Nature-based Solutions for corporate climate targets

Views regarding the corporate use of Nature-based Solutions to meet net-zero goals

A.Vidal, G. Martinez, B. Drion, J. Gladstone, A. Andrade, and L. Vasseur

INTERNATIONAL UNION FOR CONSERVATION OF NATURE

About IUCN

IUCN (International Union for Conservation of Nature) is a membership Union uniquely composed of both government and civil society organisations. It provides public, private and non-governmental organisations with the knowledge and tools that enable human progress, economic development and nature conservation to take place together. Created in 1948, IUCN is now the world's largest and most diverse environmental network, harnessing the knowledge, resources and reach of more than 1,400 Member organisations and around 15,000 experts. It is a leading provider of conservation data, assessments and analysis. Its broad membership enables IUCN to fill the role of incubator and trusted repository of best practices, tools and international standards. IUCN provides a neutral space where diverse stakeholders, including governments, non-governmental organisations, scientists, businesses, local communities, Indigenous peoples, organisations, and others, can work together to forge and implement solutions to environmental challenges and achieve sustainable development. Working with many partners and supporters, IUCN implements a large and diverse portfolio of conservation projects worldwide. Combining the latest science with the traditional knowledge of local communities, these projects work to reverse habitat loss, restore ecosystems and improve people's well-being.

www.iucn.org
twitter.com/IUCN

Nature-based Solutions for corporate climate targets

Views regarding the corporate use of Nature-based Solutions to meet net-zero goals

A.Vidal, G. Martinez, B. Drion, J. Gladstone, A. Andrade, and L. Vasseur

IUCN is pleased to acknowledge the support of its Framework Partners who provide core funding: Ministry of Foreign Affairs, Denmark; Ministry for Foreign Affairs, Finland; Government of France and the French Development Agency (AFD); Ministry of Environment, Republic of Korea; Ministry of the Environment, Climate and Sustainable Development, Grand Duchy of Luxembourg; the Norwegian Agency for Development Cooperation (Norad); the Swedish International Development Cooperation Agency (Sida); the Swiss Agency for Development and Cooperation and the United States Department of State.

This publication has been made possible by funding from the Government of France and the French Development Agency (AFD).

Published by:	IUCN, Gland, Switzerland
Produced by:	IUCN Centre for Economy and Finance – Climate Change Team

Recommended citation:	Vidal, A., Martinez, G., Drion, B., Gladstone, J., Andrade, A. & Vasseur, L. (2023). *Nature-based Solutions for corporate climate targets. Views regarding the corporate use of Nature-based Solutions to meet net-zero go*als. Gland, Switzerland: IUCN.
ISBN:	978-2-8317-2253-5 (PDF)
DOI:	https://doi.org/10.2305/ELGL1056
Cover photo:	musicphone1 / iStock
Layout and design:	Imre Sebestyén, jr. / Unit Graphics
Edited by:	Scriptoria

Table of contents

Executive summary ..... **v**

Acknowledgements ..... **vii**

Acronyms ..... **viii**

Glossary of definitions ..... **ix**

1. Introduction **1**

2. Nature-based Solutions and climate change mitigation **5**
2.1. Nature-based Solutions definition and global standard 5
2.2. The role of Nature-based Solutions in a Paris-aligned pathway 13
2.3. The Global Standard for Nature-based Solutions™ in the context of net zero 14

3. Nature-based Solutions in corporate climate strategies **17**
3.1. Assessing and disclosing climate and nature-related risks 18
3.2. Setting and achieving credible net-zero targets 20
3.3. Neutralising residual emissions 25

4. Nature-based Solutions and societal net zero **27**
4.1. Nature-based Solutions in beyond value chain mitigation 27
4.2. Nature-based Solutions and carbon credits 30
4.3. Responsible use of carbon credits and guardrails 32

5. Conclusions and further discussion **37**

6. Annexes **39**
6.1. Annex A – Core Carbon Principles for high-integrity carbon credits 39
6.2. Annex B – Emerging guidance on responsible use of Nature-based Solutions 40

Endnotes **42**

List of boxes, tables and figures

Box 1. Addressing trade-offs between biodiversity and climate change 10
Box 2. Nature-related measures in the context of the 1.5°C-aligned pathway . . . 13
Box 3. Emerging nature-related reporting guidance 19
Box 4. SBTi 1.5°C-aligned pathways. 21
Box 5. Climate and nature targets 23
Box 6. NbS insetting. 25
Box 7. Residual emissions 26
Box 8. Clarifying terminology related to climate removals 30
Box 9. Positive outcomes for the people and the planet 32
Box 10. Double counting 33
Box 11. Carbon methodologies and standards 34

Table 1. IUCN Global Standard for NbS criteria and indicators 11
Table 2. Existing and forthcoming guidelines for utilising NbS to meet net-zero targets 17
Table 3. The use of NbS in corporate and societal net zero 29
Table 4. Definitions of criteria for high-quality carbon credits 31
Table 5. Core Carbon Principle sustainable development benefits and safeguards related to the themes of the IUCN Global Standard for NbS™ Criteria 35

Figure 1. Defining Nature-based Solutions. 5
Figure 2. What are Nature-based Solutions (NbS)? 7
Figure 3. The eight criteria of the IUCN Global Standard for NbS™. 8
Figure 4. GHG emissions pathways with removals. 13
Figure 5. Key elements of a net-zero approach. 22
Figure 6. Opportunities to apply NbS for non-FLAG sector companies 22
Figure 7. Opportunities to apply NbS within the FLAG sector 24
Figure 8. Use of removals and neutralisation to meet societal and corporate net zero. 28

Executive summary

Achieving societal net zero greenhouse gas emissions is a collective goal for all stakeholders – from governments to businesses and civil society. The goal is explicitly recognised in Article 4 of the Paris Agreement, which defines net zero as "a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century." A companion goal signed at the 15th Conference of Parties to the UN Convention on Biological Diversity in 2022 aims to halt and reverse biodiversity loss this decade and foster full nature recovery by 2050.

Non-state actors are mobilised towards more ambitious climate action under the Paris Agreement through the Marrakech Partnership for Global Climate Action and the Breakthrough Agenda launched in 2022, which builds on the 2030 Breakthroughs. The Agenda and Breakthroughs set up a direction of action directly connected with nature, land and oceans, aiming to generate systemic transformation to allow nature to foster mitigation, adaptation and resilience outcomes.

In the context of mitigation potential, agriculture, forestry, wetlands and bioenergy could feasibly contribute about 30% of the global mitigation needed to limit warming to 1.5°C by 2050. The share of mitigation potential from this sector may be even higher in the near term; with up to 37% of the emissions mitigation needed until 2030.

Nature-based Solutions (NbS) are activities undertaken to protect, sustainably manage and restore natural and modified ecosystems to simultaneously benefit people and nature. NbS are critical to addressing challenges like climate change, food security, water security, disaster risk, human health, and social and economic development. NbS balances conservation with sustainable development and showcases how nature can benefit societal and human well-being. Therefore, NbS are critical to achieving a low-carbon future while facilitating climate change adaptation and resilience and supporting other critical ecosystem functions.

This publication outlines the available pathways to include NbS in corporate climate strategies consistent with the NbS definition, principles and Global Standard for NbS™. When correctly implemented, NbS can contribute to climate mitigation and adaptation while offering important benefits for biodiversity and human well-being.

Recommendations:

- The climate and nature crises are interconnected; thus, applying NbS should also be designed to address those interconnections, creating benefits at both levels.

- NbS is central to land-intensive sectors' efforts to decrease emissions and achieve net-zero targets and nature-positive outcomes in their value chains. There is a need for greater clarity from standard setters such as the SBTi on the use of NbS in neutralising residual emissions once a company has delivered its long-term science-based target. The current discussions[1] refer that companies should scale up investments now in carbon removals for neutralisation purposes to promote availability and scalability, noting that these investments could only be quantified towards a net-zero target when their long-term target is achieved. Residual emissions should decrease over time as emissions are increasingly abated directly. In addition, companies across all sectors should invest immediately in reductions and removals beyond their value chains to meet societal net zero.

- To meet societal net zero and biodiversity net-positive targets by 2050, investments in NbS beyond operational and value chains are essential, including actions to safeguard nature and not just because of its connection with mitigation outcomes. When the climate change mitigation linkage is present, beyond value chain mitigation would include investments in, and/or purchasing carbon credits from, interventions that avoid or reduce emissions from deforestation and forest degradation, and capture and store carbon via restoration of natural forest and non-forest ecosystems.

- Companies must develop and implement NbS with longevity in mind. An ambitious and rapid scaling-up of NbS must be implemented thoughtfully, guided by the Global Standard for NbS™, so that it does not cause any detriment to human rights, equity and biodiversity. This requires a long-term look at their impacts on carbon storage, biodiversity and the Sustainable Development Goals.

- The incorrect deployment of NbS could result in negative, unintended consequences for nature and society. For this reason, NbS implementation should be guided by the Global Standard for NbS™ alongside science-based net-zero standards, science-based targets for nature, as well as credible and transparent carbon accounting methodologies and carbon market standards.

- Companies should follow the best available science-based standards and guidelines to provide direction to their investments, for instance, from the IUCN Measuring Nature-Positive Approach (under development), the Science Based Targets Network and Science Based Targets initiative.

Acknowledgements

A peer review process elicited detailed feedback from Kaya Axelsson, Myles Allen, Tim Christophersen, Rahul Barua, Scarlett Benson and Gustavo Souza. The authors express sincere thanks for the thorough feedback received which helped shape this publication.

IUCN would also like to acknowledge and thank the technical and strategic support of the following persons: Christina Voigt (IUCN WCEL), Manuel Pulgar-Vidal (IUCN CCC), Frank Hawkins and IUCN Secretariat staff members Stewart Maginnis, Chris Buss, Ali Raza, Rachel Asante, Liza Murphy and Sandeep Sengupta.

