance where the principal sum (the amount lent) does not have to be returned, because they attribute value to the public goods and services supplied.

Private and public financiers have a range of instruments available to them. Generally, they are willing to provide equity (accepting more risk) as well as debt, and this applies to NbS as well as other activities. The most generous form of equity, where no return of capital and little or no return on investment is expected, are grants and nonreimbursable loans. These two grant-like instruments are usually made available to offset costs, particularly at the early stages of project development.

Private philanthropic funds and public sources may also be willing to provide more generous forms of finance where no return of capital and little or no return on investment is expected (see Box 4.5 for examples of blended finance). These grants can come in the form of technical assistance, to de-risk projects and enable them to create the plans and structures that will allow them to gain access to finance on commercial or near-commercial terms. They may also be used to gain participation in and hence influence a project, such that by covering some of its costs, its objectives can be steered toward the supply of public goods and services and thus public interest outcomes can be enhanced.

It has become common in adjacent asset classes, such as renewable energy, to blend public equity with private equity. Sometimes the public equity has an equal role to the private equity, participating on a ***pari passu*** basis, that is, when the public and private equity participants enjoy the same terms. This can bring benefits to the project. For a start—and this is especially relevant in emerging markets where contracts may be harder to enforce—the public financier often has political influence, and it can use that to insulate the project from political interference. It also has deep pockets, so it can defend the project from the worst legal threats, such as expropriation. In addition, it has experience, credibility, and access to financial markets, and this can open doors to new investors where the asset or commercial model is novel. As climate ambition continues to grow and financing models developed to meet that ambition are linked directly to Nationally Determined Contributions (NDCs), public support and engagement will become more important.

Box 4.5: Blended Finance Examples

Blended finance is an approach that involves the use of public and philanthropic funds to change the risk/return profile of investment projects in order to attract the private sector. According to Convergence, which holds the world's largest database of blended finance transactions, over the past 15 years some 600 transactions involving blended finance have mobilised an aggregate USD 144 billion from public and private sources. Sectors such as energy, infrastructure and financial services represent the majority of these transactions, where projects can service paying customers, generate revenues, and clearly measure their social and environmental impact alongside a financial return.…

In Pakistan, Earth Security worked with CDC Group—the UK's Development Finance Institution (DFI)—to define the investment value of mangroves for a coastal renewable energy investment project. The evidence suggests that mangroves will help the project developer save an estimated USD 7 million in maintenance costs, while providing another USD 5 million in income to local communities that depend on shrimp farming, improving the project's social license to operate. The DFI community has yet to consider the value that nature's assets provide to their investment portfolios and support their development impact.…

Other emerging investment opportunities focus on innovative financial instruments that unlock capital to invest in nature's services. These involve bonds, insurance products, and "payment for ecosystem services" funds of various kinds. Most are still at an early stage. One example is the Forest Resilience Bond (FRB), which was created and piloted in California by Blue Forest Conservation. The FRB is a finance instrument that enables the US Forest Service to restore forests, minimising the catastrophic risk of wildfires. The cashflow that repays the bond for investors is provided by downstream companies that benefit from the steadier supply of cleaner water and save on water treatment costs.

Source: Earth Security 2021a.

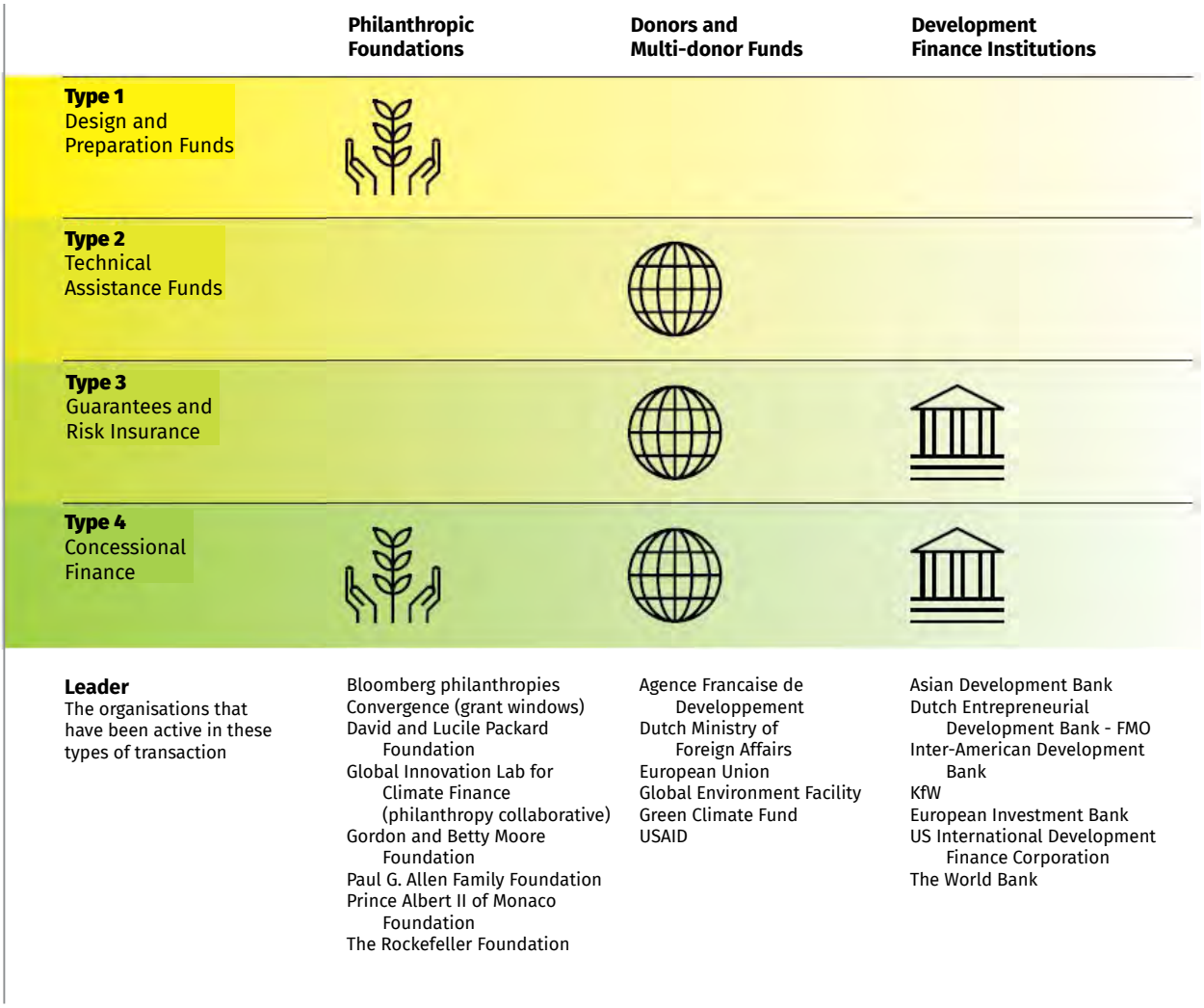
Of course, standard equity of the form mentioned above could equally well come from private sources, and they are likely to become the most important. The degree to which a private equity participant could supply political influence or market credibility to the project will depend on the attributes of the buyer. It might also offer commercial expertise, where it wishes to participate in a more active manner. Private sources might also employ more commercial terms and conditions, be able to move more quickly, and impose fewer public interest requirements.

A recent report by Earth Security (2021a) considers investment funds, financing facilities, and investment products that (a) focus wholly or primarily on investing in ecosystem conservation or restoration in a way that captures economic value, and (b) incorporate a blended finance approach of using public funds catalytically to attract private capital. The vehicles are used to finance sustainable forest management, agroforestry and agriculture, and the sustainable management of coastal and marine ecosystems. The main public finance and philanthropic actors who have provided blended finance for nature-based transactions can be grouped into three categories: philanthropic foundations, donors and multidonor funds, and DFIs (Figure 4.3).

Several other forms of equity play a more specialist role. Closest in form to standard equity is subordinated debt. If the project finds itself short of funds, even after suspending the payment of dividends to shareholders, subordinated debt is distinguished from ordinary debt because the subordinated debt holders are only entitled to payment of interest and principal once the senior debt holders have been paid. Since subordinated debt is not typically offered by private financiers, it is more likely to appear as a public finance contribution in a blended structure. Its presence reduces the amount of equity needed in the structure to achieve the same level of risk reduction to senior debt holders. Looking at it one way, it reduces the equity needed; looking at it another way, for the same contribution of equity, it allows the project to seek senior debt from a wider range of lenders and on more favorable terms.

The remaining equity-like instrument—insurance—plays a special role moving risk away from the project. A variety of losses and perils might be covered (for example, loss of revenue from carbon credit sales due to fire or disease in managed forest). Of course, a range of potential perils, levels of cover, and excess amounts could be included in the insurance. Insurance might be particularly useful in giving investors comfort that they can face the residual risks. This might widen the appeal of the project to investors (See Table 4.2). Risk mitigation is explored in more detail in section 4.4.5.

Figure 4.3: Blended Finance Types and Likely Providers



Source: Earth Security 2021a.

The final piece on instruments is securitization. It is not clear whether this will be relevant for NbS applicable to mining operations, but it is included here for completeness. Larger-scale assets or portfolios of assets that generate predictable, stable cash flows can sometimes be packaged and sold to an investor who has a particular appetite for that configuration of cash flows and risk. This is typically a way to realize maximum value for the underlying assets. It might be that in the future, some NbS with stable generation of, say, carbon credit revenues would be amenable to securitization. This would be a sophisticated option and only of relevance where an NbS developer wanted to sell off the assets. It is not worthwhile discussing it further here.

Table 4.1: Financial Instruments Potentially Available to NbS Developers, Including Mining Companies

Source	Financial instruments	Description	Relevant project stage and maturity
Concessional	Grants	Grants and nonreimbursable loans to support project viability, usually in exchange for public good	• Subcommercial return on investment • Hard to bank counterparty • Hard to manage risks • Only available from public sources of private philanthropy
Concessional	Concessional loans and credit lines	Loans at below market rates that do not reflect the full risk or transaction cost	
Blended	Equity	Direct equity participation at early stage, mixing public and private equity	• Range of risk levels and commercial viability
Blended	Credit enhancement	Insurance or third-party guarantee	
Blended	Subordinate debt or hybrid debt	Financing that ranks after other sources of finance if a company falls into liquidation	
Commercial	Senior debt and refinancing	Long-term senior lending and capital recycling at market rates	
Commercial	Securitization	Financial engineering to package an asset with a particular cash flow profile	

Table 4.2: Choice between Debt and Equity Will Condition the Choice of Financial Instruments

	Debt	Equity
Advantages	• Loan size is flexible and can range from micro (hundreds to thousands of US dollars) to large scale (hundreds of millions to billions of US dollars). Lenders usually have little or no governance role in the business; relationship with lender ends as soon as debt has been repaid	• Does not divert capital from the business to repay debt • Investor shares in the business risk along with the business owner • If the business fails, there may be no need to repay investors • The business may also benefit from guidance and access to the networks of its investors, or in some cases more hands-on business management from experienced operators (e.g., private equity houses)
Disadvantages	• Businesses with limited cash flow may need to spend a sizable portion of their monthly revenues repaying the money they borrowed • Debt has to be repaid as per the repayment schedule, regardless of revenue, or how well a business is doing • There are significant risks associated with guaranteeing a loan with collateral	• Investors own a portion of the business, and will be due a corresponding portion of the profits • An equity partner may expect a governance role associated with their equity (such as a Board role). This can be an advantage or disadvantage depending on the value of their experience, effectiveness, and alignment with the objectives of the existing management • It can become difficult to secure additional debt financing as lenders often require any entity with at least 20% ownership to sign for the loan; equity investors will usually not do this. Business owners also have little control of when an investor decides to exit a business

4.4.5. Risk Mitigation Instruments

Companies have various options potentially available to them to allocate risks in an NbS project (see Table 4.3). Generally, financial risk mitigation instruments allocate risk away from the project to a third party in exchange for payment, so they are thought of as risk ***mitigation*** instruments even though they do not reduce the total absolute risk inherent in the project. As mentioned above, risk mitigation instruments might lower the cost of finance, allow a more highly leveraged structure to be adopted, or increase the range of financiers who are willing to participate, or some combination of all these. There are also nonfinancial risk mitigation instruments that ***do*** reduce total absolute risk, and these will be dealt with in turn, below (see Box 4.6 for an example of risk mitigation).

Financial risk mitigation instruments fall under the headings of guarantees, insurance, hedges and derivatives, and long-term contracts. Guarantees and insurance will be familiar everyday terms, but in NbS projects they will be novel. With a range of NbS asset types, the perils covered by insurance include but are not limited to effects that are likely to cause damage to the underlying natural assets, for example, through pests and disease, and through natural catastrophes such as fire and flood.

Box 4.6: Risk Guarantees or First-Loss Financing

In East Kenya, BHP Billiton provided insurance as an intermediary "off-taker" for carbon credits in a USD 152 million forest protection bond issued by the IFC for a REDD+ project that paid interest payments in the form of cash or carbon credits. Although not for blue carbon, BHP Billiton committed to buy carbon credits in the case that bondholders decided to be paid in cash, demonstrating a strategic and catalytic use of donor or philanthropic capital.

Source: Earth Security 2021b.

Guarantees might play less of a role than in more technology-intensive assets, but they could be given for performance metrics, such as the survival rate of trees planted. Hedges, derivatives, and long-term contracts are all mechanisms for addressing a mixture of commercial and financial risks. There could be risks from carbon or biodiversity credit price variation or exchange rate fluctuations, for example. The pure credit price risk might be hedged, whereas where costs are incurred in the local currency (for example, Climate Finance Accelerator [CFA]), the US dollar to local currency exchange rate might be addressed through the purchase of derivatives, to avoid having to hold cash in dollars. Long-term contracts are the only way to create certainty around the future price of outputs such as carbon or biodiversity credits (and in the future, potentially water offsets). In an immature private market (and even in a mature one), long-term carbon credit purchase agreements might not be offered by credit buyers, as long-term contracts are seldom seen even in mature commodity markets such as oil and gas. This is where governments might step in and offer advance market commitments, such as a feed-in tariff or long-term purchase agreements. Governments have played that role extensively in relation to renewable energy. They have not yet done so for NbS.

The nonfinancial risk mitigation instruments, in addition to general good management, occur in two types that can be supplied externally to a project:

- **Operational assistance:** This refers to support provided by specialists to improve the quality of the project. The assistance can cover various elements, such as technical, legal, or financial structuring assistance. It is typically provided by DFIs, donors, or foundations.

- **Collateral.** This is a risk mitigation strategy used for debt. It refers to assets (for example, property) to which there is recourse in the event that the project itself defaults on its debt obligations.

Table 4.3: Three Illustrative Risks Associated with NbS Projects

Risk	Examples	Mitigation options
Revenue	Price of carbon credits in local currency	Long-term contracts, hedging, derivatives
Output loss	Pest or disease causing tree loss	Insurance
Errors due to inexperience	First-of-a-kind projects for a developer	Technical assistance

Note: *The availability of these mitigation options may vary between geographies.*

4.4.6. Financing Partners

A wide range of considerations need to be kept in mind when working with investors, as there are many aspects to an NbS project and many types of investors (Clairmondial 2017). To identify suitable investors for a specific opportunity, it is helpful to understand the range of investors and their respective preferences (see Table

4.4). The material below offers a brief introduction to select investor types.

The largest investors in land in the emerging markets are the DFIs. These publicly funded development banks mainly invest as loans but also offer guarantees, grants, and equity. There are over 450 DFIs globally, each with its own geographical and thematic interests; they tend to run country thematic programs that operate in distinct multiyear time periods, sometimes subject to restrictions within donor mandates. DFIs generally operate in a programmatic manner and sometimes distribute funds via local independent banks rather than directly. They bring political capital, which can help secure political support future of projects. They also bring a level of administrative bureaucracy and discipline on governance that will suit some and not others.

Commercial banks will be the principal lending investors once the markets develop. They will likely become more important over time as NbS as an asset class matures and its risk profile becomes better characterized. Until the commercial banks can assess risk from historic lending record, it will be difficult for them to participate unless there is a public investor alongside offering risk mitigation or the project sponsor offers collateral. Once that track record is established, they might create a set of standardized lending products suitable for typical NbS projects.

Some of the largest general investors are the institutional investors, the name given to pension funds and insurers. They have long-term obligations and generally prefer low-risk investments with steady cash generation, and they operate at large scale and in easily marketable securities—in other words, purchasing stakes in funds and in bonds. While they have very large amounts of capital available, they may find it difficult to deploy it in NbS until the NbS market is well developed and operating at scale, but then they could become important players. They offer low-cost finance, so an ultimate goal for NbS would be to become a destination for institutional finance. They make some of their investments via intermediaries, such as a bank, asset manager, or private equity fund.

Donor governments and philanthropies play an important role supporting first-of-a-kind, demonstrator, and novel projects. They may invest on a concessional or nonreturn of capital basis. Impact investors also have a public interest objective, but they generally require full return of capital. These are generally private high-net-worth individuals who are willing to sacrifice return on investment (but not their capital) in return for the creation of public goods. These financiers have an important role to play in the early stages of market development and often invest at small scale.

Sovereign wealth funds are powerful actors in international finance, with large amounts of capital at their disposal and a range of risk and reward appetites, investing directly and through third-party vehicles. They generally invest commercially and at scale, while some have a strong interest in related areas, such as forestry, for example.

Table 4.4: Overview of Financial Partners Relevant for NbS Investments

Source	Type	Instruments and role
Private	Commercial banks	Loans
	Private equity	Equity investment
	Impact investors	Grants, impact capital
	Institutional investors	Equity investment in funds and purchase of bonds
Public	Philanthropic foundations	Grants, impact capital
	Development finance institutions	Grants, guarantees, debt (occasionally equity)
	Governments (domestic and donor)	Mostly grants, impact capital
	Sovereign wealth funds	Equity investment in funds and purchase of bonds

4.4.7. The Role of Government and Recommendations

As the demand for nature-based carbon grows and the quantity of finance available for deployment is increasing, the critical role of governments in the process is coming more into focus. Governments will need to determine how the implementation of NbS can contribute toward the overall mitigation in global emissions (OGEM) as well as form part of private sector and corporate net zero strategies.