Acronyms

AFOLU	Agriculture, forestry and other land use
BVCM	Beyond value chain mitigation
CCP	Core Carbon Principles
FLAG	Forest, Land and Agriculture
GBF	The Kunming-Montreal Global Biodiversity Framework
GHG	Greenhouse gas
IC-VCM	Integrity Council for the Voluntary Carbon Market
IPCC	Intergovernmental Panel on Climate Change
IPLCs	Indigenous peoples and local communities
IUCN	International Union for Conservation of Nature
NbS	Nature-based Solutions
NCS	Natural climate solutions
REDD+	Reducing Emissions from Deforestation and forest Degradation in developing countries
SBTi	Science Based Targets initiative
SBTN	Science Based Targets Network
TCFD	Task Force on Climate-related Financial Disclosures
TNFD	Task Force on Nature-related Financial Disclosures
UNFCCC	United Nations Framework Convention on Climate Change
VCM	Voluntary carbon market
WRI	World Resources Institute

Glossary of definitions

Abatement is when measures are taken to prevent, reduce or eliminate sources of greenhouse gas (GHG) emissions within value chains (companies) or GHG inventories. Examples include reducing energy use, switching to renewable energy, and reducing chemical fertiliser use.[2]

Beyond value chain mitigation refers to mitigation actions or investments outside a company's value chain. This includes activities that avoid or reduce GHG emissions or remove and store GHGs from the atmosphere.[3] This definition is under consultation to be updated to reflect that mitigation actions or investments might not have guaranteed outcomes.[4]

Carbon removals are measures that companies take to remove carbon from the atmosphere and permanently store it within or beyond the value chain. These may include nature-based or technological solutions (*see further definitions below*).[5]

Climate neutral (defined by the Intergovernmental Panel on Climate Change) refers to a state where an actor's activities have no net effect on the climate system. Achieving such a state would require balancing residual emissions with emissions removals.[6]

Climate positive (defined by the *Race to Zero* campaign) refers to a state in which an actor's internal and external GHG removals exceed its emissions. In that case, removals must be 'like-for-like' (*see below*) and specified over a declared period. It must also be specified whether removals and emissions are cumulative or represent only the period specified.[7]

Corporate Net Zero (defined by Science Based Targets initiative's Corporate Net-Zero Standard) is when an actor reduces scope 1, 2 and 3 emissions to zero – or to a residual level consistent with reaching net zero emissions – at the global or sector level in eligible 1.5°C-aligned pathways. Then, corporations must neutralise any residual emissions at the net-zero target year and any GHG emissions released into the atmosphere after that.[8]

Like-for-like (defined by the *Race to Zero* campaign) emissions are source and sink emissions that correspond to their warming impact and the timescale and durability of carbon storage.[9]

Leakage of carbon happens when interventions or policies to reduce emissions in one area (subnational or national) merely lead to the displacement of these emissions elsewhere. Carbon leakage should be prevented by managing, quantifying, accounting for and compensating displacements.[10]

Intervention accounting methods (defined by the GHG Protocol) track GHG emissions and removals of specific projects, actions or interventions not defined by an inventory boundary.

Inventory accounting methods (defined by the GHG Protocol) meet a variety of objectives, including accounting for total emissions and removals annually within a defined GHG inventory boundary, setting and tracking progress toward targets, and identifying 'hot spots' to focus mitigation efforts.

Mitigation hierarchy refers to how companies should commit to reducing value chain emissions and implementing strategies to achieve these targets as a first-order priority, ahead of actions or investments to mitigate emissions outside their value chains. Investing outside of the value chain is in addition to, and not instead of, emissions reductions.[11]

Nature-based carbon removals involve conserving, restoring or better-managing ecosystems to remove carbon dioxide (CO_2) from the atmosphere. Examples include afforestation, reforestation, forest restoration, urban tree planting, agroforestry and building soil carbon. These solutions reduce climate change by capturing CO_2 from the air and sequestering it in plants, soils and sediments.[12]

Nature-based Solutions are actions to protect, conserve, restore, sustainably use and manage natural or modified terrestrial, freshwater, coastal and marine ecosystems which address social, economic and environmental challenges effectively and adaptively while simultaneously providing human well-being, ecosystem services, resilience and biodiversity benefits.[13]

Natural climate solutions are actions to protect, better manage and restore nature to reduce GHGs and store carbon.[14]

Nature-positive is a future where we, as a global society, halt and reverse the loss of nature measured from its status. We reduce future negative impacts while restoring and renewing nature to put both living and non-living nature measurably on the path to recovery.[15]

Neutralisation refers to measures companies take to eliminate the climate impact of residual GHG emissions released into the atmosphere at and after the company's science-based aligned net-zero target date through permanent removal and storage of carbon from the atmosphere. Carbon removals can be implemented within or beyond the value chain to neutralise residual emissions.[16]

No regrets options are responses to climate change that deliver net economic benefits and hence represent a low-risk, attractive strategy for governments, firms or households. These options for GHG emissions reduction are defined as those whose benefits, such as reduced energy costs and reduced emissions of local/regional pollutants, equal or exceed their costs to society, excluding the benefits of avoided climate change.[17] These measures are sometimes called 'win-win' actions since they simultaneously deliver multiple benefits, namely economic growth and climate change objectives. This term is used differently across contexts, notably in the literature on adaptation to and mitigation of climate change. In the mitigation literature, no regrets options deliver net economic benefits and mitigation gains. In the adaptation literature, no regrets options generate net social or economic benefits irrespective of whether climate change occurs, as well as across a range of possible climate futures.

Remaining emissions are emissions that remain in a given year as a company progresses towards the delivery of its near- and long-term science-based target.[18]

Residual emissions are emissions that cannot be completely eliminated or reduced to zero despite implementing all available mitigation measures contemplated in pathways that limit warming to 1.5°C with no or limited overshoot. In the context of science-based targets, residual

emissions refer to the companies scope 1–3 emissions that remain once its long-term emissions reduction target has been achieved.[19]

Permanence ensures that each carbon credit generated represents a long-term climate benefit, often defined as 100 years. Projects and programmes must mitigate the risk that GHG emission reductions or removals are reversed at some point in the future due to natural disasters, climate changes, human activities or other events that cause stored carbon to be released back into the atmosphere.[20] The risk of impermanence is often managed through mandatory buffer accounts. Projects and programmes set aside a portion of their credits in a buffer pool, from which credits are subtracted to compensate for carbon storage reversals.[21]

Science-based targets must fulfil three characteristics: be theoretically achievable, possible to demonstrate the degree of achievement (measurable) and supported by a clear analytical rationale as to why it is set at a particular level.[22] Specific climate change science-based targets for businesses mentioned in this publication refer to the ones developed under the Science Based Targets initiative Net-Zero Standard, in line with what the latest climate science deems necessary to meet the goals of the Paris Agreement – to pursue efforts to limit warming to 1.5°C.[23] The Science Based Targets Network work is also referred to.[24]

Technological carbon removals and storage (defined by the GHG Protocol) refer to technology (i.e. non-nature) based removals. Specific practices include carbon capture and storage, direct air capture and enhanced weathering or mineralisation.[25]

1. Introduction

The twin crises of climate change and biodiversity loss pose existential risks to the planet and its people. As the latest Intergovernmental Panel on Climate Change (IPCC) synthesis report explains, extreme environmental and climate impacts will increase in frequency alongside each incremental rise in temperature.[26] These amplified risks relate not just to extreme climate events but to water systems, species extinction, heat–humidity risks to humans, food production impacts and countless other knock-on effects. Alongside climate change, the global threats to nature and biodiversity must be urgently addressed. The *2022 Global Risk Report* by the World Economic Forum argues that biodiversity loss, along with climate change, is one of the greatest global challenges of our time.[27]

The fundamental link between climate change and biodiversity loss means that the two crises cannot be addressed in silos.[28] These emergencies exacerbate one another: rising temperatures drive biodiversity and ecosystem loss, while ecosystem destruction undermines nature's capacity to regulate emissions and shield against extreme weather.[29] Yet, healthy ecosystems harbour species and provide essential ecosystem services, including carbon sequestration. Close to one-third of the emission reductions required in the next decade could be achieved by improving nature's ability to absorb emissions.[30] These global challenges require immediate action to avoid ecosystem degradation beyond repair. Ecosystem protection offers an indispensable solution to climate change and biodiversity loss. For example, reforestation of deforested mangrove regions could capture up to 688 million tonnes of carbon dioxide equivalent over a 40-year period.[31] In addition to its mitigation potential, mangrove restoration would help preserve biodiversity in one of Earth's most productive marine ecosystems.[32]

Recent global agreements have highlighted the collective ambition of the public and private sectors to address these challenges. Article 4 of the Paris Agreement enshrined the goal of reaching net zero emissions by mid-century, by achieving a balance between anthropogenic emissions and carbon removals, to limit the increase in global temperature to 1.5°C.[33] More recently, leaders at the 15th Conference of Parties to the UN Convention on Biological Diversity signed the Kunming-Montreal Global Biodiversity Framework (GBF) to halt and reverse biodiversity loss this decade, foster full nature recovery by 2050, develop responses to minimise climate change impacts to biodiversity including through Nature-based Solutions (Target 8) and leveraging private sector actions to progressively reduce negative impacts to biodiversity (Target 11).

Moreover, non-state actors are mobilised towards more ambitious climate action under the Paris Agreement through the Marrakech Partnership for Global Climate Action and the Breakthrough Agenda launched in 2022, which builds on the 2030 Breakthroughs. The Agenda and Breakthroughs set up a direction of action connected with nature, land and oceans, aiming to generate systemic transformation across systems to allow nature to foster mitigation, adaptation and resilience outcomes.

To reach these goals of climate and nature, an unprecedented level of social and economic transformation must occur across all sectors – including energy, agriculture, land use, transportation and beyond, from private

organisations including companies and investors (e.g. pension funds, asset managers, asset owners, etc.). One estimate suggests that at least USD 4.3 trillion in annual finance flows are needed by 2030 (a compound annual growth rate of 21%) to avoid the worst impacts of climate change.[34] Global financial markets held USD 200 trillion in 2020, showing liquidity. However, to materialise the much-needed investment, key coordinated actions should be adopted from both the public and private sectors.[35] Particularly the corporate sector – and its ability to mobilise significant finance – will play an essential role in the world's transition to net zero.

The corporate sector's leadership in decarbonising the world includes actions to reduce emissions from their supply chains, divest investments away from fossil fuels and increase financing for climate-positive economic activities. They will also assess and respond to climate and biodiversity risks by contributing to the global climate and biodiversity goals through investments in nature. Nature has arisen as an unavoidable part of corporate sector investment in implementing climate change and net-zero strategies.

In particular, Nature-based Solutions (NbS) – activities undertaken to protect, sustainably manage, and restore natural and modified ecosystems while addressing societal challenges – offer the corporate sector solutions for addressing this dual crisis, while potentially reducing costs (e.g. by adopting practices like agroforestry and biological pest control instead of intensive or commercial agriculture), generating positive return on investment (e.g. by implementing regenerative agriculture) or identifying new business opportunities.[36] Nature's contribution to the global economy is worth more than USD 125 trillion annually,[37] and building conservation and NbS into projects presents a unique opportunity for businesses. NbS can be an effective framework for reversing the ongoing degradation of natural resources by increasing the alignment between conservation and sustainable development objectives.[38]

However, using NbS to meet net-zero targets has raised various concerns. These include the mischaracterisation of NbS as having the sole purpose of generating carbon removals, its appropriate role in an overarching climate strategy, and, within that, questions on whether NbS removals should be considered fungible with fossil fuel emissions as well as quality and permanence of nature-based removals. Further concerns include the methodologies used for carbon accounting and a lack of standardised methods to assess benefits beyond carbon, for example, social and environmental benefits.[39] Still, as the threats of climate change and biodiversity loss are linked, so are the solutions for addressing them. Roughly 40% of global land with high carbon storage potential is also rich in biodiversity.[40] The synergies between activities that reduce emissions and those that protect biodiversity create significant opportunities for the private sector to mutually benefit the climate and nature.

This publication outlines the application of NbS in the context of climate change mitigation. It argues that NbS must be designed with a holistic objective of benefiting biodiversity and human well-being, for which the United Nations Environment Assembly adopted NbS definition and IUCN (International Union for Conservation of Nature) Global Standard for NbS™, with its criteria and indicators, can be used to help guarantee high-quality interventions. It then presents the available pathways for including NbS in corporate climate strategies to support: (a) the decarbonisation of supply chains; (b) the potential neutralisation of hard-to-abate emissions (with the caveat explained in Section 3.3); and (c) investment in the societal net-zero goal through beyond value chain action. The wealth of experience

from IUCN, Members, Commissions and Secretariat contributes to more comprehensive perspectives of climate action. This emphasises that NbS approaches not only pursue carbon mitigation outcomes but also integrate balanced solutions to address societal challenges in the context of the dual climate–biodiversity crises.

While each economic sector impacts nature differently, the expectations on the private sector are clear: reducing direct impacts, decarbonising and investing in nature beyond one's own value chain to continue operating within planetary boundaries. Adopting net-zero and nature-positive targets as part of an environmental, social and governance policy – and meeting those by employing cost-effective and scalable NbS – helps the private sector to meet its own climate and biodiversity goals, accelerate decarbonisation in supply chains and help close the gap in ambition and financing. This is needed to achieve the societal goals of reaching balanced net zero emissions and fully recovering nature by 2050.

© alejomiranda / iStock

2. Nature-based Solutions and climate change mitigation

2.1. Nature-based Solutions definition and global standard

As per the United Nations Environment Assembly definition, which builds on IUCN's, NbS are actions to protect, conserve, restore, sustainably use and manage natural or modified terrestrial, freshwater, coastal and marine ecosystems which address social, economic and environmental challenges effectively and adaptively, while simultaneously providing human well-being, ecosystem services, resilience and biodiversity benefits[41]. NbS are grounded on the science and practice of the 'ecosystem approach' and were created as an umbrella concept to cover a range of different approaches[42] that use ecosystems to address societal challenges, such as climate change, food security, water security, disaster risk, human health, and social and economic development (*see* Figure 1).[43] Effective NbS interventions showcase how nature can benefit societal and human well-being (*see* Figure 2).[44]

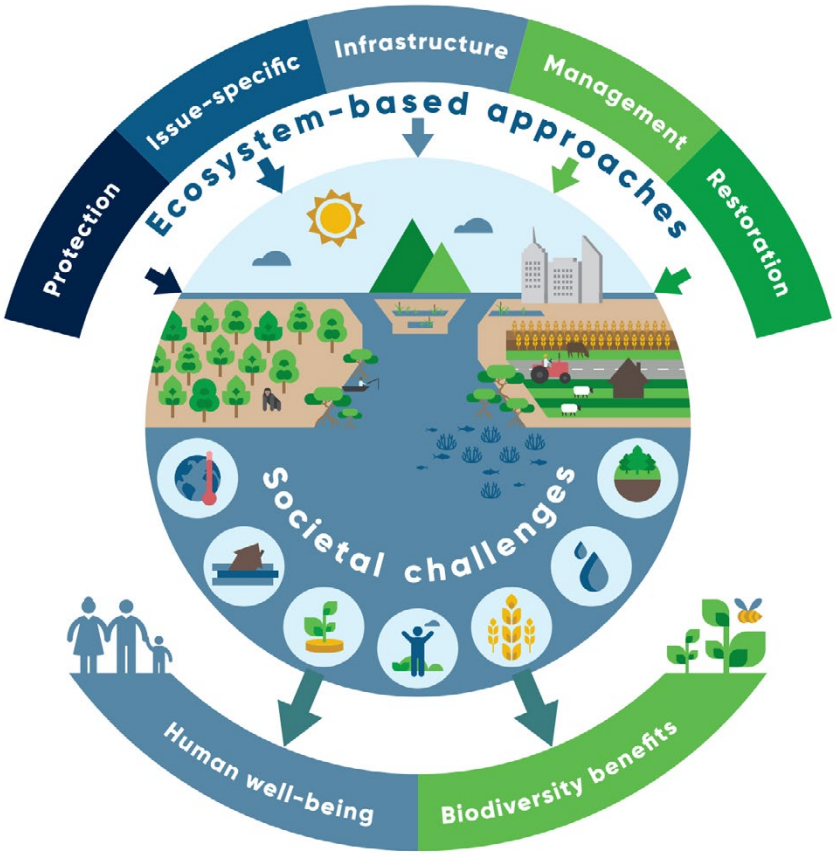


Figure 1. Defining Nature-based Solutions.
Source: IUCN. (2020). *IUCN Global Standard for Nature-based Solutions: A user-friendly framework for the verification, design and scaling up of NbS* (1st ed.).

Examples of NbS that benefit ecosystems and communities include protecting intact and high-integrity forests, like the Amazon and Congo rainforests, to contribute to local and global climate regulation, ensure clean water supplies, maintain biodiversity and protect carbon pools.[45] Restoring degraded wetlands can increase carbon sequestration, reduce erosion and flooding, buffer against storms,[46] and help to conserve threatened animal and plant species. Wetland restoration can also improve ecosystem services that benefit local communities by ensuring water quality and supplying food and raw materials. The restoration of arid and semi-arid degraded grasslands may increase carbon storage, improve water quality and quantity, and support wildlife and livestock productivity.[47] Practices such as agroforestry, conservation agriculture and regenerative agriculture can provide additional income to farmers while allowing them to diversify their income sources.[48]

Alongside the definition of NbS, IUCN has published the NbS Principles[49] and the *Global Standard for NbS*™, designed to ensure that the concept is clearly understood, communicated and interventions are implemented with the highest quality and long-term results. The global standard seeks to guide the design of an NbS and provide a means to verify that it meets the criteria of the standard. The eight process-oriented criteria respond to a project management cycle, albeit thinking beyond the project's geographical space and timelines. When a solution already exists, the standard can be used to ascertain whether it qualifies as an NbS, identifying gaps to work on to transform the intervention into a strong NbS.[50]

The eight criteria of the Global Standard for NbS™ include a set of indicators (*see* Figure 3). As the *Guidance for using the IUCN Global Standard for Nature-based Solutions* explains,[51] criteria "1 outlines the process for determining the societal challenge(s) the stakeholders and rights-holders face, as well as establishing an understanding of associated opportunities and challenges. The design of the solution must aim to address the challenge, taking into consideration the wider social, economic, and ecological contexts within which the challenge and solution exist, as per criteria 2. Criteria 2 addresses the fact that even if the execution of the solution is at a site level or smaller scale, the larger scale level considerations can greatly inform the robustness and durability of the solution, beyond its implementation. Criteria 3, 4 and 5 outline processes that can enhance the chances of positive outcomes for biodiversity, society, and the economy. However, to achieve these three criteria with respect to immediate, short-term and long-term outcomes, trade-offs need to be determined and made, which are directly addressed in criteria 6, in order to give this issue visibility and importance."

The *Guidance*[52] continues to explain that "the decision-making processes for any trade-offs that are made need to be transparent and equitable and could be within the context of one or more of criteria 3, 4 and 5. In addition, principles of adaptive management underpinned by a theory of change and iterative learning processes, as per criteria 7, can also enhance the success of NbS. Criteria 8 focuses on processes for mainstreaming NbS in spatial and temporal scales, whereby actions and impacts may be sustained beyond stand-alone projects to fully realise the potential of nature as a tool providing a solution to societal challenges."

What are Nature-based Solutions (NbS)?

NbS are defined by IUCN as "actions to **address societal challenges** through the protection, sustainable management and restoration of ecosystems, benefiting both biodiversity and human well-being." They use the power of nature and functioning ecosystems as infrastructure to provide natural services to benefit society and the environment.

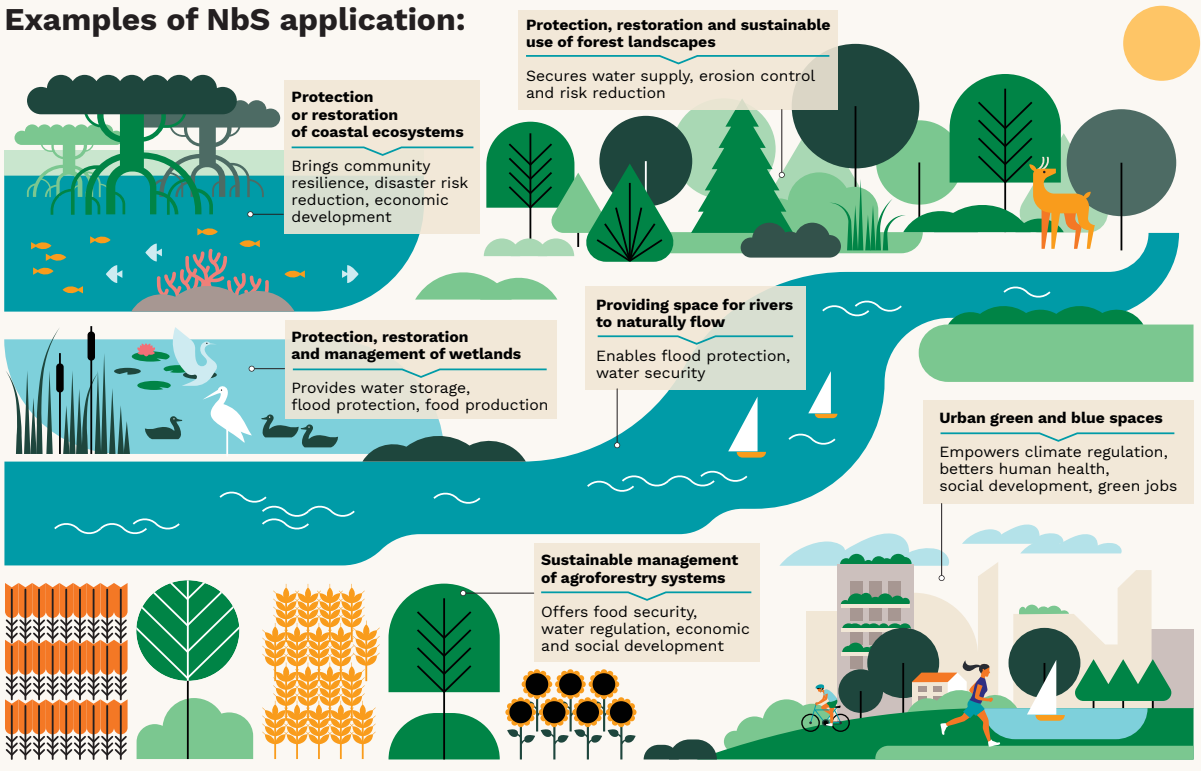
NbS have prime potential to help address global challenges such as:

- climate change
- economic and social development
- human health
- food and water security
- disaster risk reduction
- ecosystem degradation
- biodiversity loss

NbS can provide long-term environmental, societal and economic benefits:

- adaptation to climate change
- green jobs
- community resilience
- health benefits
- healthy and accessible food
- clean air and water
- disaster risk reduction
- ecosystem integrity
- biodiversity net gain

Examples of NbS application:



IUCN www.iucn.org/adapt @theadaptproject ADAPT Sida

Figure 2. What are Nature-based Solutions (NbS)?
Source: IUCN. (2022). *IUCN Website*. https://iucn.org/sites/default/files/2022-06/nature-based-solutions_infographic_english.pdf

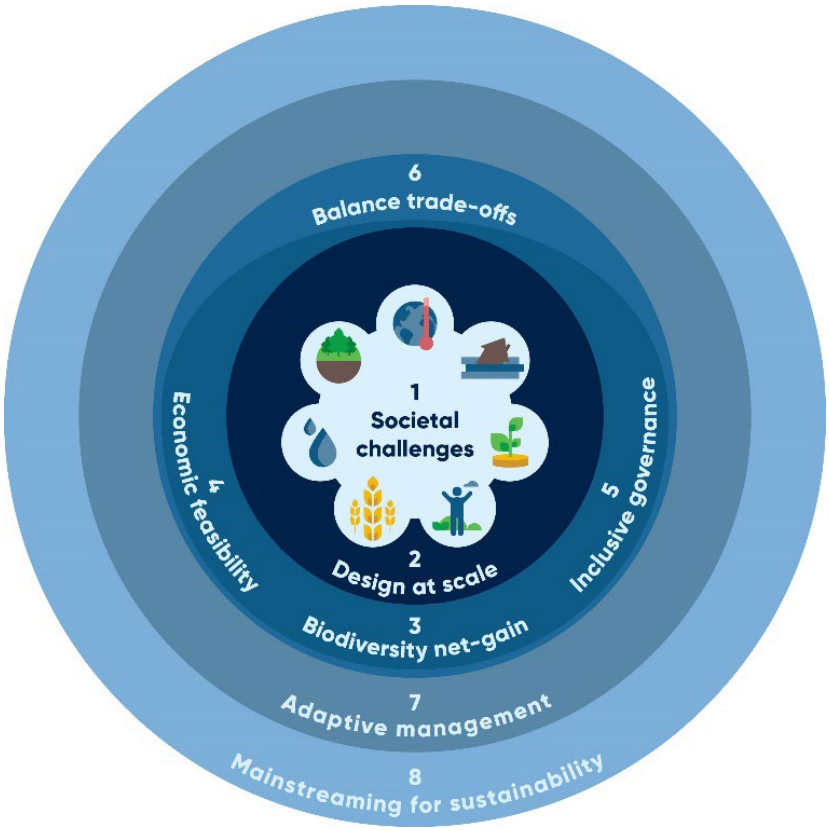


Figure 3. The eight criteria of the IUCN Global Standard for NbS™.
Source: IUCN. (2020). *IUCN Global Standard for Nature-based Solutions: A user-friendly framework for the verification, design and scaling up of NbS* (1st ed.).

Based on the criteria from the standard, critical elements should be considered in the design of new or assessment of existing NbS in the context of climate change action, including biodiversity, inclusivity and trade-offs.[53] First, to be considered an NbS, a solution must either maintain or enhance biodiversity and ecosystem integrity. This is important for ensuring that the integrity and stability of the natural system is not undermined by practices that favour short-term gains, thus compromising the ability of the system to provide for future generations.[54]

Second, interventions can only be successful by including different knowledge systems and engagement of groups directly or indirectly affected and who can strongly benefit from NbS, including Indigenous peoples and local communities (IPLCs), women and youth. Related to the latter, integrating a gender-responsive approach enables NbS implementation, as nature conservation and women's rights are inextricably linked. Also, children and youth have a tangible contribution to solving critical societal challenges while aiming at intergenerational equity. This relates to the importance of understanding the societal challenges at the local level to increase awareness of the stakeholders before any activity is proposed. Without identifying the root causes of the nexus climate change–biodiversity–societal challenges as well as the risks of implementing a specific 'solution,' the vulnerability of IPLCs and vulnerable communities may increase, jeopardising their contribution to both biodiversity gain and climate change mitigation.[55]

Third, to address the biodiversity and climate change crises, it is necessary to consider the interdependencies between them, to enhance synergies and minimise potential risks and

trade-offs. There is a risk that some solutions may decrease biodiversity by focusing solely on climate change mitigation and possibly adaptation. Monocultural forest plantations (especially exotic species) can increase exposure to hazards (e.g. wildfires, erosion), further exacerbating environmental impacts and increasing biodiversity loss. In turn, other societal challenges that might not have been considered, such as food or water security, can also become more serious, further constraining the communities that rely on this ecosystem.

Another risk is the lack of understanding of IPLCs traditions and knowledge, which may lead to top-down, inadequate climate change responses, thus affecting the well-being of these peoples. What can be perceived as good by an external organisation may be detrimental to IPLCs societal challenges. For example, in a project in Panama, local communities "had a strong preference for agroforestry, particularly coffee, a crop with negligible carbon value, but high economic value," instead of reforestation, which had a greater carbon capture.[56] "Reforestation projects for climate mitigation in community contexts embed carbon sequestration objectives within existing social economic and cultural priorities that can either align or contrast but need to be accounted for to ensure the sustainability of the project."[57]

A final risk to consider is the oversimplification of the concept of NbS to find rapid solutions. The gap in understanding the theoretical concept and the practice in the field remains a danger that can cause irreversible negative impacts. NbS practitioners must ensure that multiscale and multidimensional assessments of the context (social, economic, environmental, political) are completed and involve the IPLCs that may be directly or indirectly impacted from the start. Research has shown that the various types of governance should also be respected to ensure consensus, benefits for all and long-term sustainability of NbS.[58] There remains a danger of slippage through ineffective solutions that can exacerbate the societal challenges of IPLCs, including those related to climate change and biodiversity. Systems thinking requires a long-term and global view of the entire ecosystems and these challenges holistically.

Trade-offs can be successfully managed if the most relevant stakeholders properly assess, disclose and agree upon the consequences. Fair and transparent negotiation of trade-offs and compensation among those potentially affected is required. The Global Standard for NbS™ provides ways and means on how to address these (*see* Box 1 *and* Table 1). Trade-offs also have limits, so safeguards are necessary to ensure that ecosystem regulating and supporting services are not exceeded. Monitoring and evaluation should be adjusted, as needed, according to the type of adaptive ecosystem management process.

Box 1. Addressing trade-offs between biodiversity and climate change

Addressing the potential impact of trade-offs and the promotion of synergies between biodiversity conservation, ecosystem service enhancement and climate change is becoming necessary in conservation policy and practice. The IPCC–Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services report on biodiversity and climate change[59] includes a series of proposed actions regarding the management of trade-offs:

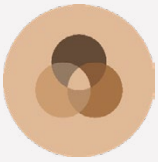
- Spatial planning approaches help achieve multiple outcomes, especially at a larger scale. Biomes, ecosystem uses and sectoral interactions should be considered in trade-off analysis. In addition, country reporting under the United Nations Framework Convention on Climate Change (UNFCCC) and the Convention on Biological Diversity frameworks provides a significant opportunity to align national mitigation and biodiversity goals. Planning should be examined in the long term, not as an immediate quick-fix solution driven by single-sided purposes.
- Even if the concept of offsets has been widely applied for carbon removal measures, the report mentions that for more than 12,000 biodiversity offsets implemented across 37 countries, only a third meets the 'no net loss' principle. The trade-offs between biodiversity offsets and climate change mitigation must be planned and assessed to ensure no net biodiversity loss and to guarantee the full respect of Indigenous peoples' rights.
- Policy decisions should consider the interactions between biodiversity, climate and society. This provides opportunities to maximise co-benefits and to minimise trade-offs and co-detrimental effects for people and nature. The climate–biodiversity–social system is a nexus most appropriately dealt with from a socio-ecological systems perspective. Such an approach accounts for trade-offs, feedback, threshold effects and nonlinear relationships between biophysical and social variables across spatiotemporal scales.
- Positive social tipping interventions can help to attain desirable biodiversity–climate interactions. Surpassing thresholds can lead to changes in ecosystem function. Ignoring the potential for strong trade-offs between biodiversity and climate change resulting from a specific policy action further risks surpassing thresholds.
- Promoting social tipping interventions to modify the ways society and nature interact can be a viable joint solution. This may involve the redistribution of benefits and costs of actions and even more profoundly, a collective shift of individual and shared values concerning nature.
- Identifying solutions for stewardship that deliver the highest co-benefits while avoiding trade-offs should be the main goal of NbS activities. Identifying integrated approaches across actions to protect, restore, manage, create and adapt is a primary concern. Many synergies and co-benefits exist across biodiversity and climate policies and actions. Still, potential negative trade-offs for nature, climate or human well-being and good quality of life are also possible. Governance systems that use a systems-thinking perspective can help manage trade-offs and adapt to risk through mechanisms such as adaptive reflexive evaluation and social learning.