- **Facilitation versus regulation**

There is increasing desire for governments to be involved in creating the building blocks and mechanisms that can enable financial flows to be delivered. In many jurisdictions, established frameworks still do not exist, or are nascent; therefore, the necessity for open dialogue

across parties and private actors is critical. This will require governments to provide regulation to facilitate and enable a transition from the mining company's narrow compliance obligations. This should include provision to support new and untried methods for financing and implementing NbS and ultimately to provide guidance and policy that is fit for purpose and help achieve climate mitigation and adaptation targets.

- **Engage strategically with different market mechanisms**

Governments should consider engaging strategically with market-based mechanisms, and in particular the voluntary carbon market, as the lines between compliance and voluntary markets become increasingly blurred. Governments should take a holistic approach rather than favor one type of mechanism for all NbS and private sector support. In this context, the need for consistent guidelines and policy are amplified, and their development will be a priority for facilitating the mining industry to engage more widely with NbS.

- **Carbon stocktakes**

A deeper understanding of national carbon stocks, threats, and potential emission reduction opportunities across jurisdictions should be prioritized by governments; they will be needed by governments to meet their NDCs. This information should be shared freely with the private sector to determine specific routes to support the achievement of the SDGs and other targets and to unlock further financial flows. The private sector—and mining companies, in particular—could potentially assist in generating the data sets for the stocktake and support the overall process.

- **Benefit sharing and carbon rights**

The right to benefit from sequestered carbon and/or reduced greenhouse gas emissions from NbS is a fundamental comment of how NbS projects operate, and the models for carbon rights that are interpreted and assigned vary greatly around the world. Governments have the opportunity (and responsibility) to create fair and equitable structures that ultimately benefit local people and communities.

Where carbon rights are linked to forest ownership or tenure (and forest ownership is likely to be with the mining company or state), the system tends to afford a degree of latitude on how rights are asserted, which can create both positive and negative outcomes.

The Democratic Republic of Congo, Madagascar, and Mozambique, for example, determine that the state has primary ownership over all carbon rights as the government determines ownership of the forest at a national level. In Madagascar, the government controls all carbon transactions, while in the Democratic Republic of Congo and Mozambique, the governments allow the transfer to private project developers. In contrast, Chile ensures that nature-based carbon benefits follow private land ownership where individuals can trade emission reductions freely into the voluntary and compliance markets. Peru and Costa Rica base their approach on the provision of ecosystem services rather than land tenure.

Overall, governments should review current legislation carbon rights and align with the most progressive and equitable strategies that can also help deliver their NDCs and scale up overall global emission reductions.

5. INNOVATIVE FINANCING SOLUTIONS FOR NATURE-BASED SOLUTIONS

5.1. Key Messages

Source: © Pixabay, Joven-mangle

Funding and Financing opportunities and options

What is the best options for financing or funding NbS and how to structure and deliver these.

Structuring the investment: *Scale , lifetime, location, rate of return. Rationale for financing on or off balance sheet. Nature of risks and availability of risk mitigation or transfer instruments. Availability of finance partners*

1. ***Different potential sources of finance*** *-for example, donors, impact investors, multilateral lenders, and commercial investors—will have different objectives, all of which can be suitable for nature-based solutions (NbS).*

2. ***The structure of NbS investment models is key, where the establishment of an investment vehicle such as a special purpose entity can prove advantageous*** *in managing multiple income streams from philanthropic, government, and impact investment.*

3. ***An understanding of a host country's readiness to receive climate finance is crucial, both at the national and local level.*** *This will require an understanding of the enabling environment, infrastructure base, and economy, as well as of existing climate finance frameworks such as REDD+.*

4. ***Climate and carbon finance is intended to cover the costs of climate mitigation and transitioning to a low-carbon global economy and to adapt to, or build resilience against, current and future climate change impact.*** *For NbS, climate and carbon finance flows tend to be channeled to mitigation activities such as afforestation/reforestation, reducing deforestation, and restoring grasslands; adaptation finance for disaster risk management, water conservation, conservation agriculture, and nature-based*

livelihoods; and blended finance with a blend of public and private capital.

5. ***Different finance options are relevant to different stakeholders,*** *from microfinance or inclusive finance models for projects involving communities and smallholders with limited access to traditional banking, through to forestry lending or other business development loans.*

6. ***A wide variety of additional finance instruments can allow for specific project, landscape, and regional requirements and intricacies to align with investor needs and risk profiles.*** *These innovative options include up-front activity-based payments, project-based and jurisdictional payments for performance (such as REDD+), green equity funds, green loan funds, enhanced or unenhanced green forest bonds or risk sharing, transfer arrangements, or other public-private partnerships.*

7. ***Payments for ecosystem services are generating continued interest from potential funders,*** *to incentivize landowners and communities to maintain intact ecosystems.*

8. ***Important learning can be gleaned from successful conservation financing options and community-based schemes*** *such as community forest enterprise, an innovative structure and process for forest conservation with social development and enterprise.*

5.2. Models for Investment

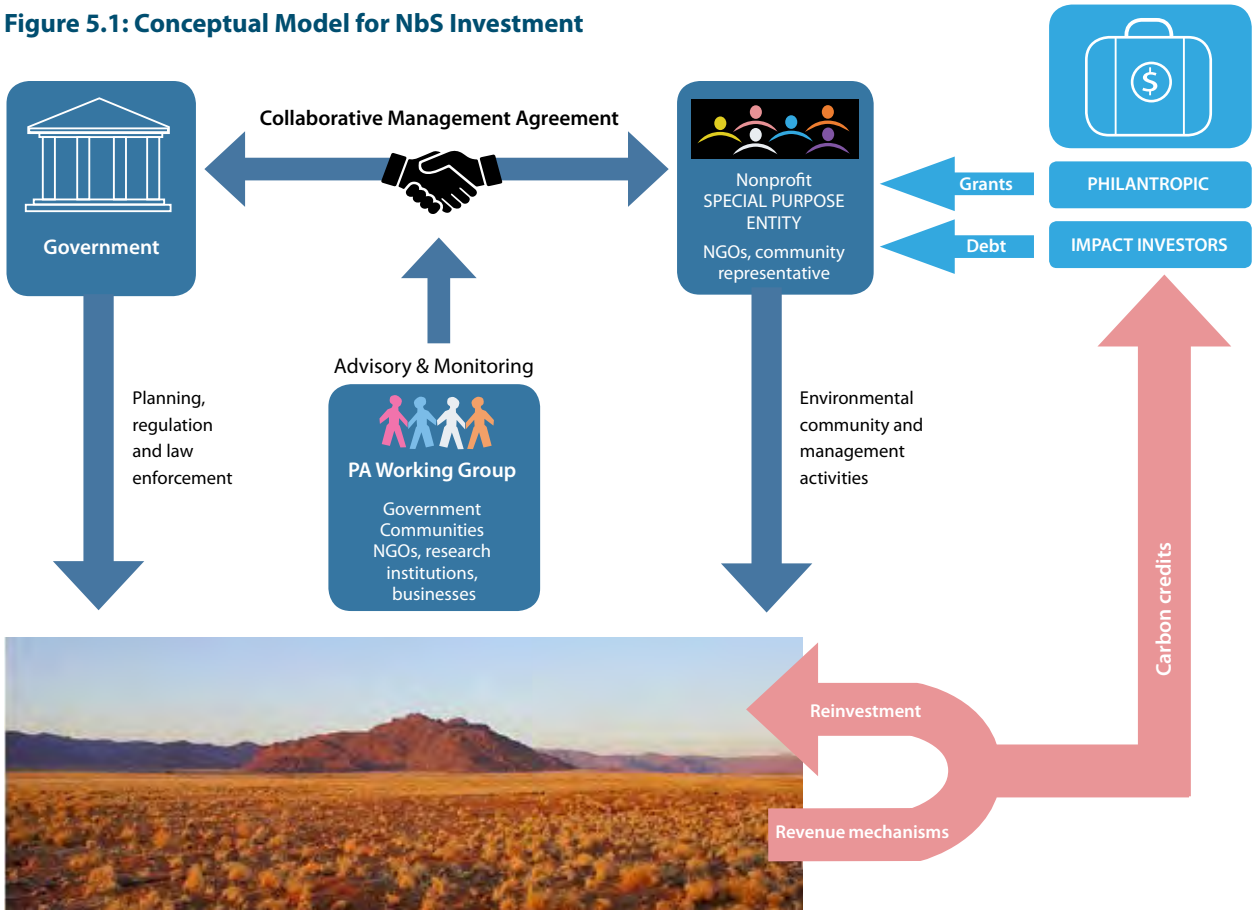
With numerous potential options and a nascent market in many contexts, a conceptual model for investment is a good place to start. Figure 5.1 shows a proven and successful model that can utilize a special purpose entity (SPE) with, for example, local and regional board members, with investment used to develop a nature-based carbon project, take to validation, and achieve verification of carbon credits. Credits transacted will generate a flow of finance back into the project, enabling the repayment of investment.

Carbon credit finance back into project benefit-sharing structures, managed by the SPE, in compliance with, for example, Verra's Climate, Community, and Biodiversity (CCB) Standards and government regulation.

Anticipate benefit sharing would accrue to the following:

- Government
- Communities
- Project developer/coordinator, to finance project management and measurement, reporting, and verification (MRV)

Figure 5.1: Conceptual Model for NbS Investment



5.2.1. Landscape Finance

Landscape finance is the investment of funds that generate a financial return for the investor and achieve positive environmental outcomes in a landscape. Organizations looking to address environmental degradation through investment in sustainable commercial activities in a landscape often include a mix of sustainable commodity production, carbon, regenerative agriculture, and tourism. Typically, there is a relatively complex financial structure that involves the establishment of an investment vehicle in a landscape by a nonprofit project developer. The investment vehicle then takes on debt or equity from an investment fund and disburses funds to one or more commercial entities engaged in securing the landscape, for example, vendors of agricultural inputs, local cooperatives, domestic microcredit schemes, and REDD+ activities. A share of the profits from each funded commercial entity is repaid directly to the investment fund over time, on a mutually agreed schedule.

Because of its ability to achieve outcomes at scale, this approach has become the dominant way in which development institutions and the private sector seek to address environmental degradation in developing countries. Well-designed landscape finance offers the opportunity to provide real economic alternatives to unsustainable use of the natural world and can allow stakeholders in at-risk landscapes to access the financial resources needed to achieve realistic, long-term landscape-level conservation (see Box 5.1 for an example of landscape finance).

Box 5.1: Forest Resilience Bond

In California, where one in three homes is at risk of wildfire, the funding gap for improving forest management and reducing wildfire risks is estimated at USD 6 billion. The Forest Resilience Bond (FRB) aims to help bridge this gap by mobilising investments from private and philanthropic capital to finance forest restoration activities at a greater speed and scale across the western United States.

The Yuba Project was created in 2018 as a collaboration between fund manager Blue Forest Conservation, Tahoe National Forest, the Yuba Water Agency and the National Forest Foundation. The project mobilised USD 4 million from private and philanthropic sources via the issuance of a bond to protect 15,000 ha of the Tahoe National Forest from wildfire risk. Early-stage design grants were provided by The Rockefeller Foundation and the Gordon and Betty Moore Foundation to enable the development of the model including stakeholder collaboration. The foundations additio-nally committed concessional debt at below market rates, enabling private investors Calvert Impact Capital and CSAA Insurance Group to invest in the bond at a higher rate.

Fund manager Blue Forest Conservation aims to issue additional bonds and mobilise enough capital to fund projects in the USD 10–25 million range.

The FRB relies on a cashflow provided by beneficiaries of the forest ecosystem services, including the Water Agency and the water utility company, which share the costs of reimbursing investors over time. These are fixed cost-share payments based on project outcomes, which include avoided fire risks, improved water quality and reduced sedimentation, and water quantities. Contracted payments to investors will be made for up to 10 years, in line with the timing of benefits expected.

The FRB model is innovative in that it takes a systemic approach to forest health and ecosystem services, making use of the expertise and resources from a range of public and private stakeholders. Another defining aspect of the FRB is its ability to raise private capital to fund the full cost of restoration upfront, meaning that restoration activities can be implemented immediately.

Source: Earth Security 2021a.

5.2.2. Climate Finance Readiness

Climate finance readiness refers to the processes through which a country, at the national and local levels, is "ready" to access and receive and then allocate and distribute finance for climate action, as well as to monitor and report on its use and results.

The national enabling environment requires a clear pathway and in-country processes and institutions to plan for climate change, and program-required finance; associated aptitudes and capacities across a wide cross-section of national institutions and stakeholders; and systems to access and spend the climate finance.

To apply climate finance, there is also a need for a well-developed infrastructure base and economy, and active engagement with nature-based climate finance to receive payments via frameworks such as REDD+, or financing of NbS.

As laid out by the Forest Carbon Partnership Facility, the appropriate activities to ascertain nature-based climate readiness include adopting national strategies; developing reference emission levels (RELs); designing measurement, reporting, and verification (MRV) systems; and setting up environmental and social safeguards.

A carbon register is needed for development activities linked with emission reductions and removals, which could also be used for carbon offsets and trading on the international market. This is still under development in many countries.

It is therefore important that companies and their partners consider nature within these wider climate finance opportunities, not only to achieve Nationally Determined Contribution (NDC) ambitions but also to drive much needed finance into NbS.

5.2.3. Climate and Carbon Finance

Climate finance is defined as local, national, or transnational financing, which may be drawn from public, private, or blended finance facilities (which combine public and private capital, using public funds to de-risk and therefore scale up private investment). These financial resources are intended to cover the costs of transitioning to a low-carbon global economy and to adapt to, or build resilience against, current and future climate change impact.

Climate and carbon finance flows to three primary use categories: mitigation, adaptation, and dual benefit finance. For NbS, the categories can be summarized as below:

- Mitigation activities, such as afforestation and reforestation, reducing deforestation, and restoring grasslands
- Adaptation financing, for example, for water conservation, conservation agriculture, nature-based livelihoods, supply and demand, general ecosystem support, and so on
- Blended finance facilities, which are a blend of public and private capital (For example, the Development Bank of Southern Africa partners with the Green Climate Fund to form the Climate Finance Facility in efforts to catalyze private sector capital using public funds.)

Mitigation activities have the potential to obtain finance through the generation of carbon credits. It is important that the differences between regulated and voluntary action in relation to carbon credits are recognized and addressed. The most likely source of such finance at present is expected to be through the voluntary carbon markets.

In many jurisdictions, carbon trading from nature-based approaches is in its infancy, with no established frameworks such as payments for REDD+ established in country, and no current changes in land use (that is, AFOLU) projects registered with any of the global carbon standards.

Climate adaptation is providing a category of NbS that has attracted climate finance in recent years (Zhang 2021). How best to turn adaptation finance into carbon credits, which have traditionally focused on mitigation efforts, will need to be explored further, but there should be no reason why revenues accrued from carbon credits could not be used to finance climate resilience activities that also restore/preserve ecosystems (see Box 5.2 for innovation in marine or blue carbon opportunities). Therefore, mining companies contributing to the delivery of such projects will be breaking new ground.

Box 5.2: Blue Carbon Bonds: Marine Ecosystem-Based Carbon Projects

Some cities are experimenting with blue carbon financing as a way to diversify their revenue streams and help to meet the financial cost of their environmental commitments. For example, in 2016 Yokohama City in Japan introduced the Yokohama Blue Carbon Offset scheme to secure payments from local companies and tourists for blue carbon offsets from its urban coastline. The Australian state of Victoria has an emissions reduction target of net zero by 2050 and is exploring the role of blue carbon in achieving this.…

Blue carbon projects for the voluntary or compliance markets can run for an initial four years before income can be realized. High upfront costs for project design, baseline studies, planting and management, and certification, mean that patient money is vital to their success. The Blue Natural Capital Financing Facility has proposed a way around this by creating a "blue carbon matching grant." Provided by philanthropists or multilateral finance from the Green Climate Fund, these grants can help municipalities to cover the first few years of coupon repayments for a mangrove bond, until carbon and other forms of income can be realised.

Source: Earth Security 2021b.

5.2.4. Payment for Ecosystem Services

Payment for ecosystem services (PES) is a market-based instrument that comprises a voluntary transaction where an ecosystem service (or land use that produces such a service) is bought from at least one seller by at least one buyer, subject to the verifiable provision of the service in question (Wunder 2007). The idea is very simple: to pay landowners to protect, restore, or manage their land to ensure the provision of a service rendered by nature, such as clean water, habitat for wildlife, or carbon storage or sequestration (see Boxes 5.3 and 5.4).

It has proved a successful mechanism in several developed and developing countries for restoring the functioning of the natural environment and providing economic returns to those responsible for having done so. Through the use of monetary and in-kind payments, PES incentivize landowners and communities to maintain intact ecosystems, restore the natural environments of degraded land, and use natural resources sustainably. PES recognize that landowners and communities face opportunity costs in forgoing certain economic activities to preserve and restore natural environments and that compensation is necessary to make these costs acceptable, particularly for poor people. The justification for these payments is that preserved ecosystems can provide important natural services, such as regulating the hydrological cycle or sequestering carbon (TIPS 2012).

The African Development Bank (AfDB), for example, stresses that PES must be adapted to the local context to mitigate the associated risks, especially those linked to increased conflict over natural resources as well as "asymmetric contracts resulting in unfair arrangements, elite capture, mismanagement and perverse incentives" (IISD 2015).

The AfDB reports "that managing such risks will require enabling institutional frameworks to, inter alia: clarify land tenure arrangements; support the organizational capacities of local communities; and generate new public and private funding for conservation. In this context, the authors emphasize that it will take time to build understanding, awareness, trust, and capacity among stakeholders during the development of such mechanisms. Among their recommendations, the report authors highlight the need to encourage project developers to delegate PES activities to local communities wherever possible, noting it helps lower transaction costs and strengthens the sustainability of the mechanism" (IISD 2015).

Box 5.3: Wildlife Credits and Incentive Schemes

Wildlife Creditsa is a type of results-based payments for ecosystem services for wildlife conservation performance, based on a tangible, global value in conserving ecosystem integrity and maintaining healthy land, water, and wildlife populations. By aligning performance to investment, the value is transferred to those on the front line of protecting the ecosystems and those total communities who carry a disproportionately large burden of the costs that come with living with wildlife, particularly with human-wildlife conflict increasing. Based on real results and conservation accomplishment, a national Wildlife Credits fund can be established. Such a model could be applied to carbon credits as bundled benefits for the schemes.

a. See Wildlife Credits, https://wildlifecredits.com/

Box 5.4: Opportunities for Innovative Financing at Anglo American's Los Bronces Mine, Chile

Restoration as a nature-based solution (NbS) at Los Bronces offers scaling-up opportunities and financial sustainability if the initiative is associated with payments for ecosystem services (PES) schemes or REDD+ approaches. For a PES, it would be necessary to work with the main stakeholders in the socioecological landscape (communities, local, regional governments, national institutions, among others) and water companies to assign resources to restoration and conservation works upstream the watershed. On the other hand, a REDD+ program can potentially nest into the national platform and gets access to resources from ongoing initiatives such as the Forest Carbon Partnership Facility or voluntary markets. These instruments are financial mechanisms that can contribute to making the NbS sustainable in the long term.