Solutions must, therefore, consider the whole system, trade-offs and the spatiotemporal implications of any action aimed at solving these crises.

Table 1. IUCN Global Standard for NbS criteria and indicators

Criteria	Definition	Indicator
1. NbS effectively address societal challenges 	NbS must be designed as a response to a societal challenge as described by IUCN	The most pressing societal challenge(s) for rights-holders and beneficiaries are prioritised
		The societal challenge(s) addressed are clearly understood and documented
		Human well-being outcomes arising from the NbS are identified, benchmarked and periodically assessed
2. Design of NbS is informed by scale 	NbS design must recognise the complexity and uncertainty that occur in living dynamic land/seascapes. Scale applies to the biophysical, geographic perspective and the influence of economic systems, policy frameworks and cultural perspectives	The design of the NbS recognises and responds to interactions between the economy, society and ecosystems
		The design of the NbS is integrated with other complementary interventions and seeks synergies across sectors
		The design of the NbS incorporates risk identification and risk management beyond the intervention site
3. NbS result in a net gain to biodiversity and ecosystem integrity* 	NbS design and implementation must avoid undermining the integrity of the system and instead proactively seek to enhance the functionality and connectivity of the ecosystem, ensuring long-term resilience and durability of NbS	The NbS actions directly respond to evidence-based assessment of the current state of the ecosystem and prevailing drivers of degradation and loss
		Clear and measurable biodiversity conservation outcomes are identified, benchmarked and periodically assessed
		Monitoring includes periodic assessments of unintended adverse consequences on nature arising from the NbS
		Opportunities to enhance ecosystem integrity and connectivity are identified and incorporated into the NbS strategy
4. NbS are economically viable 	The economic feasibility of NbS projects, the return on investment, the efficiency and effectiveness of the intervention, and equity in the distribution of benefits and costs are key determinants of success for an NbS	The direct and indirect benefits and costs associated with the NbS – who pays and who benefits – are identified and documented
		A cost-effectiveness study is provided to support the choice of NbS, including the likely impact of any relevant regulations and subsidies
		The effectiveness of the NbS design is justified against available alternative solutions, considering any associated externalities
		The NbS design considers a portfolio of resourcing options, such as market-based, public sector, voluntary commitments and actions to support regulatory compliance

* The IUCN consultation paper on Measuring Nature-Positive, which will be available for review by the Union in November 2023, contains a detailed methodology for the identification of actions to deliver on Criterion 3 in Table 1 above and will enable companies to set baselines and track progress towards the delivery of targets in line with the GBF.

Criteria	Definition	Indicator
5. NbS are based on inclusive, transparent and empowering governance processes 	NbS must acknowledge, involve and respond to the concerns of a variety of stakeholders, especially rights-holders, and have good governance arrangements in place that adhere to prevailing legal and regulatory provisions, with clear legal responsibilities	A defined and fully agreed upon feedback and grievance resolution mechanism is available to all stakeholders before an NbS intervention is initiated
		Participation is based on mutual respect and equality, regardless of gender, age or social status, and upholds the right of Indigenous peoples to free, prior and informed consent
		Stakeholders who are directly and indirectly affected by the NbS have been identified and involved in all processes of the NbS intervention
		Decision-making processes document and respond to the rights and interests of all participating and affected stakeholders
		Where the scale of the NbS extends beyond jurisdictional boundaries, mechanisms are established to enable joint decision-making of the stakeholders in the affected jurisdictions
		The potential costs and benefits of associated trade-offs of the NbS intervention are explicitly acknowledged and inform safeguards and any appropriate corrective actions
6. NbS equitably balance trade-offs between the achievement of their primary goal(s) and the continued provision of multiple benefits 	NbS proponents must acknowledge the trade-offs in land and natural resources management and follow a fair, transparent and inclusive process to balance and manage them over both time and geographic space	The potential costs and benefits of associated trade-offs of the NbS intervention are explicitly acknowledged and inform safeguards and any appropriate corrective actions
		The rights, usage of and access to land and resources, along with the responsibilities of different stakeholders, are acknowledged and respected
		The established safeguards are periodically reviewed to ensure that mutually agreed trade-off limits are respected and do not destabilise the entire NbS
7. NbS are managed adaptively, based on evidence 	NbS implementation must include provisions to enable adaptive management as a response to uncertainty and as an option to harness ecosystem resilience effectively	An NbS strategy is established and used as a basis for regular monitoring and evaluation of the intervention
		A monitoring and evaluation plan is developed and implemented throughout the intervention lifecycle
		A framework for iterative learning that enables adaptive management is applied throughout the intervention lifecycle
		The NbS design, implementation and lessons learnt are shared to trigger transformative change
8. NbS are sustainable and mainstreamed within an appropriate jurisdictional context 	NbS interventions must be designed and managed to ensure long-term sustainability, considering working with and aligning with sectoral, national and other policy frameworks	The NbS informs and enhances facilitating policy and regulation frameworks to support its uptake and mainstreaming
		Where relevant, the NbS contributes to national and global targets for human well-being, climate change, biodiversity and human rights, including the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP)

2.2. The role of Nature-based Solutions in a Paris-aligned pathway

In addition to drastically reducing emissions, all IPCC mitigation pathways consistent with limiting temperature rise to 1.5°C require investment in carbon removal and significant changes in current land use practices[60] (*see* Box 2). The IPCC states that deploying carbon removals to counterbalance or neutralise the impact of residual emissions is unavoidable if net zero greenhouse gas emissions are to be achieved[61,62] (*see* Figure 4).

Box 2. Nature-related measures in the context of the 1.5°C-aligned pathway[63,64]

The *IPCC Special Report* delivered the scientific consensus that the risks associated with exceeding 1.5°C of warming will be more severe than previously understood. The *Special Report* highlights pathways that limit warming to 1.5°C with no or limited overshoot, that is letting global temperatures rise above 1.5°C or higher and then using carbon capture to bring temperatures back down in the following decades.

The pathways proposed by the *IPCC Special Report* will require profound transitions in global energy and all economic and land systems. Along with full, or near-full, decarbonisation for energy and industrial carbon dioxde (CO_2) emissions and eliminating CO_2 emissions associated with agriculture, forestry and land use, this trajectory will also require CO_2 removals from the atmosphere to neutralise residual emissions and, potentially, sustain net negative emissions that reduce cumulative CO_2 in the atmosphere over time. Carbon removal measures may include afforestation, reforestation and improved forest management, soil carbon sequestration, biochar, and peatland and wetland restoration.

The *AR6 Synthesis Report* highlights the emissions gap based on pledges or commitments announced by 2021 to limit warming to 1.5°C and implementation gaps. A 43% reduction in net global emissions is needed by 2030 to be on track for the global temperature goal.

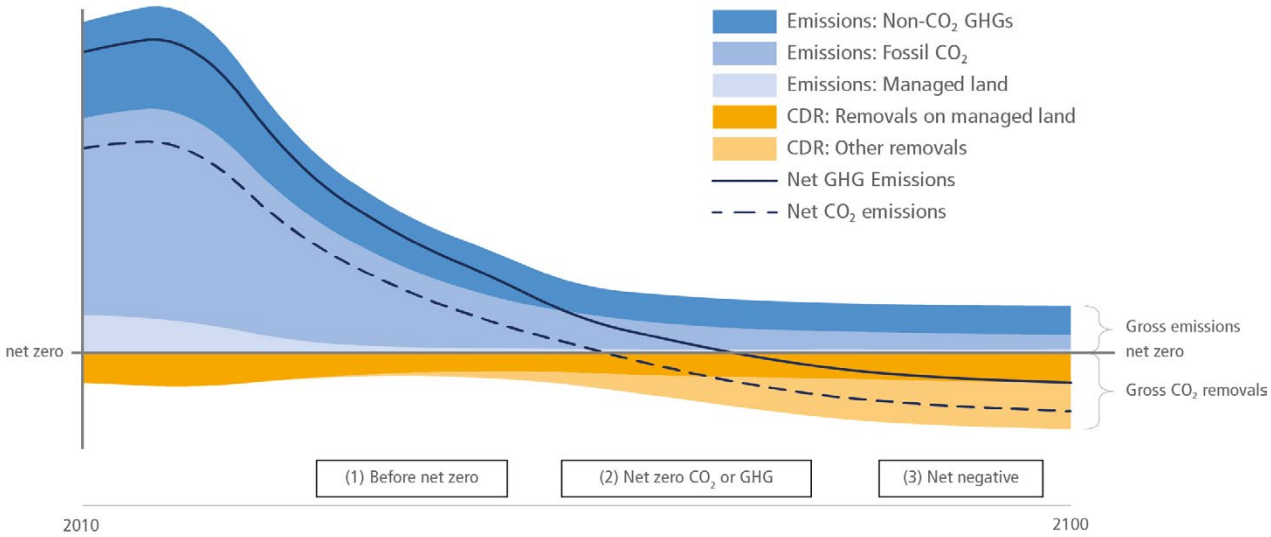


Figure 4. GHG emissions pathways with removals.

Source: Babiker, M., Berndes, G., Blok, K., Cohen, B., Cowie, A., Geden, O., ... Yamba, F. (2022). Cross-sectoral perspectives. In IPCC. *Climate change 2022: Mitigation of climate change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. https://ipcc.ch/report/ar6/wg2/

Carbon emission removals and reductions from agriculture, forestry, wetlands and bioenergy could feasibly contribute about 30% or 15 billion tonnes of carbon dioxide equivalent (Gt CO_2e) per year of the global mitigation needed to limit warming to 1.5°C.[65] Because some measures can be implemented quickly, this sector's share of mitigation potential is higher in the near term, with up to 37%,[66] or between 5–11.7 Gt CO_2e per year, of the emissions mitigation needed until 2030 to achieve net zero by 2050.[67,68] Implementing these measures is, therefore, vital to achieving a low-carbon future while facilitating climate change adaptation and supporting other critical ecosystem functions.[69] These mitigation outcomes would result from the implementation of Natural Climate Solutions (NCS) from one of four NCS categories: (a) avoided deforestation and avoided peatland impact; (b) peatland restoration; (c) reforestation; and (d) cover crops.[70]

The concept and potential of NCS pathways emerged most prominently in the Griscom et al. (2017) research paper,[71] whereby the mitigation potential in tropical countries was calculated by considering food security and fibre conditions, biodiversity safeguards (such as avoiding establishing forests where they are not the native cover type) and identifying non-carbon ecosystem services associated with each pathway related to water, soil and air. However, when implementing these pathways on the ground, the NbS definition, principles and standard should be the fundamental guidance. This will ensure adequate consideration of the biodiversity, social inclusion, and risk and trade-off issues explained in Section 2.1. Not all NCS can be considered NbS, although some NbS could be designed to prioritise climate change mitigation outcomes.[72,73] To contribute effectively to the world's climate and nature targets, NbS must be created and implemented with longevity in mind and accompanied by other decarbonisation and carbon storage forms. Ambitious and rapid scaling-up of NbS requires a long-term look at their impacts on carbon storage, biodiversity and Sustainable Development Goals.[74,75]

2.3. The Global Standard for Nature-based Solutions™ in the context of net zero

There are important principles, standards, guidance and frameworks issued to achieve net zero, including using nature for within and beyond value chain action (*see* Annex B). These include:

- Those that guide companies on aligning with a 1.5°C pathway, namely the Science Based Targets initiative (SBTi), through their Net-Zero Standard, the Forest, Land and Agriculture (FLAG) Guidance and upcoming guidance on beyond value chain mitigation (BVCM).[76]

- Principles for the use of NbS in insetting[77] and in carbon markets,[78] as developed by the University of Oxford.