5.2.5. Impact Investment

Impact investment is a strategy where risk, return, and impact are optimized to finance businesses that address the Sustainable Development Goals (SDGs). "Impact investments are investments made into companies, organizations, and funds with the intention to generate social and environmental impact alongside a financial return. Impact investments can be made in both emerging and developed markets and target a range of returns from below market to market rate, depending on the investor's goals."[2] An important trait of impact investing is the commitment of the investor to measure and report the impact of underlying investments. Boxes 5.5 and 5.6 illustrate examples of impact investment.

Box 5.5: Impact Investment with Local Government Bonds

Municipal bonds have already been used to finance mangrove restoration.

The US muni-bond market finances two-thirds of all infrastructure improvements in the country. Some coastal municipalities are experimenting with issuing bonds to fund climate resilience. In 2017, residents of the city of Miami approved the city's plan to issue the USD 400 million Miami Forever Bond. USD 192 million will be used to fund projects to combat sea-level rise and flooding, including mangrove protection and restoration.…

The state of Louisiana is reported to be considering issuing an environmental impact bond to fund its Coastal Master Plan, which comprises USD 50 billion in wetland and coastal restoration and protection projects over the next 50 years.

Source: Earth Security 2021b.

Box 5.6: Vale, Brazil: Socioenvironmental Impact Investment

The Impact Accelerator AMAZ is an incubation and acceleration program for socioenvironmental impact businesses that operate in the Amazon. It supports start-ups in the various topics such as financial and administration management and seeks opportunities for cooperation in logistics and market access. AMAZ arises from the evolution of the Platform for the Amazon Partnership Acceleration Program.

5.2.6. Microfinancing

"Microfinance, also called microcredit, is a banking service provided to unemployed or low-income individuals or groups who otherwise would have no other access to financial services"[3] (see Box 5.7 for some key points). A number of mining companies—for example, Vale and

2 *"What You Need to Know about Impact Investing," Global Impact Investing Network (GIIN), accessed September 2021, https://thegiin.org/impact-investing/need-to-know/#what-is-impact-investing.*

3 *Investopedia, s.v. "Microfinance," by Julia Kagan, accessed October 20, 2021, https://www.investopedia.com/terms/m/microfinance.asp.*

Anglo American—provide microfinancing facilities through their foundations (see Box 5.8).

While institutions participating in microfinance most often provide lending—microloans can range from as small as $100 to as large as $25,000—the goal of microfinance is ultimately to give impoverished people an opportunity to become self-sufficient. Unlike typical financing situations, in which the lender is primarily concerned with the borrower having enough collateral to cover the loan, many microfinance organizations focus on helping entrepreneurs succeed. Empowering women, in particular, as many microfinance organizations do, may lead to more stability and prosperity for families.

In Kenya, access to electricity increased from 40 to 70 percent over five years mainly using small, off-grid solar-powered energy plants. A low-cost, pay-as-you-go, mobile-money model made the system easy to expand, especially in rural areas, and 10 times more jobs were created than in traditional utilities.

Box 5.7: Microfinance: Key Points

- Microfinance is a banking service provided to unemployed or low-income individuals or groups who otherwise would have no other access to financial services.
- Microfinance allows people to take on reasonable small business loans safely, and in a manner that is consistent with ethical lending practices.
- The majority of microfinancing operations occur in developing nations.
- Like conventional lenders, microfinanciers charge interest on loans and institute specific repayment plans.
- The World Bank estimates that more than 500 million people have benefited from microfinance-related operations.

Source: Investopedia, s.v. "Microfinance," by Julia Kagan, accessed October 20, 2021, https://www.investopedia.com/terms/m/microfinance.asp.

Box 5.8: Vale-Funded NbS Projects Create Economic Benefits for Local Communities

Vale-funded nature-based solution (NbS) projects have created economic benefits beyond carbon markets. In one initiative, the reforestation of 145 hectares of land was achieved by sowing the jaborandi seed, a locally used medicinal herb at risk of extinction (Caldeira et al. 2017). Through the sustainable use of biodiversity, 39 local "extractivists" received an uplift in monthly incomes averaging between R$2,000 and R$2,500 (US$400–$500) via the sale of more than 30 tons of dried native jaborandi leaves in 2019.

Vale partners from the National Association of Cooperatives of Family Agriculture and Solidarity Economy (Unicafes), the National Council of Extractive Populations (CNS), and the Vale Fund have created a Social and Environmental Response Plan to the impacts that the coronavirus pandemic will have on the cooperatives' economy, associations, and small businesses of sustainable family farming and extractivism. This includes the following:

1. Credit: For community businesses providing low interest rates
2. Administrative–financial advisory services: Financial management and mentoring for businesses
3. Financial and legal advice: Marketing, legal, and investment advice to investor partners

5.2.7. Grant Facilities

Many mining companies support foundations that provide opportunity for project financing to deliver corporate sustainable development objectives aligned to the SDGs (see Boxes 5.9 and 5.10). This is different from Capex or "balance sheet" funding. Technical assistance grants offer donors a way to participate in blended finance by using noncommercial grants for development impact while also helping kick-start market models and an enabling environment for private investment in environmental goods. Implementing NbS projects requires the active work of local stakeholders such as local nongovernmental organizations, small businesses, local communities, small-scale farmers, and artisanal fishers, who often require training in technical, business, or financial skills.

Building the capacity of these stakeholders can in turn be vital to the viability of an NbS investment. Grant funding can help the development of necessary data and baselines and the skills training to ensure that recipients of funding are equipped to implement projects effectively. Grant-based technical assistance is also critical to improve impact measurement, reporting, and transparency, which are often cost requirements that can reduce the commercial viability of enterprises operating in nascent markets (Earth Security 2021a).

Box 5.9: Examples of NbS Grant Facilities

- "The African Water Facility provides grants and expert technical assistance to implement innovative water projects and raise investment for water projects throughout Africa. Since its inception, the African Water Facility has provided grants for project preparation with measures to strengthen water governance and water knowledge management. Overall, the Facility's action is to support projects designed to increase water, energy and food security, enhance regional cooperation and promote socio-economic growth in Africa."a
- The Land Degradation Neutrality Fund, with grant funding from the French Development Agency and the Global Environment Facility supported training in technical skills for sustainable forestry and regenerative agriculture projects as well as the development of baselines that will be used to measure and demonstrate positive impact, which will in turn encourage more investors to increase their exposure to investing in nature-based solutions (Mirova 2017).
- Nordic Investment Bank for the Baltic Blue Bond and Kommuninvest in Sweden. These bodies aggregate projects across multiple municipalities or countries into one bond issuance or fund to raise finance that is then lent to cities and regions. These aggregated projects can scale to an issuance size and length that is attractive to the fixed income market, namely $200 million–$500 million for a 10-year bond.b

a. *"Facilitating Water Project Investment in Africa," African Water Facility, accessed December 2021, https://www.africanwaterfacility.org/.*

b. *"First 'Blue Bond' to Attract Investment in Baltic Sea Protection," Stockholm Sustainable Finance Centre, accessed December 21, https://www.stockholmsustainablefinance.com/blue-bond-for-protection-of-baltic-sea/; "NIB Launches Five-Year SEK 1.5 Billion Nordic–Baltic Blue Bond," Nordic Investment Bank, October 7, 2020, https://www.nib.int/who_we_are/news_and_media/news_press_releases/3583/nib_launches_five-year_sek_1_5_billion_nordic-baltic_blue_bond.*

Box 5.10: Delivering Biodiversity Offsets and No Net Loss through NbS Grant Foundation Financing

Vale Fund and Biodiversity Offsets

More than 6,000 hectares are being restored and this result reflects partnerships between Vale's operations in Carajás, the scientific knowledge generated by the Vale Technology Institute and partner universities about species in the region, the traditional knowledge and activities of the cooperative of extractivists of Carajás (COEX-Carajás), and the support of the Vale Fund.

The Vale Fund was created 10 years ago by Vale as a voluntary investment action to act in critical biomes. Its strategy is based on strengthening businesses with a positive social and environmental impact and offering financial instruments to enterprises that value standing forests, forest restoration and sustainable land use, with a focus on low-carbon production chains. One of the initiatives it supports is the PPA Acceleration Program (Partners for the Amazon Platform), which for two years has selected 15 socioenvironmental startups, offering a package of benefits to strengthen the businesses, in addition to financial investment. In the 2019–2020 call, COEX Carajás was one of those selected.

Through the PPA, the cooperative is receiving specialized mentoring that will help it solve the main problems of the business. In addition, they have accessed a credit of R$500,000 (R$100,000 provided by the Vale Fund, plus R$400,000 from USAID and Sitawi's Collective Lending Platform). These funds, provided as a loan, will be used to train the cooperative's members, map the matrices, and purchase equipment for collection, with the aim of expanding the cooperative's operations. As a client, Vale has signed a contract to buy seeds for the next three years, for R$3 million, which gives the cooperative the security to pay its debt.

Environmental and social benefits: ITV-DS develops scientific knowledge about the species so that it does not become extinct; the Vale Fund invests in strengthening the business and its growth; and Vale, as a client, guarantees the long-term purchase of a product of the Amazon bioeconomy.

Main results achieved:

- Reforestation of approximately 145 hectares with the jaborandi seeds extracted and supplied by the cooperative to companies running reforestation projects.
- 350 species of seeds sold per year, all with the National Seeds and Seedlings Registry and inspected by a professional in the area, valuing the local biodiversity.
- Increase in the monthly income of 39 extractivists and their respective families, who today earn an average monthly income of between R$2,000 and R$2,500.
- Sale of more than 30 tons of dried native jaborandi leaves in 2019, through the sustainable use of biodiversity, showing the potential of bioeconomy for the conservation of the Amazon.

5.2.8. Public Finance

Multilateral finance institutions have financing facilities dedicated to implementing and financing green and inclusive growth projects.

In Africa, for example, the AfDB launched in 2015 an AfDB–Climate Investment Fund collaboration with nine pilot countries. In Namibia, key public investors for nature-related projects have been and continue to be the Global Environment Facility, Germany, the European Union, and the United States, with a projected investment of N$105 million in 2020/2021 (Barnes, Harper-Simmonds, and Middleton 2014).

Recently, through the United Nations Development Programme (UNDP), the Green Climate Fund has helped upgrade Malawi's climate information and early warning systems.[4] This, combined with advances in mobile access, has been instrumental in helping Malawian farmers and fishers build climate resilience.

4 *"FP002: Scaling Up the Use of Modernized Climate Information and Early Warning Systems in Malawi," Projects & Programmes, Green Climate Fund, accessed October 18, 2021, https://www.greenclimate.fund/project/fp002.*

Similarly, in Ghana, Kenya, Nigeria, and Uganda, the Green Climate Fund has supported a fund for small and medium enterprises that provides farmers with innovative financial services such as micro-insurance and mobile payments. The Green Climate Fund's anchor equity investment helped de-risk the fund, subsequently attracting private investors.

Of course, countries in the region need the high standards of governance, procurement, and financial management required by these types of climate funds.

5.2.9. Blended Finance

Development funds and philanthropic programs are seldom sufficient or do not operate without cofinancing, and these mechanisms cannot achieve the required targets for land degradation or deforestation, for example. These funds therefore need private sector investment to provide support.

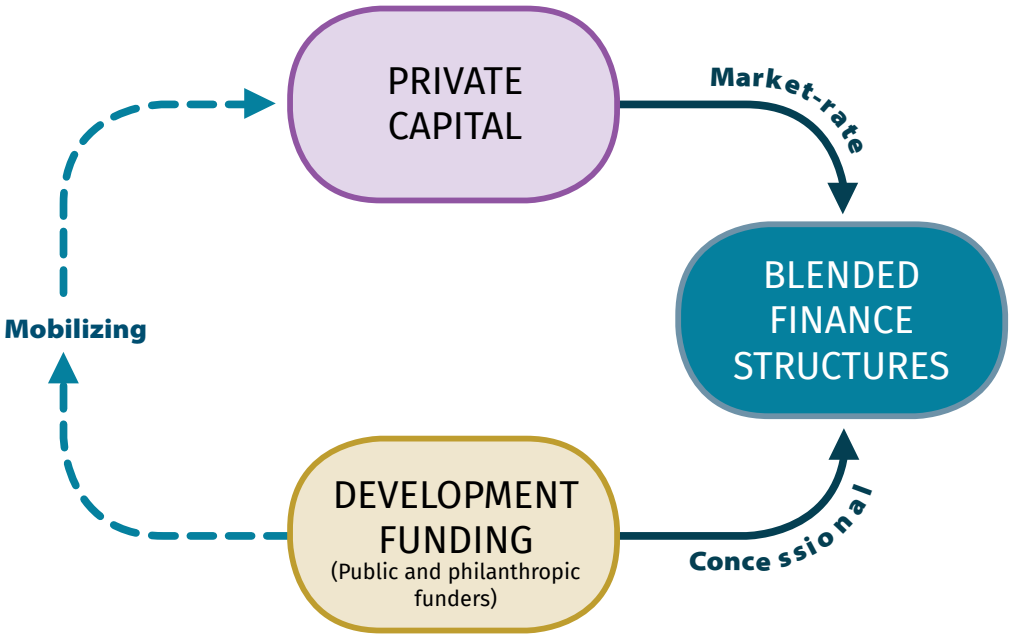
Broadly speaking, blended finance can be viewed as a method to mobilize capital flow, by combining public and philanthropic funds, with private resources, with a particular focus to change the risk/return profile of investment projects (

Figure 5.2). This structuring approach can allow organizations with differing goals to invest alongside each other, to achieve positive climate, social and/or environmental impact, and a positive financial return. This approach requires NbS projects to have a commercial element to deliver remuneration to the investor.

Where the enabling landscape has created a strong foundation, and where the environmental investment landscape has active funds and donors, mining companies can take the opportunity to build out from these established funds with a blended model, for example, to support and generate potential returns through carbon credits (or other revenue streams). An important task would be to engage with the various public and philanthropic finance institutions already active in the operating landscape—such as the UNDP, World Bank, Inter-American Development Bank, German Agency for International Cooperation (GIZ), and the AfDB—to provide de-risking capital on a bigger scale for a company to actively invest and to support the overall impact outcomes.

Opportunity within a company's existing entities could also exist to blend finance. Corporate foundations such as the Vale Fund and the Anglo American Group Foundation provide philanthropic project funding, de-risking the opportunity that can then be supported with a commercial investment from the company, to create an internal blended finance model.

Figure 5.2: Example of Blended Finance Model



Source: ICP 2021.

5.3. Applying Conservation Financing Options – Community Financing Models

5.3.1. Community Forest Enterprises

Community forest enterprises are proving a successful instrument to finance forest conservation and support community efforts in conserving their forests, biodiversity, and carbon stocks (CIFOR 2020). These are an innovative structure and process for forest conservation and social development and enterprise. Their governance structure tends to take the form of a community forest institute (or similar), which delivers the goals of the enterprise and channels the finance. However, further investment is needed to generate financial stability and traction in this opportunity as donor funding for community forest initiatives has continued to decline.

Developing investment readiness of community forest institutes and initiatives alongside the delivery of mining sector net positive impact and carbon commitments presents opportunity to develop understanding of the specific needs of the investor and to address those needs through providing sufficient information and developing credibility and trust to attract finance.

5.3.2. Conservancies Financing Model

Large parts of southern Africa are under community conservation initiatives, which form part of community-based natural resource management (CBNRM) programs, with existing policy enabling rural communities to generate sustainable benefits from natural resources through conservation efforts to protect wildlife and habitats.

Such benefits are accrued within communal conservancies mainly from royalties and rents paid by tourism and hunting operators through joint ventures. However, it has recently been identified that potential opportunities from a broader PES model harnessing the public willingness to support biodiversity have not been captured. Herein lies potential for collaboration with the private sector to deliver sustainable development objectives and the co-benefits of NbS.

Conservancies have created significant tracts of land that are important habitats and wildlife refuge, particularly in arid environments, for wildlife to move freely and to respond to changing climatic and environmental conditions. They are also safeguarding the carbon stock.

Using the PES model that already has a proven level of success as part of the CBNRM program, further benefit for communal conservancies could be generated and pooled with income from joint venture partnerships (tourism). These benefits (financial and other) should be driven back into conservation efforts, as well as direct household sharing, which on its own has proven challenging in the past. Transparency and effective financial management will be key to this success and will require external third-party oversight for both financial safeguards and conservation outcomes.

Safeguarding carbon stocks, increasing sequestration rates, and generating credits have not been applied in this context. However, there is potential within the communal conservancies to explore this in more detail with the appropriate financing model, management, and safeguards to achieve (a) social and conservation outcomes and critical financing for communities to enable the long-term stewardship of land, resources, and carbon stocks as part of a wider PES model, and (b) carbon outcomes with the generation of credits for mining companies as potential investors.

Community-based schemes like the CBNRM described above are being applied in other latitudes where conservancies represent a key strategy to face different threats related to the tension between development, natural resources use, and conservation, each with a particular governance system, adaptive capacity, and level of empowerment. For instance, in the Sierra Norte of Oaxaca in southern Mexico, the community prioritizes conservation activities instead of expanding agricultural lands (which implies increasing deforestation rates). In Brazil, the Coroa Vermelha Indigenous territory set aside 827 hectares to protect the forest against urbanization processes. In Costa Rica, a fishers community-led initiative focuses on mangrove restoration through a PES scheme based on blue carbon. All these different community-owned strategies to tackle environmental challenges respond to their historical process, motivation, and social aspirations. CBNRM therefore offers a variety of opportunities and flexibility, a space where the mining sector can contribute to strengthening and scaling up initiatives that are potentially positive for conservation and other co-benefits.

6. INTEGRATING NATURE-BASED SOLUTIONS INTO MINING PROJECTS

6.1. Key Messages

Source: © Pixabay, Colombia-mangle-naturaleza-caribe

How to design NbS according to IUCN Principles

Eight fundamental principles to ensure NbS are designed and delivered sustainably and equitably.