- Good practices for engaging with carbon markets include the Integrity Council for the Voluntary Carbon Market (IC-VCM),[79] the Carbon Credit Quality Initiative,[80] the Voluntary Carbon Markets Integrity Initiative,[81] the World Resources Institute (WRI) *Guidance on Voluntary Use of NbS Credits through 2040*[82] and other guidance on high integrity use of carbon credits.

Complementary to these, the Together for Nature principles for NbS are good references to "responsibly tackle the climate crisis, restore biodiversity and benefit planetary health and human well-being."[83]

Moreover, campaigns like *Race to Zero*[84] and *Race to Resilience*[85] *backed by the* United Nations Framework Convention on Climate Change (UNFCCC) provide sector-wide, science-based requirements to accept net-zero commitments from businesses, cities, regions, investors and universities. Recently, the UNFCCC Secretariat announced the establishment of the Global Climate Action Recognition and Accountability Framework for non-Party stakeholders. This will set the principles of engagement, governance and information or data management to increase transparency and the credibility of climate action pledges and plans by disclosing progress, including net-zero targets and strategies.[86] The Accountability Framework would consider actions connected to nature, building upon the recommendations from the UN High-Level Expert Group on the Net Zero Emissions Commitments of Non-State Entities (*see* recommendations 3 and 7).[87]

The Global Standard for NbS™ critically complements these existing tools. It provides the specifics of how to design a solution from the bottom up without predetermining a single mitigation priority but seeking a comprehensive solution that addresses a diversity of societal challenges in a balanced manner. In the context of climate change mitigation and net-zero action, this is particularly important for these actions' credibility, transparency and integrity. To include NbS as part of net-zero action, they must be carried out in a systematic approach, ensuring quality control of the interventions and adequate assessments and minimisation of risks to biodiversity and society.[88] Chapter 3 will present options for implementing NbS in the context of climate change strategies, bearing these ideas in mind.

© Sam maulidna / Shutterstock

3. Nature-based Solutions in corporate climate strategies

Corporate net-zero efforts must be underpinned by high integrity and transparent guidelines. The *Corporate Climate Responsibility Monitor*[89] outlines criteria for robust corporate climate strategies, which include four focus areas:

1. Transparently and regularly tracking and disclosing risks, impacts and progress;

2. Setting credible science-aligned short-, medium- and long-term targets;

3. Steadily reducing a company's own emissions in line with a clear decarbonisation plan; and

4. Responsibly utilising climate removals to neutralise residual emissions.

This section presents options for the application and use of NbS to implement robust corporate climate strategies, referring to existing corporate guidelines and standards which would be complemented by the application of the Global Standard for NbS™ in what pertains to the integration of nature into these strategies (*see* Table 2).

Table 2. Existing and forthcoming guidelines for utilising NbS to meet net-zero targets

Publication	Focus Area(s)	Application for NbS
Task Force on Climate-Related Financial Disclosure (TCFD) Disclosures Recommendations	Climate risk reporting and disclosure	Climate-related risk disclosure for all sectors
Task Force on Nature-Related Financial Disclosure (TNFD) Disclosure Recommendations	Nature risk reporting and disclosure	Nature-related risk disclosure for all sectors
GHG Protocol Land Sector and Removals (final guidance forthcoming)	GHG accounting	Emissions and removals from land management, land use change, biogenic products, carbon dioxide removal technologies and related activities
Quantis Accounting for NCS Guidance	GHG accounting	For use until the final *GHG Protocol Land Sector and Removals* is launched in 2023
SBTi Net-Zero Standard	For all companies to deliver long-term decarbonisation of their value chains, including the FLAG sector, and for all companies to neutralise the impact of residual emissions once long-term targets have been achieved	Meeting net-zero targets

SBTi FLAG Guidance	FLAG sector delivering emissions reductions and removals in its value chains, consistent with the 1.5°C global goal	Meeting science-based targets in the FLAG sector
SBTi BVCM (final guidance forthcoming)	All sectors channelling finance beyond their own value chains into mitigation outcomes, including, but not limited to nature	Investing in NbS beyond value chains
SBTN Land Targets (draft guidance)	Corporate target setting at entity and landscape level to deliver nature outcomes	For steps 2 and onwards in connection to interventions for freshwater and land
Accountability Framework initiative	Principles for implementation of deforestation and conversion-free supply chains	Not specified
Race to Zero	Verifying science-based and Paris-aligned net-zero commitments	Not specified

3.1. Assessing and disclosing climate and nature-related risks

Robust corporate climate strategies should be informed by transparent monitoring, assessment and reporting of potential risks, dependencies and impacts on nature. Assessments of corporate risk from climate change should cover both physical risks (e.g. hazards such as heat waves, floods, wildfires and impacts such as biodiversity loss) and transition risks (e.g. financial and social challenges related to the economic transition required to meet climate targets). Risk assessments can also be utilised to identify opportunities, for example, using NbS to mitigate physical risks associated with rising sea levels and extreme weather events.[90]

Numerous frameworks and guidelines are available to support risk and opportunities monitoring and reporting, including emerging guidance for assessing and disclosing nature-related risk. The Task Force on Climate-related Financial Disclosure (TCFD) requires businesses to identify, manage and report on climate-related risks using scenario analysis. The TCFD framework includes reporting on operational and value chain emissions and anticipating climate risks and opportunities to inform corporate climate strategies.[91] On the other hand, the Task Force Nature-Related Financial Disclosure (TNFD) aims to provide a framework for organisations to assess nature-related dependencies, impacts, environmental risks and opportunities to divert much-needed finance into nature-positive action. TCFD and TNFD contribute to a broader reporting architecture.

Nature-related risk is generated by biodiversity loss and ecosystem degradation. This may be manifested as dependency risk, where negative impacts on nature reduce the ability of corporations to generate revenue, and impact risk where companies operations damage nature. Given the complex array of factors and the location specificity, nature-related risks and impacts are difficult to measure without a good understanding of the local socio-ecological conditions. The TNFD proposes an approach to move from nature-

negative to nature-positive activities. The IUCN Measuring Nature-Positive approach can help companies identify and measure impact risk and generate opportunities to move towards delivery of targets for ecosystems and species. The Science Based Targets Network (SBTN) framework can help identify targets for land use and freshwater use. Together, these frameworks may help facilitate disclosure and action in line with the goals and targets of the GBF[92] on climate and nature and help to identify any nature trade-offs between actions and targets for nature and climate[93] (*see* Box 3).

Box 3. Emerging nature-related reporting guidance

The Task Force on Nature-Related Financial Disclosure[94]

To facilitate measurement and reporting of nature-related impacts and dependencies, the TNFD is developing a risk management and disclosure framework for organisations to report and act on evolving nature-related risks, with the aim of supporting a shift in global financial flows from nature-negative to nature-positive outcomes. The Task Force consists of 34 individual Task Force Members representing financial institutions, corporate and market service providers with USD 19.4 trillion in assets. The TNFD's work will build on several principles:

- Develop a framework for market usability;
- Follow a science-based approach;
- Embrace nature-related risks that include immediate, material financial risks;
- Be purpose-driven;
- Build integrative and adaptive measurement and reporting frameworks;
- Employ an integrated approach to climate and nature-related risks, scaling-up finance for NbS; and
- Ensure the framework is globally inclusive.

The IUCN Measuring Nature-Positive Approach

A consultation document of this approach will be under review by the IUCN members in November 2023. It contains draft pathways for companies to identify, prioritise and act on opportunities to reduce impact risk for species and ecosystems, in line with the GBF goals and targets. The approach identifies separate pathways for companies with direct landholdings, those involved in important commodity value chains, and finance companies that invest in a combination of these.

Kunming-Montreal Global Biodiversity Framework [95]

At the fifteenth meeting of the Conference of the Parties (COP 15) to the Convention on Biological Diversity, and after a four-year consultation process, the GBF was adopted. The GBF lays out an agenda of four major goals and 23 targets for 2030 to transform the world through restoring, protecting and sustainably using nature. The GBF has been described as a "Paris Agreement for nature"[96] due to the historic, high-level agreement by policymakers across the world that secured it. Within the GBF, Target 15 was adopted to encourage and enable the private sector to monitor, assess and disclose risks and impacts on biodiversity; promote sustainable consumption; report on compliance with regulations to reduce biodiversity-related risks to business and financial institutions; and promote actions to ensure sustainable patterns of production. Guidelines on reporting against the GBF are expected to emerge in the coming months.

A central component of a company's risk is its direct impact on nature, including GHG emissions. According to the *GHG Protocol*,[97] all companies should account for their scope 1 (direct emissions), scope 2 (indirect energy use emissions) and scope 3 (other indirect emissions in a company's upstream and downstream value chain).[98] For agricultural companies, scope 1 emissions must include direct emissions from agriculture and forestry activities. For many companies, especially those with extensive supply chains, scope 3 can constitute most of their emissions. The *GHG Protocol* advises companies to disclose a breakdown of annual emissions and historical data for each source. As a recent analysis shows, companies have ample opportunities to incorporate nature-related considerations in their assessments and reporting on risks, impacts and responses.[99]

Having completed a corporate climate and nature-related risk assessment and tracked GHG emissions within a company's inventory and beyond, corporates should be ready to: (a) identify opportunities, such as applying NbS interventions to mitigate climate impact and advance nature-positive actions; and (b) set emissions reduction and nature-positive targets. The following section will cover target setting using available guidance.