***1:** Setting the goal **2:** Setting the appropriate scale **3:** Ensuring a net gain in biodiversity **4:** Ensuring economic viability **5:** Arranging appropriate governance **6:** Maximising co-benefits **7:** Integrating adaptive management **8:** Ensuring sustainability and mainstreaming*

1. *The International Union for Conservation of Nature (IUCN) Global Standard for Nature-based Solutions outlines a framework of eight principles that define what an effective intervention should entail. Using these criteria, this section outlines the main considerations required to apply nature-based solutions (NbS) associated with a mining project.*

2. *When preparing to implement NbS, it is important to understand which activities available are most suitable to the specific site and landscape, the resources required, and an approximate timescale for establishment.*

3. *The first IUCN principle is to establish and prioritize the selected **objectives** for the NbS to achieve. These need to be defined within the context of the landscape the project is operating within and local community needs.*

4. *The second principle is to define an appropriate **scale** for the project that balances the maximization of benefit generation with implementability as well as to design a project that is scalable.*

5. *The third principle is to ensure the project results in **net positive biodiversity impact**, regardless of the primary objective of the project. All NbS projects impact upon, and are directly affected by, biodiversity and functioning ecosystems, so any implementation should ensure a net positive impact. Consideration must be given not only to underlying biodiversity levels*

but also to the structure and function of ecosystems services generated by biodiversity.

6. *The fourth principle relates to the importance of establishing the **economic viability** of a project. Given its likely importance for mining projects seeking to establish the business case for NbS, this principle is the focus of section 4.*

7. *The fifth principle defines how **NbS projects are governed**. This is absolutely critical for effective NbS, with good governance for such projects ensuring transparency, inclusivity, and empowerment across the design, decision-making, and implementation phases. Good governance includes the need for stakeholder mapping, engagement, and the establishment of free, prior, and informed consent (FPIC) as a crucial component of project design.*

8. *The sixth principle outlines the importance of **maximizing co-benefits** from the project, the need for trade-offs, and how to map the costs and benefits of different options. Considering who pays and receives the costs and benefits is a key component of this, and the concept of carbon rights is introduced. Various established environmental and social safeguards can help in this process.*

9. *The seventh principle outlines the need for **adaptive management** that accounts for potential permanence, additionality, and leakage issues, and the establishment of a robust monitoring and evaluation system for ensuring the project is doing what it is designed to deliver.*

10. *The final principle outlines the need to **mainstream the project to ensure sustainability**. NbS projects across the mining sector can help develop and improve the overall approach to NbS through sharing best practice, case studies, and successes and failures. This will form part of the next phase for NbS, to drive mainstreaming into private sector operations and strategic approaches, ensuring their sustainability and growing the capacity of NbS to significantly contribute toward global climate and biodiversity commitments at scale.*

6.2. Defining the Right Way to Implement NbS

Successful NbS involve good project planning and design, implementation, and delivery of key goals, followed by monitoring and evaluation. NbS interventions are, at their core, specific to geographic location, political context, and community involvement, and they are intrinsically dependent on the functionalities of ecosystems. This combination of factors presents multiple opportunities and challenges to implement NbS at both a mine site level and regional level throughout the mine life cycle.

Key elements of successful implementation of NbS, and conversely where interventions can fail, often combine a clear understanding of the ecosystem's complex functions and related services, with a participatory and transdisciplinary approach to understanding community needs and stakeholder engagement (Giordano et al. 2020). Conditions to create an enabling environment for NbS with effective stakeholder engagement are explained throughout the document (see also sections 2 and 3).

A cautionary approach should be employed when designing and implementing NbS; where they are wrongly conceived or planned, negative consequences can occur. Widespread afforestation provides a good example, presenting both potential solutions and challenges for climate mitigation (Doelman et al. 2020), adaption (Abiodun et al. 2013), and biodiversity, depending on how and where it is delivered. Planting trees across grasslands, savannas, or scrublands, or in sites where forests are not suited, can negatively affect biodiversity, water, and livelihoods. Therefore, to deliver NbS well, they must be based upon science and the most up-to-date information available.

To deliver NbS well, forest-based projects should try to achieve a number of defining features:

- Integrate the approach across ecosystems and socioeconomic systems to address an overarching societal goal, with multiple co-benefits.
- Aim to mitigate climate change and enhance biodiversity, and not undermine natural systems.
- Ensure additional emission reductions to what would have happened anyway, and account for displacing emissions elsewhere.
- Be durable and permanent, locking up carbon for long periods of time.
- Be socially responsible and account for and involve the leadership of local and Indigenous communities.

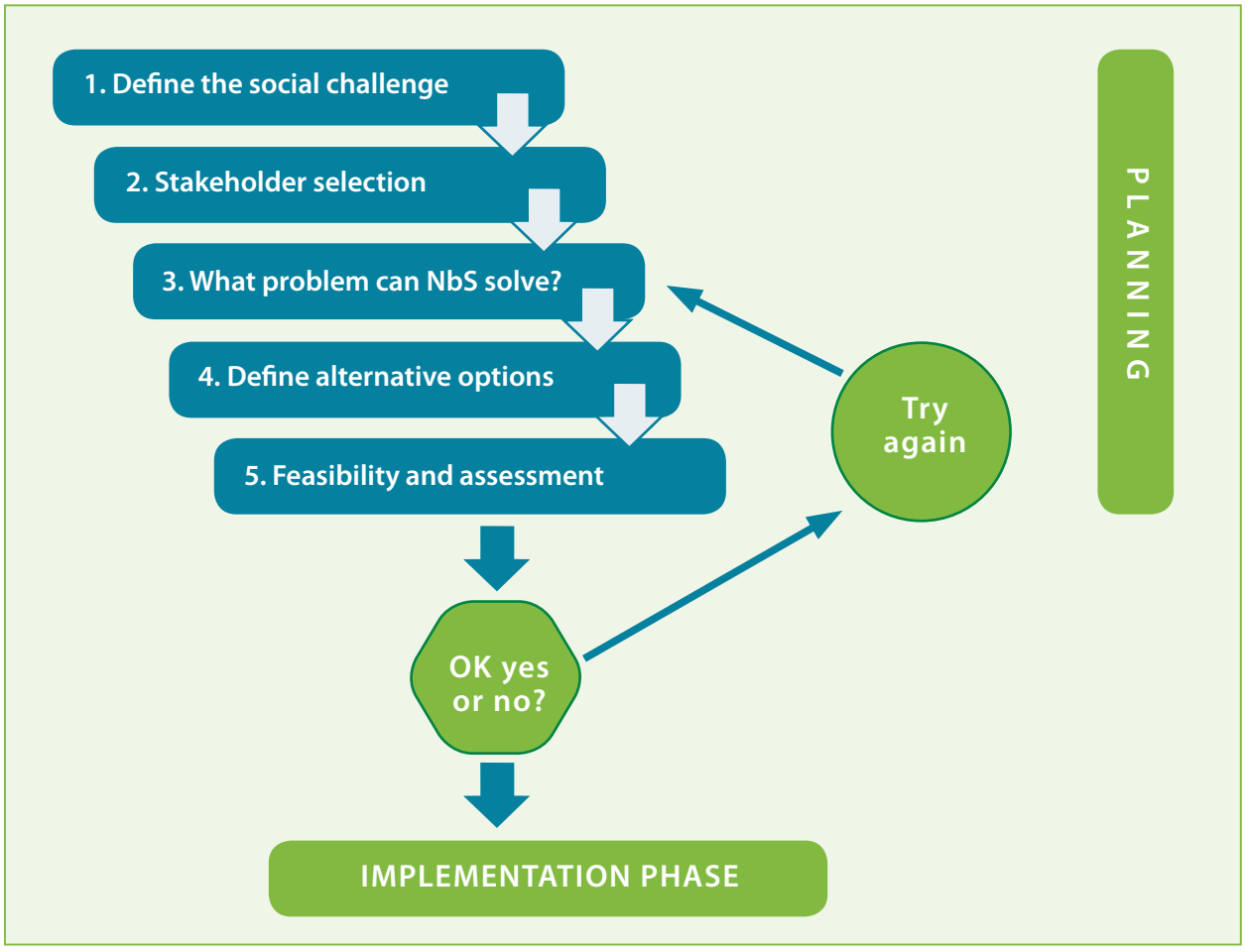
Consistent and replicable standards have been required for some time to guide the design and implementation of high-quality NbS interventions around the world, while linking with existing frameworks such as the mitigation hierarchy. The IUCN Global Standard for Nature-based Solutions provides a set of specific criteria that can help shape NbS options for implementation, mainstreaming, and long-term success.

The guidelines laid out in this section use and adapt the IUCN Global Standard's eight principles as the structure around which to implement forest-smart mining NbS projects:

1. Aim to address societal challenges through environmental protection, restoration, and improved management pathways.
2. Operate at an appropriate scale, across spatial, temporal, and social contexts, to be embedded within a landscape-scale system.
3. Ensure a net positive impact (or net gain) in biodiversity and aim to conserve, restore, and manage habitats and ecosystems to enhance their functionality, connectivity, and resilience.
4. Ensure economic viability, to manage the risk of short-term investment and ensure long-term feasibility, protecting both investors and the landscape and local communities.
5. Arrange appropriate governance that is locally appropriate, transdisciplinary, and follows a process that is inclusive, transparent, and empowering.
6. Maximize co-benefits for climate, nature, and people while recognizing and addressing potential trade-offs and negative impacts.
7. Integrate adaptive management, where the intervention outcomes can inform ongoing project management, resource management, and policy development.
8. Ensure sustainability and mainstreaming by sharing best practice and iterative learning, generated from robust monitoring and evaluation, and by communicating to build new projects.

To support this framework, the Think Nature Handbook (Somarakis, Stagakis, and Chrysoulakis 2019), developed with support from the European Union, lays out a clear generic implementation pathway with iterative and sequential steps that can be adapted for multiple scenarios. The planning stage of this approach provides a useful framework when identifying appropriate options at an early stage, to be completed before moving on to implementation and delivery (Figure 6.1).

Figure 6.1: Logical Planning Process to Identify Appropriate NbS Options



Source: Adapted from Somarakis, Stagakis, and Chrysoulakis 2019.

6.3. Identifying Requirements to Deliver Appropriate NbS Options

6.3.1. Intervention Type

The list of successful NbS projects is growing, with positive outcomes achieved across agriculture, forestry, and other land uses and multiple case studies around the world,[1] providing a strong evidence base to support the implementation of NbS within the mining sector. The three main areas of NbS activity can be broadly summarized as natural pathways through protection, restoration, and management (Griscom et al. 2017), considered either on their own or in combination (see section 3 for more detail). In addition, successful combinations can be created between NbS and gray infrastructure, referred to as hybrid solutions.

6.3.2. Resources Required

Identifying the multiple benefits derived from NbS can present the opportunity to redirect internal resources toward this more holistic approach, potentially allocating from existing budgets that, overall, can have greater positive impact for the business and wider landscape.

NbS can and should be considered during operations' pre-planning stages, but they also can prove to be very effective when retrospectively applied to the life of a mine that is already well under way and incorporated into environmental management plans that are under implementation.

To expand existing approaches and deliver NbS requires time, skill, finance, and an enabling environment in which to succeed, where different skill sets are required at different stages of implementation for planning, design, financing, operations, and maintenance. Project developers therefore need to understand the process and structure the appropriate teams around them.

Developers should access geospatial data, information, tools, and methodologies to perform technical and risk assessments, impact analyses, and financial analyses for the project life cycle. Research input will be required for the application of any guidance and for reviewing case studies from other sectors and different geographies where NbS have been successful.

Project developers within the mining sector may also need enhanced capabilities and support to manage the stakeholder engagement process, as the range of stakeholders associated with NbS tends to be wide and complex (see Box 6.1).

Box 6.1: Targeted Actions to Build Capacity for Nbs within the Mining Sector

Identify overlaps between existing process used in, for example, environmental management plans, and existing skillsets within the operation that can be transferred to nature-based solution (NbS) approaches.

Utilize existing geospatial expertise and quality data sets that already exist within the sector to help identify NbS opportunities.

Develop in-house capabilities and skills to support stakeholder engagement processes.

Prioritize the development of the business case as a means to create commercial products supportive of NbS finance.

6.3.3. Timescale

By their nature, NbS are designed to be delivered over relatively long periods, potentially up to 100 years in some instances, so timing is an important factor to consider when identifying how and when an NbS can have the most impact. These longer time spans are often seen with afforestation pathways, where the time to establish new forest growth and deliver, for example, the desired volumes of sequestered CO2e, may stretch to many decades. Similarly, bioremediation of soils, tailings facilities, or groundwater may take decades to achieve outcomes for restoration of ecosystem health.

The exact timeline for individual NbS actions to become fully effective depends on many specific factors and complexities within the local and regional landscape, so the temporal scale over which NbS become effective will vary. Some indicators, such as flood peak reduction and erosion protection, can be realized almost immediately, while the effectiveness of indicators such as carbon sequestration may take longer to be realized.

The speed of efficacy is influenced by the underlying quality of the existing habitat where the project is located; higher levels of biodiversity, water, sunlight, nutrient availability, and soil organic matter will all positively influence the speed of an NbS in reaching its objectives, particularly when it comes to carbon sequestration.

6.3.4. When to Implement

Timing of the initial implementation is important because impacts from mining on forests tend to peak around the construction phase. Optimum benefit is derived when NbS are included in the engineering and design phase and integrated into the project planning

1 *Multiple NbS case studies from around the world have been collated by the Nature-based Solutions Initiative.*

from the outset. While forest-smart approaches can and should be deployed at all stages of a mining project cycle to deliver positive impacts throughout the life of a mine, opportunities to avoid and mitigate forest impacts become more limited once mines are operational as well as more technically difficult and expensive to introduce retrospectively. It is also recommended that where offsets are to be secured, this should be done ahead of the impact occurring.

However, operational mines can still represent good opportunities for NbS through progressive rehabilitation, reforestation, and afforestation, which can be considered at the mine closure stage. NbS can also contribute to ongoing land management to improve dust and noise abatement, water attenuation, and erosion control.

6.4. Setting the Objective of NbS to Achieve Wider Societal Goals

The first step toward setting the goal is to identify the challenge that an NbS can address (see sections 2 and 3 for more detail on specific challenges), and to do that, an understanding of the existing landscape with activities taking place and identifying local need is required. All NbS projects can and should be viewed in a local or project context when looking at direct impact, in a regional and national context when looking at indirect impact, and in a global context to align to Sustainable Development Goals (SDGs), for example (see Box 6.2 for an example at ArcelorMittal Liberia's mine).

Challenges to be addressed must be within the context and scope of the project, where NbS can be implemented to reduce impacts and bring benefits at different scales. These can be ecological challenges such as deforestation, flood risk, water quality, or erosion. Societal and economic challenges include loss of income from tourism or lack of resource rights. Prioritizing the challenges most relevant to the specific mining project and surrounding landscape is an important part of the goal-setting process.

Box 6.2: ArcelorMittal's Biodiversity Conservation Program in Liberia

ArcelorMittal has been mining iron ore in the Nimba region of northern Liberia, near the border with Guinea, since 2011. The Nimba region is a complex and dynamic transboundary landscape with numerous mining companies at varying stages of the mine life cycle. The area is recognized for its high global conservation value and harbors a remarkable diversity of species and habitats.

ArcelorMittal Liberia has been applying the mitigation hierarchy to avoid, minimize, and rehabilitate the direct impacts of the operation footprint. To compensate for residual biodiversity impacts and recognizing that extensive areas of forest were also being affected by other land uses, the company launched its Biodiversity Conservation Program in 2011.

The program was designed to achieve a net gain for biodiversity and be multidisciplinary in its approach to address threats to biodiversity, including underlying drivers of livelihood insecurity and unsustainable farming practices. The program focuses on the protection and management of a much larger area than that of the direct footprint of the mining operations and associated infrastructure. The main components include improving the management of the East Nimba Nature Reserve and three community forests; negotiating and managing conservation agreements with communities to reduce illegal activity and deforestation through an incentive-based scheme; and promoting the uptake of sustainable agriculture to improve production per area of land and improve food security, with the aim of reducing the background rate of biodiversity loss.

See this report's accompanying full case study for further details and references.

6.4.1. Existing Landscape and Activities

NbS are deeply integrated within a landscape and social setting, one that will often have many diverse uses, complex ecological systems, and social and economic drivers. Of particular importance when determining an appropriate option for NbS is to understand and assess what other nature-based activities are already taking place, to allow a decision-maker to quickly prioritize

potential options (and de-prioritize as appropriate). From an ecological and spatial perspective, an understanding of these various activities can help capture key drivers for degradation as well as the ecological and social processes that characterize the landscape and underpin the existing range of ecosystem services in the region.

A spatial assessment approach should be used to identify and map specific areas of interest and capture the key drivers for degradation as well as the ecological and social processes that characterize the landscape and underpin the existing range of ecosystem services in the region. The assessment should include the following:

- Critical biodiversity areas
- Vegetation cover
- Carbon stocks above and below ground where data exists
- Forest loss
- Land use
- Land tenure
- Population

In addition to spatial and ecological assessments, an understanding of the political and policy landscape is important for generating a picture of the overall enabling environment that will support (or hinder) the implementation of NbS. It should include an analysis of the host country's Nationally Determined Contribution (NDC) as part of their commitment to the Paris Agreement, and where appropriate aligning to the Forest Carbon Partnership Facility.

6.4.2. Identifying Local Need

Identifying local community need is critical when setting the objective of the NbS and is covered in more detail in section 5.7 for project design and implementation. Inclusive, transparent, and empowering governance is key to deliver successful NbS. However, even during early-stage feasibility studies, the needs of local and regional communities should be considered and evaluated alongside the assessment of the ecological and political landscape. This approach will provide a route toward avoiding unnecessary trade-offs and maximizing co-benefits (sections 6.10 and 6.11) while still achieving the main objective of the chosen NbS. The International Council on Mining and Metals (ICMM) provides a useful Community Development Toolkit that can be used in the context of NbS.

6.4.3. Setting the Scale

The spatial scale and interconnectedness of an NbS project can significantly impact the efficacy of its implementation as well its ability to enhance overall ecosystem functionality. The multiple and simultaneous benefits that NbS can deliver may not be sustained in isolation, since those benefits can depend on the very systems that are operating at a wider landscape scale. This is important when considering the design of NbS and relating them to the scale of direct and indirect impacts that a mining project will have.

Examples of landscape-scale NbS initiatives include the following:

- Newmont: Watershed management in neighboring forests in Ghana
- Anglo American, Quelleveco Project: Wetland management program in Peru
- Vale, Carajás mine: Landscape-level forest conservation and carbon management in Brazil
- ArcelorMittal: Landscape-level biodiversity conservation program in Liberia focusing on forest protection and management in a protected area and community forests

6.4.4. Scalability

The ability to upscale an NbS project, even when the project is implemented at a specific site level, is considered a valuable part of the planning process (Bradley 2020), where adequate attention must be given to the multifunctionality of landscapes themselves. Landscape- or jurisdictional-level planning of NbS and impacts, rather than managing solely on a project-by-project (or site-by-site) basis, will also help deliver success (Box 6.3).

Three examples follow describing where to focus attention when considering how to scale an NbS: First, where site-specific actions are implemented without considering wider landscape drivers or causes of ecological degradation, the short-term benefits of the activity may be lost if external threats that had not been considered continue to degrade the site. Second, landscape-scale planning can develop an awareness of wider interactions within the landscape, such as existing subsidies that may support or hinder the project's implementation and ability to scale up. Third, connectivity among NbS interventions can be generated to increase both effectiveness and resilience but also to provide economies of scale.

Box 6.3: Key Considerations for Scalability of NbS

- Apply multiscale and multidisciplinary approaches to provide a holistic landscape perspective.
- Consider multifunctionality of the landscape.
- Plan nature-based solutions (NbS) at landscape scale to maximize ecosystem benefits.
- Consider connectivity between NbS initiatives to increase efficacy and resilience.
- Identify options for jurisdictional scale and the consider regional policy.
- Collaborate with other sectors to maximize ecological benefits and wider impacts.
- Collaborate with carbon partners for optimum financing and market benefits.
- Build capacity for project developers.
- Share information with conservation and business partners and academic institutions to ensure data and learning contribute to continued improvement.

Using a multiscale and multidisciplinary approach for NbS, with greater integration of the mining sector with other land-based sectors such as forestry, conservation, water, agriculture, planning, disaster risk management and renewable energy, can create the required holistic overview. This approach has proven successful for the Guinea Alumina Corporation (GAC), where collaboration with other mining operators and strong implementation partnerships—with a conservation nongovernmental organization (Wild Chimpanzee Foundation) and the government—were cited as key contributors to the success of the NbS (World Bank 2019b).

Financial and markets-based collaborations can also be developed, for example, with carbon trading partners and carbon offset generation. Capacity building, information sharing, and continued education for project developers could be achieved through partnerships between businesses and conservation organizations, professional associations, and academic and financial institutions and would support the approach that is highlighted with more detail in section 5.10.

The aim of upscaling an appropriate NbS approach is an important factor to consider; however, scalability is not simply about creating larger spatial projects (Box 6.4). NbS do not suit a one-size-fits-all approach, and there can be tension between the need to scale across landscapes and the context or specific nature of successful NbS, which are shaped to local social and ecological realities. This highlights the need to embed and integrate implementation within a complex and dynamic landscape system.

Box 6.4: Options for Setting the Scale of NbS

Local and Project Scale

Operating within the local context and being shaped to local ecological and social trends is vital for nature-based solutions (NbS) to succeed, while being set within the wider landscape to provide the ability to scale up where appropriate. Essentially, local and project-led approaches are an important part of the overall process, particularly when focusing on climate adaptation and local need. Co-creation and stakeholder engagement at the local level and enhancing biodiversity as a direct impact from a project are part of a local focus. The ability to work at the local level is a key defining factor because it affects the inputs into the project with stakeholders, rights owners, and the correct choice of species, spatial arrangement, or vegetation management. It also affects the social, ecological, and climate benefits that may be direct and immediate at the local scale. The crucial element of this local approach is to recognize the link between the local context and the larger scale opportunities.

Regional and National Scale – A Jurisdictional and Nested Approach

NbS approaches need to be able to operate at scale and move beyond isolated project-based approaches if they are to make a dent in the global GHG emissions and work toward the Paris Agreement targets. Linking planned project-level actions with national-level planning to ensure that local interventions can thrive alongside national processes, policies, and frameworks is referred to as a jurisdictional and nested approach.

It creates a complex planning environment, and one that is evolving around the world with the implementation of NbS and REDD+ projects, requiring interaction across different sectors and land use types with multiple stakeholders to enable broader implementation. The opportunity exists to achieve results that are bigger than the project level but at a more manageable scale than operating at a national or transboundary level. The appropriate scale of a jurisdictional approach depends on the country context and where the responsibility and authority for land use decisions lie, often through government ministries. This approach is becoming more important to ensure that accounting of emission reductions within a country are accurate and integrated, and to enable equitable benefit sharing (Pearson, Casarim, and McMurray 2016).

Nesting specifically refers to how a project is embedded within a subnational or national scenario. A project can nest within a jurisdictional emission reduction scheme and potentially provide a transition toward establishing a national scheme, if one does not already exist. However, if there are already national emission reduction schemes in place, and if a project is big enough, it can look at direct project to national level nesting and incorporating directly into a national program. For forest-smart mining projects, it is important to understand the direction of travel in the country and region, development of jurisdictional and nested approaches, and plans to develop further.

Transboundary Scale

Operating across boundaries has been an approach adopted by international conservation activities for some time, in attempts to overcome challenges presented by ecosystems crossing administrative boundaries and to maximize and scale up impacts. A successful example of this approach is the International Gorilla Conservation Program, where Fauna & Flora International and three other conservation organizations have been able to promote transboundary collaboration across Uganda, the Republic of Congo, and Rwanda. The lessons learned from the implementation of such schemes are important for NbS, where the private sector can come together with international nongovernmental organizations to replicate successes of conservation projects such as this. Of particular relevance is the fluidity, or shifting nature, of elements within an ecosystem, such as rivers or migratory species, where interventions in one place can have effects further downstream, and cross international borders. This may require coordination to develop areas of agreement across boundaries and administrations.

6.5. Ensuring Net Positive Impact for Biodiversity

NbS are fundamentally derived from and rely upon biodiversity and functioning ecosystems, maintaining and enhancing both while also being dependent upon them for success. All NbS rely on a range of services that are essentially generated by nature. Therefore, the integrity of the biodiversity and the ecosystem will directly impact on the efficacy of a given NbS, with the delivery of any ecosystem service reliant on the ecosystem itself. It has been shown, for example, that across the tropics, tree species richness positively correlates with carbon stocks (Steur et al. 2020).

NbS therefore need to impact positively on biodiversity, aiming to conserve, restore, or manage habitats and ecosystems to enhance the functionality, connectivity, and resilience of the specific natural system. To achieve this, an understanding of the baseline condition of the area's biodiversity as well as key drivers for degradation and decline is required. Measurable conservation-based targets should be set and incorporated into the delivery plan, with appropriate monitoring and evaluation completed during implementation, using an evidence-based assessment of the current condition of the system the project sits within. Much of this approach may already be incorporated into existing environmental management plans.

Parallel to ensuring positive impact for biodiversity, a key element of NbS implementation is to avoid undermining or weakening the functionality of an ecosystem. For example, simplification of an ecosystem through an afforestation project designed as a monoculture plantation can have significant adverse impacts on the functionality of an ecosystem and the biodiversity within it. Therefore, the existing risks within an ecosystem must be assessed prior to implementation, and an evidence-based review of the potential negative impacts and risks to biodiversity should be included.

6.5.1. Positive and Negative Effects on Biodiversity from NbS

Structure and function of ecosystems and their services

Careful consideration should be given to ensure that a focus on protecting areas of land to safeguard biodiversity does not negatively alter the social functionality of a landscape and conflict with sustainable development objectives and immediate needs of the local community. Viewing through the lens of ecosystem services can support this approach, particularly important in the global south, where the highest levels of direct dependence on biodiversity and ecosystem services are seen (Kumar and Yahiro 2014). Services include sustainable timber production, enhanced pollination activity, and improved water quality through river and catchment management, all of which can have a positive impact on biodiversity and the services it provides.

Maintaining diversity and avoiding monocultures

With a determination to simplify projects and ensure costings, inputs, and benefits are clearly measurable and fit within a defined business model, there is a danger to oversimplify NbS interventions and undermine the complexity of the natural systems on which the project is dependent. For example, a monoculture planting approach creates a negative impact on biodiversity and a less resilient carbon stock. Oversimplifying ecosystems should be actively avoided.

Connectivity, when implemented near natural ecosystems

Connecting habitats and wildlife populations has long been a critical tool in the armory of conservation practitioners. Wildlife needs to move, dispersing and expanding ranges, shifting gene pools, and acquiring adequate food sources, all of which underpin ecological processes and maintain biodiversity levels. With added stress from a changing climate, population growth, or infrastructure development (of particular relevance to mining projects), connectivity becomes even more important (Ament et al. 2014). In the broader context of NbS, the development of ecological networks at a landscape scale through a series of linked interventions (such as wildlife corridors) or protected buffer zones with sustainable resource use can create a coherent and functioning system, conserving biodiversity and building resilience.

6.6. Net Positive Impact and the Mitigation Hierarchy

The relationship between NbS and forest-smart mining when working toward net positive impact (NPI) targets can be viewed through the lens of the mitigation hierarchy. NbS can support the delivery of NPI for biodiversity. NbS require the implementation of a range of approaches that span the mitigation hierarchy, which should be guided by an overarching policy commitment to no net loss of forest cover and, where possible, a commitment to NPI where there is potential for improved management, reforestation, or afforestation.

The mitigation hierarchy framework enables projects to manage their negative effects on biodiversity, to ensure no adverse impacts (no net loss) and, wherever possible, a net gain on biodiversity. The mining sector has had a focus on biodiversity and NPI for some time and is relatively advanced in its actions and strategic approach. NPI as a concept has encouraged the much-

needed setting of targets and metrics to measure impact, and some key lessons can be transferred to the implementation of NbS. For example, the quantification of losses and gains of quality forest habitat that may host critical species and ecosystem services.

The mitigation hierarchy framework comprises a series of steps that are applied sequentially and iteratively to achieve objectives of no net loss or NPI. However, it is important to note that this is a highly dynamic and adaptive process, with each step regularly revisited and attempts made to ratchet up responses to reduce negative overall impact.

1. Avoiding negative climate impacts and biodiversity loss
2. Minimizing impacts and losses that still occur
3. Rehabilitating and restoring forest cover and biodiversity where there are unavoidable negative impacts and losses
4. Offsetting remaining negative impacts or losses through substitution or compensation

For new projects, the first two steps of the mitigation hierarchy—early avoidance and minimization—should form the focus of any mitigation effort, identifying high biodiversity values in the area and preventing them from being damaged, degraded, or destroyed. This could include interventions to protect primary forests, riverine habitats, or specific areas valued and used by local communities.

NbS and forest-smart approaches to early avoidance and minimization include undertaking impact assessments, earmarking avoidance areas for mining, and minimizing polluting waste. The protection of carbon stores through forest carbon projects and the carbon market should further stimulate the avoidance and minimization steps of the mitigation hierarchy and play a fundamental role that goes beyond the last resort of carbon offsetting. Approaches to remediate impacts include land restoration such as reforestation and, if appropriate, afforestation, and the development of carbon and biodiversity offsets that can potentially be taken to market. Application of the mitigation hierarchy is now required by most international lender-driven sustainability standards, such as the International Finance Corporation (IFC) Performance Standards.

6.7. Setting Appropriate Governance

NbS should employ a transdisciplinary, multistakeholder approach, engaging local stakeholders from the start. The importance of how NbS projects are governed cannot be underestimated and should be viewed in conjunction with the economic and ecological conditions (Box 6.5). Effective stakeholder engagement can help ensure that interventions are locally appropriate and consider the socioeconomic and environmental needs of the local communities. An overarching approach that emphasizes equity, trust, and learning builds not only the license to operate but the long-term sustainability of a project (Reed 2008).

Box 6.5: The Approach to Good Governance

Inclusivity

Ensuring inclusivity potentially requires involving a wide range of stakeholders and may require proactively involving traditionally excluded or marginalized groups to participate in the process. This should not only include different social groups but make sure that diverse and opposing views are heard during the planning and implementation processes, where the different stakeholder perspectives are fully considered, and inclusivity can be reached.

Transparency

As a relatively new concept, nature-based solution (NbS) is exploring new territory but also bringing together multiple actors and sectors under the umbrella approach to address climate and biodiversity challenges. With the added complexity of multiple benefits and resource use, projects need to operate with a high degree of transparency to build trust and cohesion around the concept. This can be achieved through the dissemination of data, particularly around the decision-making processes and the immediate and long-term implications of the NbS interventions, which supports the stakeholder engagement and adaptive engagement approaches.

Empowerment

The distribution and sharing of power have implications for NbS projects, and in this context, the focus is often on gaining power over decision-making, closely linked to participation and inclusivity as part of the good governance approach. Issues of inequity can inevitably cause conflict when not addressed, especially for those most marginalized or excluded from traditional decision-making processes that may have gone before. Developing authority and responsibility for communities, and providing ownership over appropriate aspects such as community-owned enterprises for income generation, can generate real empowerment, and IUCN's National Resource Governance Framework can provide a robust tool to support and guide this approach.

Sustainability

NbS should be positioned within the framework of sustainability, where economic impact is coupled with environmental and social benefit, each given equal importance that is underpinned by the appropriate governance structure. Careful consideration of the finance, technical, and governance aspects for NbS stewardship will be critical to ensure long-term success, from community engagement through to appropriate financing structures. Challenges to this governance approach can exist in countries at different stages of economic development, where priorities of multiple actors may not already be coordinated, so the long-term stewardship of any project must not be overlooked.

6.8. Stakeholder Engagement

The long-term success of any NbS project depends on identifying and including all relevant stakeholders across the decision-making, planning, implementation, and delivery phases and understanding their specific roles and level of influence on the project.

Representative stakeholders should be involved early on and contribute during the preliminary design stage, where their concerns and expectations need to be understood and documented, to ensure their needs and views are accounted for and the proposed activities are socially acceptable.

Stakeholders to consider include politicians, public agencies, scientists, institutions, experts, communities, non-governmental organizations, landowners, developers, and private sector firms. Because of the range of actors, there is often a need for highly skilled facilitation. This may be beyond the capacity of many project developers, at which point specialists can be employed to facilitate community consultations.

Most forests in which mining companies operate are inhabited in some form, and it is the Indigenous Peoples and local communities who will experience the specific impacts of mining operations. Indigenous Peoples and local communities need to be consulted and engaged as active contributors at every stage, and they can offer insightful strategies for on-the-ground implementation. Applying the principles of free, prior, and informed consent is outlined in section 6.9.

6.8.1. Stakeholder Mapping

Stakeholder mapping is a method of identifying and representing the perceptions of key people, groups, and institutions, their importance, relationships, and decision-making roles. It provides insights into stakeholder motivations and is a powerful tool for comparing the different viewpoints and relative capacities of the various parties involved with an NbS project. A high-level approach will identify people, groups, and institutions that have some interest in or will be affected by a project and then assess the level of influence and support that each group will have either for or against the proposed project.

Stakeholder mapping should aim to generate the following:

- An understanding of the relative importance, accessibility, and impact of different organizations and actors across different social groups, indicating the power dynamics between those groups
- An understanding of the interests, participation, and relationships of different social groups and local organizations
- An understanding of access to services for different social groups and availability of social safety nets
- Help for an organization to locate itself in relation to other organizations and groups, identifying potential entry points for strengthening or improving relationships between different actors
- An understanding of the potential role and influence of different stakeholders in equitable benefit-sharing mechanisms
- An assessment of and consequent planning for climate change adaptation

If repeated at intervals (every one or two years), stakeholder mapping can be used to monitor and analyze changes in the organizational context.

6.9. Free, Prior, and Informed Consent

Free, prior, and informed consent (FPIC) is an important social safeguard that gives the stakeholders affected by a project the ability to challenge, accept, or refuse a proposed project implementation (Box 6.6). The underlying principle is that a community has the right to give or withhold its consent to proposed projects that are likely to affect the lands and resources it customarily owns, occupies, or otherwise uses.

FPIC has been enshrined in the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) since 2007, and it is increasingly being extended to include the statutory and customary rights of other communities to their land and resources. FPIC is a core part of establishing successful NbS projects, and it is a requirement of REDD+ initiatives and internationally recognized by voluntary standards such as Verra, Gold Standard, Plan Vivo, and The REDD+ Environmental Excellence Standard (TREES).

Any NbS project will need to prove it can be considerably better than other alternatives that communities could engage with, making the support of an NbS more attractive, with increased benefits and ensuring the flow of finance. This may require competing with proposals from other actors in the landscape, or competing sectors, generating a market-style approach for engaging the community and generating consent and support for one project over another. FPIC gives communities a real choice, so the NbS needs to be better than what other parties might be offering. Conflict of interest can potentially arise and must be recognized during the FPIC process, for example, where forest conservation efforts are prioritized over and above local livelihoods. To overcome this, the FPIC process must ensure alternatives are fairly represented.

Box 6.6: Fundamentals of the FPIC Process

Free

No pressure, intimidation, or influence on the community decision-making process, from project planners, government, or any other source.

Prior

The project owners should have community permission (consent) far ahead of beginning any activities; all information relating to the activity is provided to communities in advance and the community have the time to talk and understand the project before agreement is reached; and this must be respected by all parties.

Informed

All information is objective, accurate, and presented in clear way that the community understand. Important information includes the following:

- The nature, size, duration, and scope of any proposed project
- The reason(s) or purpose of the project
- The location of areas that will be affected
- The possible economic, social, cultural, and environmental impacts on the community and their lands and resources, including potential risks and realistic benefits
- Personnel likely to be involved in the implementation of the project
- The rights that the community has and the procedures that the project may entail, with the right to benefit from independent legal advice and other experts and nongovernmental organizations

Consent

Projects can only go ahead if communities have agreed to an activity or project that concerns them. Communities also have the right to refuse their consent or to give consent but only on conditions that meet their needs, priorities, and concerns. Consultation must be undertaken in good faith, requiring that community views are considered in the process or fair reasons are provided as to why such consideration is not possible. All parties must establish a dialogue allowing them to identify good and workable solutions in an environment of mutual respect and full and equal participation, with enough time to reach decisions.

6.10. Maximizing Co-benefits

NbS generate numerous benefits, many of which provide key building blocks of the SDGs, and it is their capacity to produce several services simultaneously, such as carbon sequestration, biodiversity enhancement, livelihoods and societal/economic impacts, and reduction in soil erosion, that differentiates them from traditional gray infrastructure.