3.2. Setting and achieving credible net-zero targets

Target setting is a critical component of a company's strategy to reduce impacts on climate and nature. There are many possible transition pathways toward achieving a state of global net zero emissions, each with different implications for our climate, nature and society.

SBTi[100] provides authoritative guidance for setting corporate emission reduction targets in line with the latest climate science, including for net-zero targets. SBTi defines corporate net zero as "achieving a state in which the activities within a company's value chain result in no net impact on the climate from GHG emissions."[101] Specifically, a credible net-zero pathway entails reducing scope 1, 2 and 3 emissions to zero – or to a residual level consistent with reaching net zero emissions – at the global or sector level in eligible 1.5°C-aligned pathways (*see* Box 4). Crucially, SBTi requires companies to neutralise residual emissions by the net-zero target year and thereafter.

SBTi's *Net-Zero Standard* provides guidance for companies from different sectors to set credible net-zero targets. SBTi proposes a science-based framework for setting near-term and long-term targets to achieve net zero emissions by 2050. Importantly, near-term and long-term targets are not interchangeable; these targets are complementary, and both must be adopted for a company to have an approved SBT.

1. **Near-term science-based targets** are meant to identify immediate opportunities, galvanise the action required for significant emission reductions to be achieved by 2030, and align with the decision horizon of most businesses. Default near-term targets require companies to reduce annual emissions at an average rate of 2.5% to 4.2% to be consistent with a 2°C goal – or a greater reduction for a 1.5°C goal – over the target period.[102] Near-term targets do not have a specific end year but must have a target year 5–10 years from the date of submission to SBTi.

Box 4. SBTi 1.5°C-aligned pathways

According to the IPCC, the remaining budget to limit global warming to 1.5˚C with 50% probability is an estimated 460 Gt CO_2.[103] SBTi uses a 1.5°C-aligned pathway that stays within the 500 Gt CO_2 budget to reach net-zero CO_2 at the global level by 2050, assuming at least 1–4 Gt CO_2 removal per year by 2050.

The SBTi has developed a cross-sector emissions corridor within this framework that covers CO_2, CH_4 and N_2O emissions from energy supply, buildings, industry and transport based on published studies and expert judgement.

Based on the emissions corridor, the SBTi's cross-sector pathway reduces emissions by at least 42% by 2030 and 90% by 2050 from 2020 levels[104] before considering the impact of CO_2 removals. Outside the boundary of the cross-sector emissions corridor, deforestation from internationally traded commodities should be eliminated before 2030; total emissions from deforestation should be eliminated by 2050; and agricultural CH_4 and N_2O emissions should be reduced through a combination of strategies.

These profound emissions reductions across all sectors must be complemented by swift action to scale-up CO_2 removals under conditions that resolve social and environmental concerns while aiming to maximise storage durability.

2. **Long-term science-based targets** drive long-term business planning and substantial capital investments to achieve the global emission reductions needed to combat climate change. The SBTi Net-Zero Standard requires companies to explicitly commit to emission reductions of at least 90% below 2019 levels across all scopes and a company's full value chain. These long-term targets must be achieved no later than 2050 (or 2040 for the power sector).[105]

SBTi proposes a science-based framework with different approaches for companies to achieve net zero (*see* Figure 5).

1. **Abatement** (black bars) includes measures that prevent the release of GHG emissions within the company's operations and its value chain. All companies can use NbS to abate/reduce emissions directly (*see* Figure 6), while the FLAG sector may also use removals, such as NbS insetting, as abatement efforts (*see* Box 5).

2. **Neutralisation** measures (purple bars) include the use of GHG emissions removals and permanent storage to 'neutralise' a company's residual emissions. A company would only neutralise residual emissions once its long-term target has been achieved. All residual emissions released into the atmosphere after the long-term target has been achieved must be neutralised (see Section 3.3).

3. **BVCM** measures (grey area) include GHG emissions reductions that result from financing activities external to the company's value chain. BVCM investments are contributions to societal net zero and can include NbS credits (see Section 4).

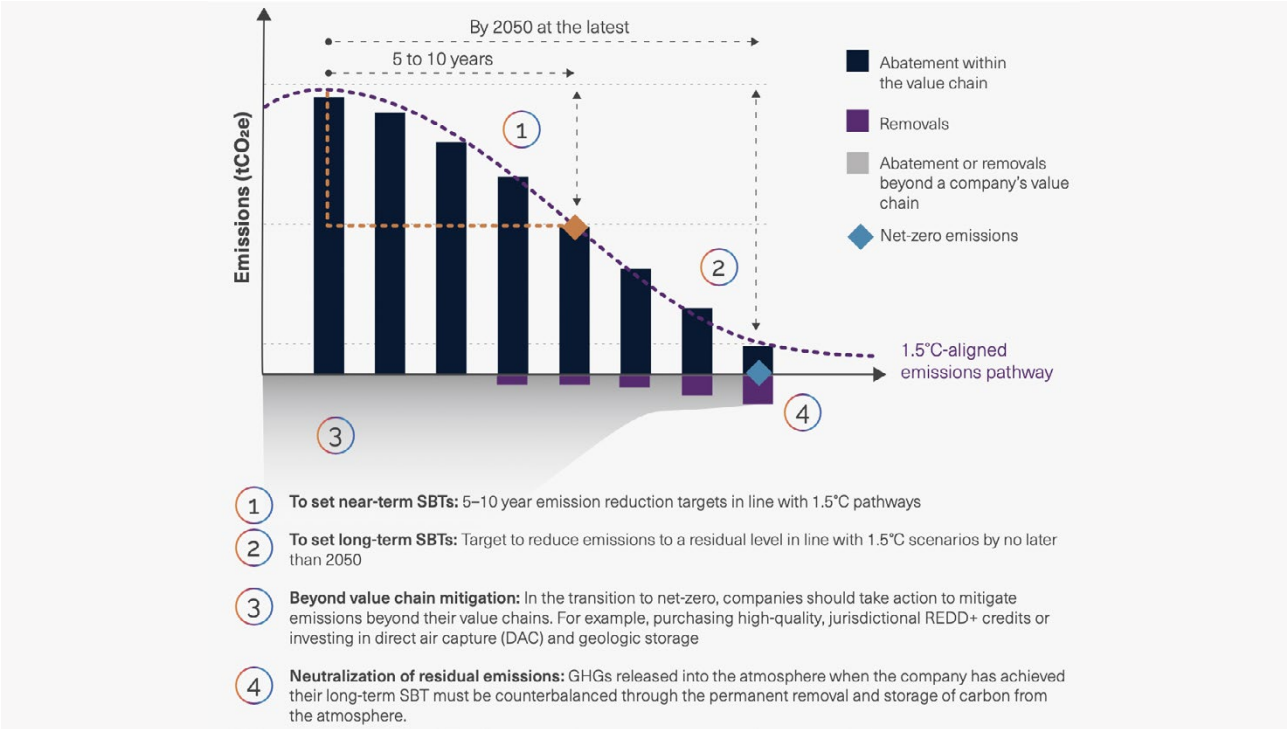


Figure 5. Key elements of a net-zero approach.
Source: SBT. (2023). SBTi Corporate Net-Zero Standard Version 1.1. SBTi. https://sciencebasedtargets.org/resources/files/Net-Zero-Standard.pdf

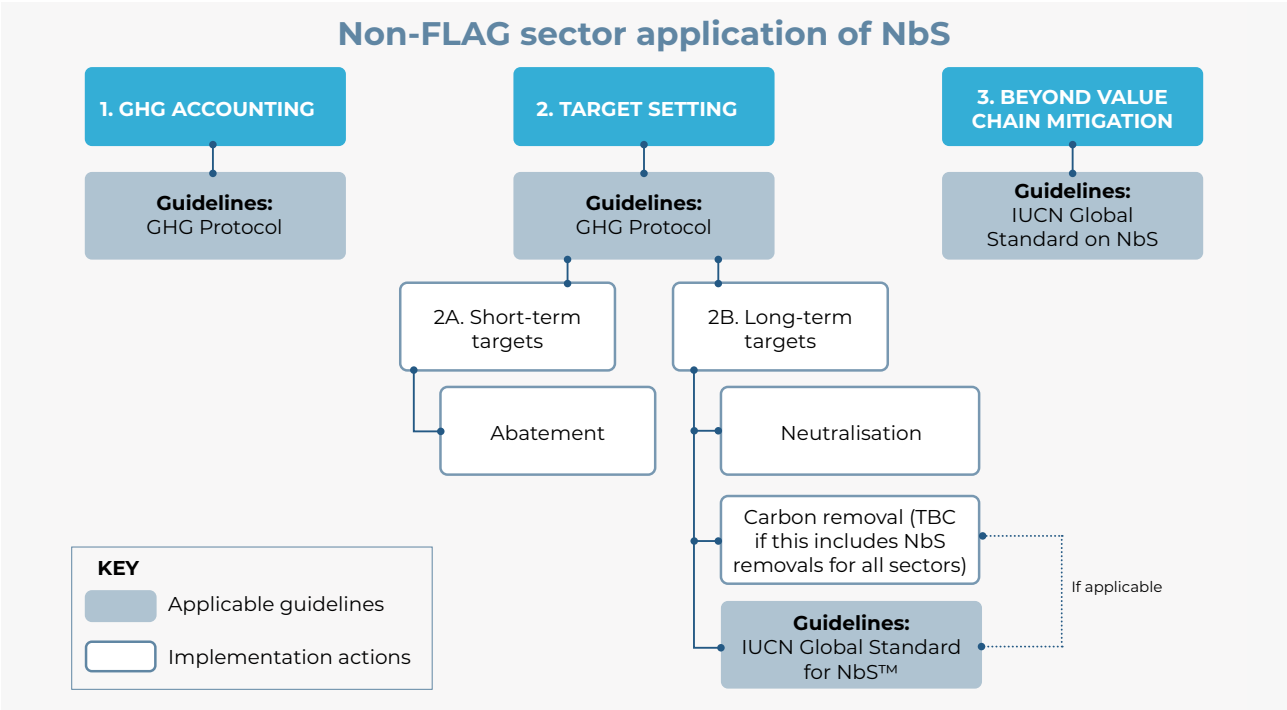


Figure 6. Opportunities to apply NbS for non-FLAG sector companies

Box 5. Climate and nature targets

Multiple guidelines on corporate target setting are poised to shift expectations for corporate climate and nature ambitions. The SBTi FLAG guidance outlines SBTi-compliant pathways for land-intensive sectors for 1.5°C and well-below 2°C pathways based on land-related GHG emissions and removals.[106,107] The FLAG guidance will enable land-intensive sectors that account for 22% of global emissions to develop emission reduction targets in line with climate science. The SBTi guidelines incentivise emissions reductions and removals, including a no-deforestation commitment. To avoid risks of having adverse effects on nature or biodiversity, such as planting monoculture plantations to sequester carbon, which can undermine biodiversity and resilience in the local ecosystem, companies should complement corporate action with the Global Standard for NbS™ to avoid these critical negative consequences.