Benefits can be broadly categorized as environmental, social, or economic, delivered through the implementation pathways of protection, restoration, and management. The level of these services provided will be dependent on the scale of specific NbS, whether implemented at a microscale or macroscale, or somewhere in between. Key considerations and approaches to maximize co-benefits include the following (Box 6.7):

- Recognizing and managing potential trade-offs
- Mapping the costs and benefits
- Understanding stakeholder rights, including land tenure and carbon rights
- Implementing social and environmental safeguards

Co-benefits to society and the environment

Climate change mitigation
Climate adaption
Water security
Livelihoods
Biodiversity protection and delivery on commitments

Box 6.7: Multiple and Simultaneous Benefits

NbS can produce multiple and simultaneous benefits in addition to climate mitigation.

- "Water. Terrestrial and coastal ecosystems play an important role in improving water quality and protecting water security. For example, restoring wetlands boosts the land's ability to filter freshwater. Certain agricultural practices improve water use efficiency and proper fertilizer management help to protect the water supply from nitrogen runoff.
- "Air. Reducing fire-driven deforestation helps keep the air clear and breathable. Protecting forests can even help to restore natural rainfall patterns.
- "Soil. Soil conservation and other agricultural improvements can boost productivity, helping to meet the growing demand for food without expanding the footprint of farming.
- "Biodiversity. Conserving and restoring natural lands (and employing more sustainable forestry and agriculture management strategies) will protect native habitats for plants, animals and other organisms.
- "Livelihoods. Restoring nature is also great for jobs: in 2014 it employed over 120,000 people in the United States, significantly more than iron and steel production or coal mining. Often, people think of climate change mitigation and development as being at odds with one another. In reality, well-crafted development policies and programs can create growth and prosperity while also curbing emissions. Worldwide, some 2 billion people depend directly upon the land and coast for sustenance. Improved farming practices improve their livelihoods and can revitalize rural communities. Sustainable forestry can have similar benefits for individual incomes and communities."a
- Adaptation and Resilience. While much of the international finance community have focused on limiting CO2 emissions though mitigation strategies, NbS are increasingly recognized for their ability to lessen the impacts of climate change and pave the way for more sustainable outcomes for ecosystems and society. Of particular importance is disaster risk management, and increasing resilience of ecosystem through NbS, and subsequently increasing resilience of local communities on the front line of climate change.

a. "Benefits," Science, Nature4Climate, accessed October 2021, https://nature4climate.org/science/benefits/.

6.11. Trade-offs

A key challenge of any NbS management is to optimize the multiple benefits and minimize the negative impacts, often referred to as trade-offs, generating different costs and benefits for stakeholder groups, ecosystem services, and biodiversity. Trade-offs can result from a number of circumstances, particularly where projects with low biodiversity value such as afforestation of non-native monocultures are being encouraged, resulting in maladaptation and reduced resilience, or where a particular ecosystem service such as clean drinking water is prioritized over and above another, such as agricultural production. Recognizing these trade-offs and making decisions in a transparent and democratic way (see section 5.7) is essential for avoiding problems and conflict later in the project (see Box 6.8 for an example of trade-offs from planting trees).

Box 6.8: Trade-offs from Planting Trees

Afforestation (creating forests) has been shown to create multiple positive benefits and ecosystem services, including reversing erosion, biomass cover loss, and freshwater flooding, but it is often traded off against water supply, where the plantation will slow water catchment and absorb groundwater (Filoso et al. 2017).

Where agricultural policies have been used to encourage vegetation cover and slow soil erosion on degraded lands in China, geospatial data have shown a decrease in soil erosion, but at a cost to soil moisture and water flows—a clear result of unsuitable species selected for the arid region, creating negative impacts and associate costs (Jian et al. 2015).

Negative impacts as described above, tend to be generated within more heavily managed or "unnatural" systems, where plantations of fast-growing non-native species, such as pine or eucalyptus, have been established in water-scarce regions. Fewer examples of such trade-offs are seen in natural or seminatural ecosystems, where, for example, native broadleaved forests in temperate regions tend to have benefits for water supply.

Where the focus is on protection, restoration, or improved management of natural or seminatural forest systems, forests can enhance water availability, in parallel with a range of other climate benefits. This supports the view that to effectively implement large-scale nature-based solutions and landscape approaches, and maximize co-benefits, adequate attention must be given to the multifunctionality of the landscapes themselves.

6.12. Mapping the Costs and Benefits

Stakeholder mapping and FPIC procedures can be used to map the possible negative impacts and understand who bears the cost associated with an implementation. Trade-offs can be managed successfully by assessing the potential consequences and then conducting fair and transparent negotiations, potentially leading to compensation toward livelihoods that are negatively affected.

Cost-benefit analysis is a well-known tool and can be extremely beneficial when establishing priorities for NbS implementation and making comparisons against conventional/engineered solutions. While economic viability is covered in more detail in section 4, here the focus is on determining environmental and social costs and benefits, which are often intangible or difficult to value and can potentially be overlooked.

NbS can provide cost-effective interventions, and when looking beyond the short term, benefits outweigh costs. But NbS require initial investment, which can deter project originators from implementing them themselves. The multiple values of forests are often underappreciated, and the perceived economic value of mining is almost always higher than the perceived value of any forest. However, it is difficult to measure the value of the intangible aspects of ecosystems, which are often undervalued in conventional financial valuations. Additionally, pricing becomes less meaningful when critical ecological thresholds are being approached and ecosystem services become impossible to replace (Filoso et al. 2017). Costs of environmental or social degradation resulting from mining, in addition to wider land degradation and deforestation, droughts, soil degradation, fire, flooding, and other natural disasters, now provide clear evidence of the cost of not implementing appropriate solutions.

Estimates of the timing to deliver benefits and associated cost incurred is necessary to allow for proper discounting effects using, for example, net present value of forest carbon assets (discounted cash flow). This can prove challenging as the time span for valuation of NbS interventions in a cost-benefit analysis takes long periods of time, which can increase uncertainty of the initial choice of intervention.

Remote sensing data provide a valuable and expanding opportunity to overcome uncertainty, where that data can be used to correlate changes in vegetation cover following restoration projects with associated changes in, for example, soil loss, erosion, or water yield over large areas. This in turn can provide valuable information to determine the costs and benefits resulting from a potential intervention.

6.12.1. Stakeholder Rights

When identifying co-benefits, it is important to determine early on the individual rights to a specific asset. The rights of people and stakeholders to secure their livelihoods, live with dignity, and maintain healthy and productive environments on which they depend are closely related to and influenced by the implementation of NbS, where the pursuit of addressing a wider societal challenge can have positive co-benefits alongside trade-offs.

Integration of stakeholder rights should begin with adopting standards and guiding principles that reflect internationally recognized human rights approaches,

providing a strong foundation for equitable and effective outcomes. With international and regional frameworks in place, rights-based approaches have been adopted across all sectors from government, private sector, and civil society when implementing conservation projects, and while the goal of effectively integrating human rights principles into the implantation of NbS is widely embraced, how best to realize it can still be debated.

While governments and states normally hold primary responsibility, private sector actors and landowners clearly share accountability for certain human rights. Many discussions related to rights are inevitably highly charged and will not always be quickly resolved when fundamental differences or conflicts exist. It is argued that focusing on them to the exclusion of areas where agreement can be reached may be counterproductive, so being able to focus on areas of agreement rather than disagreement can open a pathway to achieving goals to which both parties are committed.

6.12.2. Carbon Rights

With carbon becoming recognized as a fungible commodity, the question of who owns the right to the resource is a complex and often contentious issue. Determining who should reap the financial benefits generated from, for example, the sale of carbon credits, carbon taxes, or cap-and-trade carbon markets means understanding the rights to the carbon (Table 6.1).

Carbon rights are generated from the benefit of reduced greenhouse gas (GHG) emissions and/or sequestered carbon, based on an activity that leads to forest conservation (Streck 2020). More locally, they can be determined by national legislation or contracts that vary greatly from country to country, and investment and donor funding will often require clear and uncontested carbon rights. Project developers therefore need to consider how a project will meet both national and international requirements for the distribution of carbon finance.

Table 6.1: Overview of Carbon Rights Systems

Land ownership	Carbon rights	Ability of non-state entities to engage in carbon offset activities
All forest land is owned by the government	Carbon rights follow the right to the land and are owned by the state, but the right to generate ERRsa can be transferred to private entities	Carbon rights can be transferred to private and public entities via concession or license
State or diverse forest ownership with weak private land titles	Carbon rights (e.g., Madagascar) or rights to ecosystem services (e.g., Ecuador) are centralized and managed at the level of the national government	Private projects or transactions involving ERRs are not permitted
Diverse forest ownership with community and private land titles	Carbon rights are regulated, and special rules apply	Private entities are free to participate in voluntary carbon market projects subject to restrictions
Diverse forest ownership with strong community and private titles	No special regulation. Carbon rights pertain to landholders	Private entities are free to participate in voluntary carbon market projects within the limits of the law regarding

a. An ERR refers to a reduction in greenhouse gas emissions and increase of carbon absorption by biologic sinks calculated against a reference scenario and monitored using standardized measurement, verification, and reporting rules.

Carbon rights can flow from either the ownership of the asset or from the control of the activity that led to the reduction or removal of emissions. Where a national approach is taken, with centralized accounting and a national benefit-sharing scheme, the carbon revenue will be shared between government, asset owners, and project developers. The details of the scheme are based on a range of indicators that are country specific, such as rewarding landowners who actively engage in emission reduction activities and forest protection or management.

Keys issues for project implementation include deciding which model is most appropriate and preferable within a host country and identifying the beneficiaries under each approach. Specific elements to address include the following:

- Who owns the land?
- Who owns the forest carbon stored in that land? (This is not always directly linked to the landowner.)
- Who owns the title to the carbon credits generated by emission reductions achieved on that land?
- Who are the beneficiaries of the carbon revenues, and how are the revenues distributed?

6.13. Environmental and Social Safeguards

Incorporating a series of safeguards into the design and delivery of NbS will manage the risk of negative environmental or social impacts. Safeguards (or standards) can protect red lines agreed by the stakeholders and prevent trade-offs beyond those expected and agreed as part of the project.

Safeguards can include those already established at an international level by multilateral agencies such as the World Bank and IFC, coalitions and conventions such as the Convention on Biological Diversity (CBD) and the United Nations Framework Convention on Climate Change (UNFCCC), environmental funds such as the Green Climate Fund and Global Environment Facility, as well as market-based mechanisms such as REDD+.

Providing information to explain how the safeguards are being met is a key element of any NbS and will be required by investors and auditors. The widely used UNFCCC Cancun Safeguards, specifically developed for REDD+ projects, are described below. This type of approach must be considered, promoted, and supported when undertaking forest-based NbS projects, and it aligns closely with the overall approach detailed in this document, based on the IUCN Global Standard for NbS.

The Cancun Safeguards

- "That actions complement or are consistent with the objectives of national forest programs and relevant international conventions and agreements;
- "Transparent and effective national forest governance structures, taking into account national legislation and sovereignty;
- "Respect for the knowledge and rights of indigenous peoples and members of local communities, by taking into account relevant international obligations, national circumstances and laws, and noting that the UN General Assembly has adopted the United Nations Declaration on the Rights of Indigenous Peoples;
- "The full and effective participation of relevant stakeholders, in particular indigenous peoples and local communities;
- "That actions are consistent with the conservation of natural forests and biological diversity, ensuring that actions are not used for the conversion of natural forests, but are instead used to incentivize the protection and conservation of natural forests and their ecosystem services, and to enhance other social and environmental benefits;
- "Actions to address the risks of reversals;
- "Actions to reduce displacement of emissions."[3]

6.14. Integrating Adaptive Management

Assessing the effectiveness of NbS is a complex and adaptive process, required to track progress toward achieving intended outcomes as well as long-term social, environmental, or economic impacts. Of particular significance is the deployment of a range of indicators requiring robust methodologies and linking, where appropriate, to credible verification standards and methodologies.

6.15. Addressing Permanence, Additionality, and Leakage

Requirements for permanence and additionality and to ensure against leakage must be incorporated into all NbS projects, particularly those that focus on emission reductions, through avoidance or removals interventions. Below, an overview of the concepts highlights their importance to NbS. While the technical details for each assessment criteria are not covered at length here, further detail can be found for all the relevant international carbon standards.

Permanence

Projects must aim to ensure that the removal of carbon dioxide, or the avoidance of its release into the atmosphere, remains permanent and will not be reversed

1 *"Safeguards," Fact Sheets, REDD+ Web Platform, 2018, https://redd.unfccc.int/fact-sheets/safeguards.html.*

in the future. Forest-based projects will always carry an element of risk, based on the likelihood of reversibility, where carbon contained in the vegetation and trees is at risk of being lost through direct intervention such as deforestation, or from natural causes such as fire, disease, pests, or extreme weather events.

The approach to managing the risk of permanence (or loss of) should employ a combination of comprehensive risk assessments, with an additional risk management mechanism called a buffer approach, similar to an insurance policy. Here a buffer account holds a number of carbon credits that the projects pay into, which can be paid out in the event of reversal or loss.

The initial risk assessment must be undertaken to determine potential losses to carbon stocks based on major risk factors associated with the project activities. Risks can be categorized as internal, such as project management and financial viability; external, such as land tenure, community engagement and the enabling environment; and natural. Based on the evaluation of the project against these risk factors, the overall risk classification for the project can be determined, and each carbon standard has specific ways to assess this, such as Verra's Non-Permanence Risk Tool.

Following the project's risk classification level, the appropriate number of carbon credits to be deposited in a buffer account will be determined. The buffer account is a principle used across all major carbon standards, designed to safeguard investments made by carbon buyers as well as maintain the integrity of a given project. The exact percentage of contribution and process to generate the buffer is specific to each carbon standard.

Additionality

Projects must be able to demonstrate that their outcomes are additional, where the avoidance or removal of GHGs directly associated with the project intervention could not have occurred without the given project or activity. Although each carbon standard uses a slightly different method to demonstrate additionality, the overall approach includes an analysis of land use scenarios, an investment analysis, and a barrier analysis. Under the financial analysis of the project, it is only considered additional if the carbon finance is required to ensure the project is viable, without which the project could not go ahead.

Leakage

Projects must ensure that the activities targeted to reduce and avoid emissions, such as tackling deforestation, are not simply shifted outside the project boundary. An assessment of the changes to carbon stocks that occur outside of the project boundary and can be measured as directly attributable to the project activities must be undertaken to determine leakage. Where leakage emissions are generated, corresponding emissions are deducted from the projects to determine net tCO2e benefits.

Leakage assessment requires detailed knowledge of the drivers of deforestation or degradation in the local area, and each international carbon standard has a specific methodology to assess and determine leakage, covered within their supporting documentation and guidance. Broadly, two main types of leakage can occur, and they are particularly relevant to forest-smart mining:

- Activity shifting leakage. When an activity that was taking place in or near to the project site is moved, causing land use change elsewhere that results in deforestation or degradation.

- Market driven leakage. When the given project activity causes the production of a commodity to cease, and the production is increased elsewhere in a response to market forces and demand. This is of particular relevance to forest-based projects, where a reduction of timber supply from a NbS intervention can cause an inflation of timber prices and generate further deforestation and emissions elsewhere.

Although there are standardized approaches, which focus on eligibility criteria that rule out project activities that are prone to high leakage levels, most options for controlling leakage will tend to be project specific. These include selecting a site that has limited current use or is highly degraded, where the activities will not be shifted elsewhere, and offering alternate land use options and economic benefits that are comparable to non-NbS interventions.

Where activities will cease because of the project implementation, alternative livelihood strategies need to be developed that will provide adequate benefits to replace rather than relocate emission-intensive activities such as deforestation, and link closely to the stakeholder engagement process. In addition, "leakage contracts" can be used to secure a legal requirement for the activities not to be continued elsewhere. However, apart from being difficult to enforce, these contracts can have negative connotations and there is the risk of potential harmful results for the communities involved, which can undermine much of the recommended stakeholder engagement approaches.

6.16. Monitoring and Evaluation

Monitoring and evaluation are required to demonstrate that the project is achieving what was originally proposed,

improve ongoing management, and understand positive and negative impacts.

NbS performance should ideally be evaluated by comparing the status prior to and after the implementation, with the establishment of a pre-project baseline. The baseline for relevant measurable parameters serves as a benchmark against which performance and impact of NbS implementation can be assessed. However, natural systems are not static; ongoing environmental changes may improve NbS efficacy, but they may also undermine the integrity of ecosystems and negatively affect the NbS outcomes. Hence, NbS projects can benefit from using the dynamic assessment approach called the theory of change: a model to develop robust understanding, identify barriers to achieving goals, and a logical approach to monitoring and evaluation.

Box 6.9: Theory of Change Process

1. Identify the long-term change that the project is aiming to achieve as part of the goal setting process.
2. Map backward to identify the key barriers for achieving that long-term change or goal, considering the real-life situation at project level, to develop understanding of what needs to be in place to overcome the barriers and reach the longer-term ambition.
3. Look at the larger context within which the project will operate to acknowledge all the factors that affect the change needed (both the ones the project can and will tackle, and the ones it won't).
4. Articulate the individual logic steps between project elements, clearly showing cause and effect.
5. Consider what known assumptions are being made that are necessary for success.
6. Identify the strategies or activities that are needed and could be used by the project to achieve change.

NbS performance and impact indicators provide the foundation for any monitoring process and should be explored early in the planning phase of the project. The simplest metrics are those that involve a single assessment of the pre-NbS baseline condition, relative to the NbS impacts over time. However, there is a vast range of potential indicators for NbS projects; these need to be streamlined to ensure relevance to local contexts and stakeholders. A growing selection of sources can help develop a more standardized list of indicators and evaluation frameworks, such as that developed by the EKLIPSE Working Group on Nature-based Solutions to Promote Climate Resilience in Urban Areas. These standardized approaches can then be refined into a series of specific metrics for project monitoring and future evaluation.

A particularly important and challenging element of designing a monitoring scheme is determining the spatial scale to be included in the approach, particularly when the design considers the landscape level context. Important points to consider include the extent to which the NbS will be expected to deliver benefits beyond its spatial boarders, and if and how it fits into a wider network of connected interventions. This highlights the importance of not only understanding the existing landscape but also communicating approaches and sharing information with other developers, which underpin the whole mainstreaming approach to NbS.

The Forest Carbon Partnership Facility outlines a specific approach to good practices for monitoring and adaptive management:

- Consider socioeconomic impacts. The inclusion of socioeconomic impacts in monitoring and evaluation systems, as opposed to solely focusing on environmental outcomes, is useful for improving effectiveness and can foster support from politicians, donors, and other stakeholders.
- Implement simple, practical monitoring. Monitoring is best kept as simple and practical as possible while still being adequate.
- Use a participatory approach. Beneficiary participation in monitoring activities in exchange for paid wages can constitute an important local benefit.
- Integrate adaptive management. Adaptive management of the design and implementation of benefit-sharing arrangements based on the results of monitoring and evaluation is critical for improving effectiveness, efficiency, and equity over time. Piloting of benefit sharing can help facilitate adaptive management during the design phase, to include cycles of scenario visioning, evaluating, and adjusting the process. It is this kind of adaptive management approach that enables the ability for iterative learning, which in turn can guide and improve future NbS interventions.

Therefore, a solid monitoring instrument should consider a combination of information gathered in the field as well as remote sensing tools to respond to different

levels of accuracy and indicators. A number of resources are available to guide building a robust baseline and monitoring scheme: The Cross-Sector Biodiversity Initiative (CSBI) has compiled best practices for the collection of biodiversity baseline data; the IUCN has produced guidelines for planning and monitoring corporate biodiversity performance; the Biodiversity Indicators Partnership (BIP) has developed the Guidance for National Biodiversity Indicator Development and Use; and Global Forest Watch offers spatial data, among others.

6.17. Ensure Sustainability and Mainstreaming

NbS is still a relatively new concept; therefore, it requires constant development and improvement, where information flow is critical to develop it further into a more mainstream approach. The ability and willingness to share learnings should be factored into the delivery of any project, not only to develop the technical understanding but to feed directly into policy development and align with global targets and commitments on climate and biodiversity.

Learnings and case studies are required, which will in turn increase the demand for high-quality NbS projects linking to market mechanisms that can ultimately supply the flow of finance. This approach will rely on communication, engagement, and outreach.

6.18. Policy and Legislation

NbS projects must be designed to take account of existing legislation, policies, and the wider enabling environment that a project is due to take place within. A review of current policies and legislation should be undertaken, and engagement may be required with stakeholders and in particular government ministries. This can prove challenging and time-consuming, so it must be clearly allocated in the resources and capacity required.

In many cases, the current frameworks are far from perfect and can even be inhibitive, where policy implementation can actively contribute toward deforestation or degradation of ecosystem functionality. There can be conflict and a lack of cohesion between the local delivery of legislation and the national policy context set out in, for example, a country's NDC. But well-designed NbS can provide options to drive significant change and innovative improvements to link national policy with local implementation, and through close consultation with stakeholders, issues can be highlighted with potential solutions developed.

The longevity of NbS activities means that they will continue beyond the time frame of many existing policies, which may be short-lived. Therefore, as much as they need to align with existing legislation at the starting point of a delivery, they can also be viewed independently, to ensure success over time that stretches far beyond the initial project intervention. This evolving and long-term view is important to feed into the adaptive management approach described in section 5.15—as the policy landscape develops, the ongoing management can adapt. Continued success of NbS projects can critically start to drive the new policy needed to achieve climate and biodiversity commitments.

6.19. Contribution to Global Targets

The overall goal of NbS is to contribute toward addressing societal challenges at a local, regional, and global scale, but for many of the reasons stated earlier, NbS interventions will never accomplish this goal if they operate in isolation. A growing set of national and global targets on climate change, biodiversity, development, and human rights are providing an increasingly wider set of goals for NbS projects. Many of these targets depend on each other and will become ever more so as we further understand the interconnectedness of the challenges we face for our climate, our planet, and its people. NbS will provide a fundamental contribution toward achieving such targets, from complementing aggressive decarbonization and emission reduction strategies to reducing climate risk and establishing resilient communities, enhancing biodiversity, and delivering social justice.

It is the responsibility of the project developer to identify relevant targets and inform the associated bodies overseeing the process. This will enable the regulating bodies to document the project intervention and make the formal linkage of how the project is contributing toward the specific target. In the context of global climate policy, this is vital for understanding contributions toward national targets and can feed directly into the global Paris Agreement and continue to mainstream NbS approaches around the world.

6.20. Legacy and Exit

As described, NbS interventions are designed to be long term, often to be delivered and maintained over many decades, and in some cases there are commitments of up to 100 years. This presents challenges for project developers whose business models are not designed to look that far ahead and will require exit strategies built into the project design while ensuring sustainability of the project. This is particularly true for mining operators, where the life span of a mine is finite together with the operational commitment of the company involved. It

is therefore important to consider aligning the shorter-term needs with the longer-term legacy.

Ultimately, NbS can play an important part in the mining sector's ongoing challenge around sustainable legacy and an operator's ability to exit without leaving lasting damage to the ecological and social functionality of the site and surrounding area.

An exit strategy may involve designing and identifying a point to hand over to local or national organizations (who should be involved in the design phase to ensure understanding of capacity and agreement of future commitments). This can involve a phased co-management approach for a restoration project, where the community is increasingly involved over time, to build the skills, capacity, and institutional structure to manage the ongoing concern of a project.

This can also be approached through a protection pathway, where the ecological management required on the ground is minimal, and the local community can take responsibility for the protection and safeguarding process over the longer term, with future rights to carbon and associated benefits being increased over time as their input into the project grows.

This approach should be built into the overall mine operating exit strategy covering, where appropriate, land reclamation, community support, or incentives. The main additional element required for successful NbS is to address the issue of permanence (explained earlier in this section) and the legal requirements of landowners, project managers, investors, and state actors who may all be involved in the project, to encourage and reward maintenance and verification of the NbS over the project's duration.

Table 3.1: Challenges Common to Large-Scale Mining Projects and the Potential for NbS to Be Part of the Solution

Mine cycle stage	Challenges	Potential NbS response	Examples?[a]	Mitigation hierarchy stage
Exploration	Meeting exploration permit conditions	NbS can help improve ESG scores, which are fast becoming an important consideration for investors	• NbS to rehabilitate and restore disturbed lands through revegetation and ecosystem restoration with native species • Reporting biodiversity and ecosystem services management and applications of NbS at site level contributes to the ESG due diligence of many finance institutions	• Avoid • Minimize • Restore
	Exploration is often expansive, leaving road and drilling trails that require recovery or rehabilitation	NbS can help rehabilitate disturbed lands and close access routes, thus preventing induced and indirect impacts, and reducing the residual impact footprint of exploration	• Reinstatement of forest through introduction of natural ecological succession and restoration practices to close road access to explored areas	• Restore
	Roads are often temporary and may be under-engineered	NbS can prevent erosion or impacts of weather events or can increase slope stability and resilience in the event of rainfall or flood events	• Venetia mine, South Africa, applying local perennial grass species on road verges to enhance water attenuation and reduce soil erosion	• Restore
	Community relationships	NbS can be implemented with communities as part of good social management programs	• Identifying local ecosystem services in the landscape and community dependencies thereon and ensuring either these are not disturbed or actions are implemented to enhance them (conservation agriculture or watershed management)	• Minimize • Restore
	Exploration clearance for drilling	NbS can help rehabilitate and restore disturbed lands	• Reinstatement of forest through introduction of natural ecological succession and restoration practices to rehabilitate cleared areas	• Minimize • Restore
	Noise and light emissions	NbS can provide screening for exploration activities	• The use of vegetation (e.g., forest, bush, and woodland) is kept intact as far as possible, as screening between exploration activities and nature or communities	• Minimize
	Footprint of drilling rigs and access vehicles	NbS can eliminate or reduced footprint	• The use of ice roads in winter to prevent fragmentation or direct impact of permanent infrastructure	• Avoid

Development	Access to capital	NbS can help improve ESG scores, which are fast becoming an important consideration for investors	• Reporting biodiversity and ecosystems services management and applications of NbS at site level contributes to the ESG due diligence of many finance institutions (e.g., GRI, FSTE, NASGAQ, etc.)	• All
	Obtaining license to operate	NbS can boost reputational standing and likelihood of being granted license to operate	• The overall planning and management of mining concession, including (a) protection of High Conservation Value/High Carbon Stock areas within concessions and (b) support to sustainable management of forest within concession/support to development/implementation of local sustainable development strategy, which may include water and land use management • In northern Liberia, the location of the ore body within ArcelorMittal's concession overlaps with a Key Biodiversity Area and critical habitat triggering species and habitat. To avoid and minimize impacts, infrastructure was located outside areas of high biodiversity and a small section of the ore body has been forgone to avoid impacts to forest habitat and water	• All
	Addressing unsightly infrastructure	NbS can help mitigate visual impacts while delivering co-benefits	• Establish vegetation using indigenous planting as field boundary hedging to screen or provide vegetation cover to infrastructure as visual mitigation; vines can also be used on buildings • Revegetation at contaminated sites and integration with landscape architecture and urban planning	• Minimize
	Staff accommodation and leisure facilities (large numbers in development phase)	NbS can enhance the environment and well-being of staff through green infrastructure, landscaping, rest and relaxation facilities and outlook	• Oyu Tolgoi staff recreational area with outlook to natural environment, in addition to indigenous gardens, etc., for use by staff	• Minimize
	Emission reductions of CO_2 to meet voluntary carbon offset targets	Ecological connectivity for biodiversity net gain, water security Carbon sequestration with verified emission reductions, as part of the business climate strategy	• Reforestation of native species at Carajás mine (Vale, Brazil)	• All

Mine cycle stage	Challenges	Potential NbS response	Examples?[a]	Mitigation hierarchy stage
	Development phase is often expansive, leaving road and materials storage footprint that require recovery or rehabilitation	NbS can help rehabilitate disturbed lands and close access routes, thus preventing induced and indirect impacts, and reducing the residual impact footprint of exploration	• Reinstatement of forest through introduction of natural ecological succession and restoration practices to rehabilitate cleared areas and to close road access	• All
	Habitat loss driven by mining	NbS can help rehabilitate disturbed lands	• Propagation and conservation of species for rehabilitation and restoration of ecosystem at Carajás mine (Vale, Brazil) • Tree nursery and revegetation trials with indigenous plant species, and regeneration of impacted areas using native species to facilitate expansion of plants and smaller animals into restored land from unimpacted forest refuges near site (ArcelorMittal, Liberia)	• Restore
	Forest fragmentation and degradation inevitably leading to loss of biodiversity, local climate change, and depletion of ecosystem services	Establishment of protected areas for conservation of biodiversity	• The creation of native seedling nurseries to support conservation of threatened species, providing important stocks of flora diversity for use in restoration, Carajás mine (Vale, Brazil) • Protection from encroachment of anthropogenic landscapes created by an advancing agricultural frontier, vast smallholder settlements, timber, and artisanal mining activities	• Restore
	Roads are often temporary and may be under-engineered	NbS can prevent erosion or impacts of weather events or can increase slope stability and resilience in the event of rainfall or flood events	• Applying local perennial grass species on road verges to enhance water attenuation and reduce soil erosion • Reinstating vegetation along new drainage lines and providing seeps and attenuation areas to reduce runoff and erosion	• Minimize
	Community relationships	NbS can be implemented with communities as part of good social management programs	• Creation of natural resource management options for livelihoods generation including, e.g., sustainable biomass; sustainable charcoal production; agroforestry and conservation agriculture, clearance programs for alien invasive species; avoided loss program with alternative planting and harvest of building materials (e.g., building poles and thatch)	• Minimize • Restore • Offset

	Encroachment of anthropogenic landscapes created by an advancing agricultural frontier, vast smallholder settlements, timber and artisanal mining activities	Establishment of agroforestry systems to increase connectivity to support the conservation of forest species and help them cope with land use and climate change	• Agroforestry systems at Vale's Carajás mine replicate the multistoried structure of a native forest to benefit from synergies between crop and forest plants, while supporting both subsistence and livelihoods. These systems have been implemented using crops such as maize, beans, cassava, sweet potatoes, bananas, papayas, acai, cocoa, andiroba, Brazil nuts, and guava	• Restore • Offset
	Community programs	NbS can enhance water, soil productivity, pest management, pollination, protection of nature-based activities (agriculture and livestock)	• Mine land rehabilitation success by Vale can be enhanced by pollinator and seed disperser activity, and therefore plant species providing a food source for these animals should be prioritized in the rehabilitation program. The goal in planting these species is to accelerate regeneration by reinstating and restructuring lost interactions	• Restore
	Noise and light emissions	NbS can provide screening for development activities	• The use of vegetation (e.g., forest, bush, and woodland), is kept intact as far as possible as screening between exploration activities and nature or communities	• Restore
	Footprint of construction equipment and access vehicles	NbS can eliminate or reduced footprint	• Rehabilitating anthropogenically disturbed areas by Vale to restore natural habitats in this region and expand and reestablish native forest cover can serve to offset impacts from the mine project that could not be avoided and/or mitigated, while also supporting the reestablishment of wildlife populations and forest connectivity through the formation of ecological corridors	• restore
Production	Reduce GHG emissions	Emission reductions for mining will generally focus on operational and energy changes; however, if there are substantial land holdings, emission reductions may be possible through reduced deforestation or improved agriculture approaches	• The protection of existing habitats prevents the further release of GHG through land conversion in terrestrial systems, and reduction of seabed activity in the marine realm, safeguarding the biodiversity that depends on such habitats as well as the wider ecosystem services they provide • The restoration of degraded habitats can actively improve the ability of natural systems to remove GHG from the atmosphere, as well as recover biodiversity and ecosystem services	• Minimize

Mine cycle stage	Challenges	Potential NbS response	Examples?[a]	Mitigation hierarchy stage
	Increase GHG sequestration	Avoiding deforestation and forest degradation is generally the most effective way Reforestation, ecosystem restoration, and enhancing land management	• By improving the management of productive landscapes, mitigation can be achieved by the enhancement of carbon storage and the reduction of emissions (e.g., increasing organic matter in farmland soils) • On land, the restoration of peatland, protection of native woodland, and expansion of upland forests on mineral soils would absorb atmospheric carbon, regulate water flows across the catchment, and promote biodiversity. Protecting existing terrestrial carbon stocks in the United Kingdom could secure 16,231 megatons of CO_2 equivalent ($MtCO_2e$), and an additional climate change mitigation of 75–123 $MtCO_2e$ by 2030 and 278–492 $MtCO_2e$ by 2050 could be achieved through restoration of degraded peatlands and creating new woodland	• Minimize • Restore • Offset
	Degradation of natural systems from climate change	Ecosystem services and habitat restoration	• Vale's Forest Connectivity Program—which aims to rehabilitate pastureland purchased in areas surrounding the S11D iron ore mine, near the southern boundary of the Carajás National Forest, in northern Brazil—will contribute to restoring and conserving biodiversity but can also reinstate and improve ecosystem services at a local and regional scale	• Restore
	Reduce biodiversity impacts	Conservation area protection	• Vale's Forest Connectivity Program (see above) • ArcelorMittal Liberia's Biodiversity Conservation Program was designed to compensate for residual impacts on biodiversity from mining operations in the western Nimba Range, Liberia. A core focus for the program has been to improve the management of the East Nimba Nature Reserve and Community Forests while supporting more sustainable agricultural production • In Guinea, Guinée Alumina Corporation (GAC) and Compagnie des Bauxites de Guinée (CBG) have together committed significant finance ($48 million) to create the Moyen Bafing National Park (MBNP) and support chimpanzee conservation activities in the park as part of their offset commitment for bauxite mining projects in the Boké region	• Restore • Offset

	Damage to wetlands and riparian systems	Revegetation and ecological restoration of riverine habitats	• Restoration of riverine habitats and hydrological flows at Los Bronces mine, Chile • Protection of aquifers and borehole water supplies through the protection of habitats and improvement of water attenuation and ingress (recharge) at Los Bronces, Chile	• Restore
	Environmental vulnerabilities in the ecosystem surrounding mining operations	Defining strategies for incorporating biodiversity conservation into mined land rehabilitation activities	• Carajás National Forest Extractive Cooperative (Brazil) is selecting vegetation species for collection of seeds. Collected seeds are supplied to the Mined Land Rehabilitation Program to increase the presence of these species in revegetation areas, thus optimizing conservation efforts • Environmental offsets to improve environmental quality and ecosystem services in the region	• Restore • Offset
		Deliver NPI for biodiversity through co-benefits of NbS when designed concurrently with other disciplines and objectives	• Anglo American Los Bronces protected areas project • Vale's Forest Connectivity Program delivering benefits including ecological connectivity for biodiversity net gain, water security. Carbon sequestration with verified emission reductions, as part of the business climate strategy. As a result of the pastureland rehabilitation process, average sequestration of 0.55 tC/ha and 2.03 tCO_2e/ha, and total sequestration of 927 tC and 3,402 tCO_2e • Large-scale collection of high-quality seeds, effective seed germination and seedling establishment, and protection of local populations to ensure phenotypic diversity in addition to species diversity at Carajás mine (Vale, Brazil)	• Minimize • Restore • Offset
		NbS are part of impact mitigation when applying the mitigation hierarchy, particularly restoration	• The primary procedures used in the forest restoration process include site protection with fencing to prevent access by cattle, creation and maintenance of fire breaks, promoting natural regeneration by creating patches of trees to attract dispersers, and forest enrichment by planting seedlings, transplanting seedlings from the soil seed bank, direct seeding, and natural regeneration	• Minimize • Restore • Offset
	Ore processing	Bioleaching	• Bioleaching is the extraction of metals from their ores through the use of living organisms. Bioleaching can involve numerous ferrous iron and sulfur oxidizing bacteria. • Several species of fungi can be used for bioleaching	• Minimize

Mine cycle stage	Challenges	Potential NbS response	Examples?[a]	Mitigation hierarchy stage
	Maintain water supplies	NbS watershed management, wetland management, reservoir management to improve water availability, quality and to risks related to water-related extreme events	• Soil moisture retentions and groundwater recharge through vegetation • Natural and constructed wetlands systems • Reforestation of watershed to harvest and retain water • Reinstatement or maintenance of riparian vegetation buffer strips to ensure integrity of river systems	• Minimize • Restore • Offset
	Reduce flooding	NbS watershed management, riparian vegetation restoration and management, increased vegetation coverage to absorb and attenuate rainfall runoff	• Sponge City initiative in China, installing green infrastructure in cities to reduce flooding • Urban green spaces and green buildings to absorb and attenuate storm water and rainfall	• Minimize • Restore
	Reduce erosion	Control of water runoff and erosion control using reforestation and revegetation of slopes to prevent damage to infrastructure	• At Venetia mine, South Africa: Ecological rehabilitation of landscape processes to assist natural processes to achieve physical, structural, as well as chemical and ecological stability of the landform (soil substrate and hydrological components). This will promote a self-perpetuating and productive vegetation cover that will allow feasible and economical end land use • Initiate green "soak-away" areas within the district, along with reed beds in overflow channels/ponds (as per the mine area) and a tree planting program to stabilize slopes that erode from storm water and regenerate and attenuate water flow on watersheds • Revegetation of slopes and drainage channels at ArcelorMittal's mine sites in northern Liberia • Los Bronces mine, Chile—revegetation with native species of slopes around mine areas to reduce water runoff and erosion. This also helps to reduce road maintenance arising from land slippages and landslides in the vicinity of the mine	• Minimize • Restore

	Reduce water contamination	Wetland restoration can increase the capacity of the local system to absorb and filter pollution. Riparian habitat restoration can improve water provision and stability. Reforestation can reduce runoff from contaminated lands into watercourses	• Milwaukee Metropolitan Sewerage District provides water reclamation and flood management services for 28 communities in southeastern Wisconsin. In the early 2000s, the utility faced public backlash when wet weather events led to sewage overflow, contaminating local waterways and Lake Michigan and causing beach closings. Their service area is fed by six different watersheds. NbS portfolio integrates natural infrastructure into the utility's everyday operations and is centered on the notion that residents play a role in improving water quality. Projects include rain gardens, rain barrels, porous pavements, green roofs, bioswales, trees and tree boxes, as well as rainwater harvesting	• Minimize • Restore
	Water security	Increasing capacity of watershed to regulate water flow, provisioning and attenuation, reduce erosion and flooding	• Removal of alien invasive species across watersheds and restoration of riverine habitat to restore ecological function and ecosystem services of the watershed at Los Bronces mine, Chile. Afforestation and habitat restoration could provide benefits to ecological connectivity and ecological objectives in the landscape and increase carbon pool	• Restore
	Reduce soil contamination	Bioaccumulation, bioremediation, biological treatment of soil, enhancement of soil with nutrients through NbS and green planting (organic manures, composts, etc.)	• Using nature-based remediation technologies, such as phytoremediation and bioremediation • Constructed wetlands at brownfield sites are suitable for treating groundwater and surface water contaminated by low concentrations of easily biodegradable contaminants • In the Franche-Comté region of France, an artificial wetland consisting of four shallow ponds was constructed for landfill leachate treatment. The performance was monitored for 16 years. Overall, leachate contaminants were effectively eliminated via precipitation and microbiological reactions, with the efficiency reaching 75%–90% removal	• Minimize • Restore
	Soil degradation	Sustainable livestock farming to stop soil degradation	• Los Bronces mine, Chile, working with local pastoralists and farmers to improve livestock practices to enhance soil carbon content and reduce overgrazing	
	Reduce air contamination	Reforestation can reduce dust/noise pollution	• Planting robust hedge rows and lines of screening vegetation close to dust road and planting noninvasive ground covers can limit the spread of dust from dirt roads	• Minimize • Restore

Mine cycle stage	Challenges	Potential NbS response	Examples?[a]	Mitigation hierarchy stage
		Bioactive surfaces reduce some pollutants	• CityTree is a biotech filter with the aim to improve the air quality in cities. The CityTree is a compact and mobile construction, vertically planted with different species of mosses on its front and back side. The moss surface helps improve air quality through the binding of air pollutants like particulate matter and nitrogen oxide	• Minimize • Restore
		Stabilizing soils to reduce windblown erosion	• The measures of bioengineering for the protection of water banks and hillsides with medium to high inclination against water and wind erosion	• Minimize • Restore
		Matting (raffia and straw, etc.) to cover exposed ground to reduce dust	• Used in Namaqualand mine, Northern Cape, South Africa, to reduce windblown dust • Used at Richards Bay minerals to stabilize dunes for replanting and ecological restoration to reduce windblown dust and removal of top soils	• Minimize • Restore
	Reduce noise pollution	NbS – vegetation screens, NbS adsorption of noise through vegetation planting on verges of roads	• Green noise barriers are effective measures to reduce noise emissions along highly frequented roads. They are often designed as walls with a ground-based greening	• Minimize • Restore
	Reduce the spread of desertification in arid environments	NbS stabilizes and enriches soils NbS increases soil humidity	• The Great Green Wall of China reforestation project • Sahel green wall—planting vegetation to reduce the spread of Sahara desertification	• Minimize • Restore
	Management of processing waste	NbS approaches are already well established in the stabilization and management of tailings, slag, etc.	• A properly designed vegetated cap can prevent water infiltration into the tailings by utilizing all the incoming precipitation • Air and groundwater pollution can be reduced by stabilizing the mine tailings • With a mix of native plants including shrubs, cool-season and warm-season grasses, and annual herbaceous species such as native wildflowers. Plants are chosen for their ability to control the water balance in the cap layer. Deeper rooted shrubs can utilize water throughout the cap layer. Hence, they provide the primary control of the water balance	• Minimize • Restore

	Unproductive use of nonmined land assets	Reforestation can be used to improve appropriate land. Improved agriculture NbS can be used to improve agricultural lands	• Working with African farmers to improve cocoa production techniques to reduce deforestation and earn carbon credits • Establishment of agroforestry systems that attempt to replicate the multistoried structure of a native forest in order to benefit from synergies between crop and forest plants while supporting both subsistence and livelihoods. These systems have been implemented using a range of crops. In addition to playing an important restoration role by protecting biodiversity, mitigating climate change, and increasing connectivity, agroforestry initiatives help provide livelihoods for local communities	• Restore
	Mining causing forest fragmentation and degradation inevitably leading to loss of biodiversity, local climate change, and depletion of ecosystem services	Honey production, assisted pollination and restoration of ecosystem services at mine rehabilitation sites	• At the Native Bee Biofactory in Carajás, Brazil, colonies of different stingless bee species rescued from areas cleared for mining provide a source of livelihood for local communities and help conserve biodiversity. From rescued parent colonies, important pollinator and honey species are multiplied at large scale, in a process that connects bees, communities, and conservation by creating colonies of native species for beekeeping in municipalities neighboring the Carajás National Forest	• Restore • Offset
		Biodiversity conservation in Carajás	• Collecting and supplying seeds for seedling production, mine land rehabilitation, and species conservation	• Minimize • Restore • Offset
	Improve community relations	NbS can provide/maintain important services to local communities as well as be sources of economic opportunity	• The Carajás National Forest Extractive Cooperative, in the municipality of Parauapebas (Pará, Brazil), was founded in 2006 to organize harvesters active in the region since the 1980s. Members derive their primary livelihood from harvesting and selling leaves from the jaborandi, a threatened species that is used to produce medicines for glaucoma and cancer by extracting pilocarpine nitrate and hydrochloride from plant's dry leaves. The cooperative sells the raw material without processing, as well as seeds from 350 other native species for land rehabilitation and habitat restoration activities	• Minimize • Restore
	Improve workforce well-being	NbS can help demonstrate a wider purpose to mining, making it more attractive to younger workers	• Attracting and retaining staff	• N/A

Mine cycle stage	Challenges	Potential NbS response	Examples?[a]	Mitigation hierarchy stage
	Improve government relations	NbS can contribute to government commitments on carbon, biodiversity, and development	• Conservation of the ferruginous cangas of Carajás and thus meeting compliance requirements for biodiversity management (Vale, Brazil)	• Minimize • Restore • Offset
	Volatility of commodity prices	NbS can provide alternative revenue streams	• Generating alternative livelihoods for communities in the region through engagement with agroforestry projects, restoration initiatives, and mine closure	• Minimize • Restore • Offset
	Reduce health and safety risks	Some NbS are specifically designed to reduce the risk of disaster	• Stabilizing rock dumps • The use of vegetation and vegetation-rock combinations for long-term stabilization of uranium mill tailings	• Minimize • Restore
Reclamation	Restoration of mined lands		• Use of reforestation of coal strip mining site, U.S.A. • Use of bamboo to restore land previously used for gold mining in Ghana (Nature-Based Solutions NBS Facilitation Team 2019). • Reclamation of the subsidence area around Pan'an Lake, China (Nature-Based Solutions NBS Facilitation Team 2019)	• Restore
	Decontamination of land	Bioleaching and mineral farming	• Anglo American uses bioleaching (or biomining)—a process in mining and biohydrometallurgy (natural processes of interactions between microbes and minerals) that extracts valuable metals from a low-grade ore with the help of microorganisms such as bacteria or archaea • Bioleaching techniques are often more effective than traditional mining applications and can even be used to clean mine tailings sites	• Restore
	Increased water attenuation	Vegetation and habitat enhancement to increase water retention and attenuation in hyperarid or water-stressed environments	• Los Bronces mine, Chile, revegetating and enhancing habitat to increase water attenuation in high-altitude wetland areas	• Restore
	Bioremediation of land	Remediation of mine tailing deposits	• Bioremediation is a process that uses mainly microorganisms, plants, or microbial or plant enzymes to detoxify contaminants in the soil and other environments • Bioremediation is commonly used for cleanup of soils contaminated with acidic mining drainage	• Restore

	Cover tailings facilities	Remediation of mine tailing deposits and abandoned mine areas	• Phytocapping is cost-effective, environmentally friendly, and has multifunctional role against various problems of mine tailings: It provides erosion control, landscape rehabilitation, enhances the soil properties for further colonization of other more demanding vegetal species, reduces the leachability of metals downward the groundwater, and favors the immobilization of metals forming less bioavailable species	• Restore
	NbS for bioremediation of contaminated water sources	Wetlands	• Constructed wetlands-based treatment uses natural geochemical and biological processes in an artificial (man-made) wetland ecosystem	• Restore
	Restoring land use alternatives for local communities (often in agreement)	Habitat restoration and revegetation	• At Venetia mine, South Africa, ecological rehabilitation of landscape processes to assist natural processes to achieve physical, structural, as well as chemical and ecological stability of the landform (soil substrate and hydrological components). This will promote a self-perpetuating and productive vegetation cover that will allow feasible and economical end land use	• Restore
Mine closure	Restoration of mined lands	Ecological rehabilitation and soil recovery with succession planting, etc.	• Mine land rehabilitation by herd effect—cessation of tilling, elimination of pesticides and synthetic fertilizers, planting cover crops to reduce soil exposure and erosion, increase plant diversity, and integrate livestock and cropping operations at Voorspoed mine, South Africa	• Restore
		Passive restoration of protected land	• Vale supports small-scale projects at its site in Carajás, Brazil, that demonstrate the potential economic and environmental benefits of NbS. The projects include passive restoration of protected land (covering 1,678 ha) and active reforestation combined with sustainable harvesting (covering 145 ha). Although the projects are small in scale, they illustrate the potential for NbS by mining companies	• Restore

Mine cycle stage	Challenges	Potential NbS response	Examples?[a]	Mitigation hierarchy stage
	Decontamination of land	Phytoremediation	• At Namaqualand mine, South Africa, a variety of plants are carefully sewn into degraded soil in the hopes of eradicating contaminants and restoring the soil to a "pure" and healthy state, capable of once again supporting the growth and subsequent thriving of endemic flora and fauna. If this rhizosphere biodegradation proves successful, then the plants will release nutrients into the soil via their root systems, essentially "defibrillating" the naturally occurring microorganisms therein and compelling the contaminants to degrade	• Restore
	Cover tailings facilities		• As above	• Restore
	Bioremediation of leachates	Wetlands	• As above	• Restore
	NbS for bioremediation of contaminated water sources	Wetlands	• As above	• Restore
	Restoring land use alternatives for local communities (often in agreement)	Habitat restoration and revegetation	• The Diamond Coast Hiking Trail, jointly managed by De Beers and the Namaqua National Park, links the former mining towns of Kleinzee and Koingnaas, situated near the border between South Africa and Namibia	• Restore
Post-closure and relinquishment	NbS to generate alternative land use post-closure – land recovery	Grazing, agriculture, wildlife refuge/ nature reserve, carbon farming	• Agroforestry systems implemented using a range of crops, with benefits through ecosystem restoration including protecting biodiversity, mitigating climate change, increasing connectivity, and improving livelihoods for local communities. In some contexts, forest fire outbreaks may be reduced following establishment of agroforestry systems	• Restore
	Co-benefits of NbS	Biodiversity offsets (restoration)	• Contribution to maintaining regional biodiversity and establishing wildlife connectivity. Delivery on the environmental offsets program required under the environmental license for the mine and under Federal Decree 5 975/2006, in which land is being purchased to offset the disturbance of the natural environment caused by mining. Protected areas contain the most important native forest remnants in southeast Pará State, and are part of the South Amazon Ecological Corridor, a priority area for biodiversity conservation	• Restore

Note: *ESG = environmental, social, and governance; NbS = nature-based solutions.*

a. For further examples of NbS in action, please see the UN NbS Contributions Platform, the NbS Initiative case studies, or the Nature4Climate case studies.

Table 3.2: Climate and NbS Approaches Taken by the Top 13 Mining Companies (by Market Capitalization) and Companies Involved in Pilots for This Guidance

Size	Company	Market cap (US$, billions)[a]	Climate target	NbS coverage in climate policy	Reporting[b]	Internal carbon price[c]	Race to Zero?[d]	SBT[e]
1	BHP (BHP 2020)	138	Net zero emissions by 2050 (Scopes 1 and 2)	Experience since 2014. Included in climate strategy. Reduce operational emissions by at least 30% from the level they were in 2020. Achieve net zero operational emissions by 2050	TCFD, CDP	Yes	No	No
2	Rio Tinto (Rio Tinto 2019)	117	Net zero emissions by 2050, 15% by 2030 (Scopes 1 and 2?)	Included in climate strategy. Follow Nature4Climate principles. Targets—to reduce absolute emissions by 15% by 2030 and emissions intensity by 30% relative to 2018 equity baseline—are consistent with a 45% reduction in absolute emissions, relative to 2010 levels, and align with the IPCC pathways to 1.5°C. They are supported by commitment to spend $1 billion on climate-related projects from 2020 to 2024	TCFD, CDP	Up to $140/ ton	No	No
3	Vale (Vale 2019)	71	Net zero emissions (Scopes 1 and 2) by 2050, 33% by 2030; 15% reduction in Scope 3 by 2035	Monitoring carbon in 1 million ha forest areas controlled	TCFD, CDP	$50/ton	No	No
4	Glencore (Glencore 2020)	63	In line with the ambitions of the 1.5°C scenarios set out by the IPCC, target a short-term reduction target of 15% by 2026 and a medium-term 50% reduction of total (Scopes 1, 2, and 3) emissions by 2035 on 2019 levels. Post-2035, ambition is to achieve, with a supportive policy environment, net zero total emissions by 2050	"Working to deepen understanding of offsets." Small NbS in Peru	TCFD	No?	No	No
5	Anglo American	48	Carbon neutral by 2040 (Scopes 1 and 2), 30% reduction by 2030, Scope 3 reductions where possible	Exploring NbS with IUCN and Fauna & Flora International	TCFD, CDP	No?	No	No

6	Freeport-McMoRan	47	15% GHG emissions intensity reduction target for the Americas copper business by 2030, and committed to aligning its future climate reports with the recommendations of the TCFD. 30% GHG emissions intensity reduction target for its Indonesian operations by 2030. Freeport aspires to participate in, and positively contribute to, a 2050 net zero economy	No mention	TCFD	No	No	Yes
7	Nornickel	47	Continue to maintain absolute Scopes 1 and 2 GHG emissions from operations below 10 $MtCO_2e$ amid production growth by 30%–40% (Ni-equivalent production vs. 2017)	No mention	-	?	No	No
8	Southern Copper	43	To reduce GHG emissions	No mention	-	?	No	No
9	Newmont (Newmont 2019)	43	Net zero by 2050, 30% reduction by 2030	Utilizing their land position to support carbon offsets. Forest based offsets in Australia and Peru. No % target	TCFD, CDP	$50/ton	No	No
10	Zijin Mining	41	Adhere to the Paris Agreement and the "strategic goal of carbon peak by 2030 and carbon neutrality by 2060" proposed by Chinese government	Invested RMB 1.92 billion, which is 50.6% more than last year, in environmental and ecological protection, including 3.333 million sq. m of vegetation restoration and 409,000 plants of flowers and trees	_	_	No	No
11	Nutrien	37	By 2030, achieve at least a 30% reduction in GHG emissions (Scopes 1 and 2) per ton of products produced from a baseline year of 2018	No mention				
12	Fortescue (Fortescue 2020)	33	Net zero emissions by 2040 (Scopes 1 and 2). 26% by 2030	No mention	TCFD, CDP	Yes	No	No
13	Barrick Gold	32	10% reduction by 2030	No mention	TCFD, CDP	$25/ton	No	No

Size	Company	Market cap (US$, billions)[a]	Climate target	NbS coverage in climate policy	Reporting[b]	Internal carbon price[c]	Race to Zero?[d]	SBT[e]
A number of ICMM member companies now also have a net zero target: Members of the ICMM have committed to a goal of net zero Scopes 1 and 2 GHG emissions by 2050 or sooner, in line with the ambitions of the Paris Agreement								
33	Teck Resources	32	Reduce the carbon intensity of operations by 33% by 2030 and carbon neutral by 2050. Procure 50% of electricity demands in Chile from clean energy by 2025 and 100% by 2030	Pilot for this NbS guidance	TCFD, CDP	No	No	No
XX	ArcelorMittal		Net zero by 2050 and in Europe target is to reduce their CO_2 emissions by 30% by 2030 over 2018	Pilot for this NbS guidance	?	No	No	No

Note: CDP = Carbon Disclosure Project; GHG = greenhouse gas; ICMM = International Council on Mining and Metals; IPCC = Intergovernmental Panel on Climate Change; NbS = nature-based solutions; TCFD = Task Force on Carbon-related Financial Disclosures.

a. "The Top 50 Biggest Mining Companies in the World," Mining.com, September 30, 21, https://www.mining.com/top-50-biggest-mining-companies/.

b. The Task Force on Climate-related Financial Disclosures (TCFD) provides an internationally agreed framework for reporting on carbon emissions. CDP runs a global environmental disclosure system that is aligned with TCFD recommendations.

c. Setting internal carbon pricing is recognized as one of the key mechanisms for driving emission reductions (CDP 2017).

d. The UN Race to Zero campaign defines minimum criteria for net zero commitments. Approved companies are listed here.

e. Science-based target (SBT) approved by the Science Based Targets Initiative. The only mining company with an approved SBT is Hindustan Zinc. Several metal and mineral processing companies and manufacturers have SBTs.

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