Meanwhile, the SBTN has published *Science-based Targets for Nature,* which expands on the SBTi's FLAG guidance, looking beyond climate change and including guidelines to set up targets focused on nature (freshwater and land systems). The freshwater targets are ready for companies to use, and the land targets have been released as a beta version for piloting before a version 1 rollout anticipated in early 2024.

The current SBTN freshwater (v1) target-setting protocol focuses on issues like water use, pollution and effluents, pesticide use, erosion control and other actions which promote can reduce pressures on biodiversity. SBTN Land targets also go beyond the SBTi's zero-deforestation commitment and focus on reducing land use change and participate in land use planning processes[108]. The SBTN target-setting protocols will be complemented by the IUCN Measuring Nature-Positive approach which enables companies to identify and set targets for species and ecosystems. In addition to SBTi's FLAG guidance, the SBTs for nature are expected to complement the Accountability Framework initiative and GHG Protocol *Land Sector and Removals Guidance* and agreements like the GBF.

The integration of nature and climate targets is necessary to safeguard nature. Moreover, a focus on land indicators, because of their spatial nature, will also favour system-level, multi-stakeholder solutions. Land indicators often involve landscape and jurisdictional solutions, interventions that consider interactions between landscapes (e.g. biodiversity corridors in habitat restoration) and require more significant community engagement. Land indicators integrated into nature, climate and people will enable companies to manage compounding risks better and align their strategies with a net zero, nature-positive and equitable future.

Setting and achieving net-zero targets for the land use sector

NbS are particularly important for land-intensive sectors given their outsize role in generating land-based emissions, and their vulnerability to the impacts of climate change and biodiversity loss. Globally, forests and agriculture account for 31%[109] and 38%[110] of total land area, respectively. Because of the sheer physical scale of the FLAG sector (agriculture accounts for half of the world's habitable area[111]), not to mention its importance to the economy and millions of livelihoods across the world, the land sector serves as a distinct entry point for NbS implementation.

Land use change, including deforestation and degradation, accounts for 10–12% of global GHG emissions.[112] Companies in land-intensive sectors must commit to no deforestation across their primary deforestation-linked commodities by 2025 to operate in line with

a net-zero pathway. These commitments should be tracked and implemented using the Accountability Framework initiative guidance.[113]

While emissions from land use change have not been regularly included in corporate GHG inventories, new guidance for the FLAG sector will improve emissions accounting and reporting. The forthcoming *GHG Protocol Land Sector and Removals Guidance* will guide companies in calculating GHG emissions and removals from land-based activities.[114] This guidance suggests companies in the land sector follow the principles of relevance, completeness, consistency, transparency, accuracy, conservativeness and permanence when compiling a GHG inventory that includes land sector activities and/or removals.[115]

Meanwhile, SBTi recently published *FLAG Guidance*[116] to aid companies in setting science-based targets that include land-related emissions and removals[117]. Under the guidance, FLAG companies' long-term targets must be more ambitious than the default pathway by covering at least 95% of scope 1 and 2 emissions generated by agriculture, forestry and other land use (AFOLU) activities. They must also cover at least 67% of scope 3 AFOLU emissions.[118] Companies with AFOLU emissions are also required to set FLAG SBTs – specific targets that cover the portion of their emissions generated from the land sector – as well as default SBTs to cover the non-AFOLU activities of the company.[119]

NbS may be utilised in all aspects of climate management by companies operating in the FLAG sector (*see* Figure 7).[120] FLAG companies also have a unique path to meeting near-term targets. These companies can include removal activities through on-farm or forest-based projects within their own scope 3 supply chain boundary[121] to abate their value chain emissions. This practice – known as insetting – can be contrasted with offsetting, which refers to emissions removals achieved through projects unrelated to a company's supply chain[122] (*see* Box 6). FLAG companies can also meet near-term targets by reducing emissions from deforestation and degradation (via a no deforestation commitment), reducing emissions from agriculture, restoring forests, improving forest management and enhancing soil health.

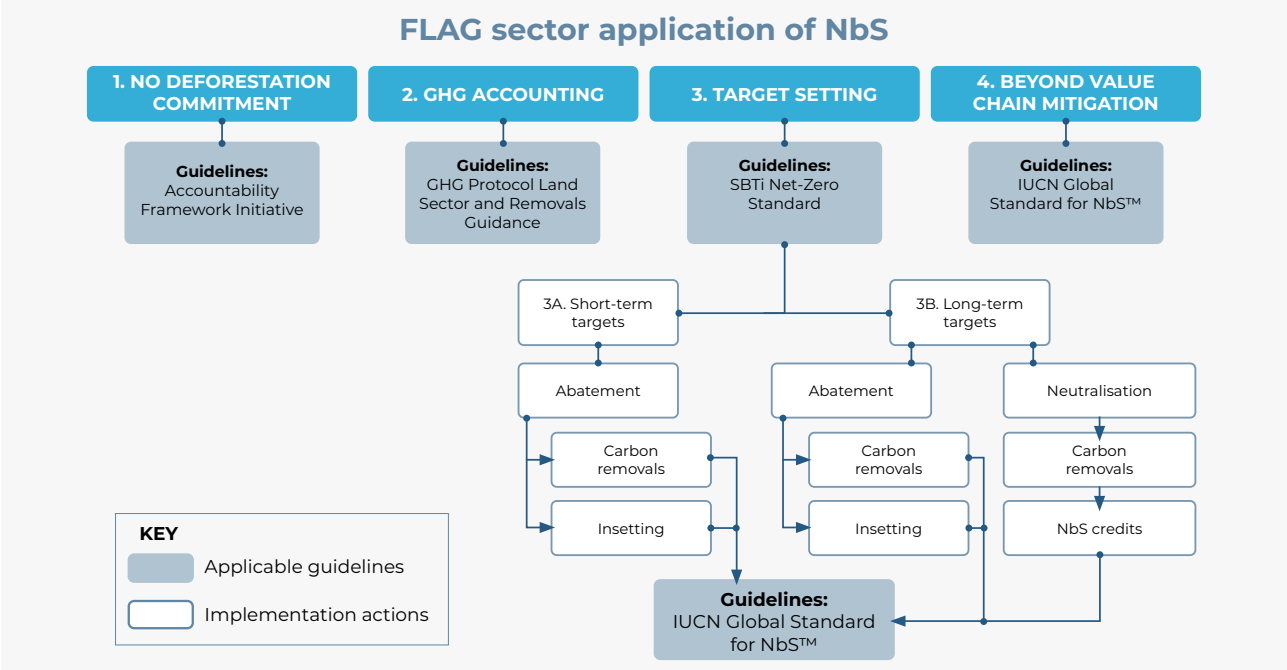


Figure 7. Opportunities to apply NbS within the FLAG sector

Box 6. NbS insetting[123]

According to the Nature-based Insetting initiative of the University of Oxford, nature-based insetting targets activities along a supply chain where NbS can be directly integrated, developed and monitored. NbS insetting involves implementing NbS within a company's supply chain to offset damage to the climate, biodiversity and people, and to increase the resilience of supply chains. Insetting also involves embedding the value of biodiversity and consideration of climate into all levels of decision-making.[124]

For example, implementing agroforestry across commodity-production landscapes and protecting and restoring nearby ecosystems in adjacent areas to company value chains can enhance yields and encourage landscape-wide transformations. Such activities also make commodity supply chains more resilient to the effects of climate change, such as the increasing intensity and frequency of droughts, flooding, fire and pests. Other NbS insetting examples include soil sequestration on farm and pasture, conservation set-asides and implementing silvopasture practices.[125]

The use of insetting carbon credits in value chains should consider the differences and challenges in carbon accounting methods to be used for insetting (intervention or project accounting) versus the required inventory accounting for scope 1 to 3 GHG emissions, which have different baselines as well as other carbon accounting disparities. Moreover, the GHG Protocol Land Sector and Removals Guidance draft requires companies to avoid double counting between insets and the scope 3 inventory. A way to address this risk is to purchase and retire carbon credits from suppliers or other value chain partners as part of their scope 3 inventory.[126]

New approaches are emerging to support companies in making informed decisions on managing their impact on the environment and society. Nature-based insetting draws on these innovations to develop a robust strategy for monitoring and managing impacts and implementing NbS to future-proof supply chains. The Nature-based Insetting initiative provides a framework and monitoring strategies to allow companies to better understand their social and environmental impacts and dependencies, improve the value and resilience of the landscape they impact, and meet social, nature and net-zero pledges.

3.3. Neutralising residual emissions

Once a company's emission reduction target has been validated as an SBT and the target has been met, any residual emissions (*see* Box 7) are expected to be neutralised with an equivalent amount of CO_2 removals. However, there is a need for greater clarity from standard setters such as the SBTi on the role of NbS for use in neutralising residual emissions (e.g. whether they could be used by all industries and which type of NbS removals could be considered) – guidance is forthcoming. What is generally agreed upon is that neutralisation should not be used as a replacement for emission reductions but can be used to address projected non-abated emission reductions. Residual emissions should decrease over time as emissions are increasingly abated directly.

Residual emissions must be neutralised with removals rather than avoided emissions – reductions compared with an expected outcome or baseline. For example, under REDD+ (Reducing Emissions from Deforestation and forest Degradation in developing countries), conservation of forest carbon stocks, sustainable management of forests and enhancement of forest carbon

stocks would be considered removals except for the avoided emissions from projects which preserve existing biomass and embedded CO_2 that may otherwise have been emitted, leaving existing CO_2 untouched. As they do not sequester additional CO_2, they would not count toward neutralisation.

To ensure additionality and consistency with the science of net zero[127], calculations of carbon removed through NbS must exclude the CO_2 that would be absorbed by an equivalent area of unmanaged land or ocean in response to past emissions, through CO_2 fertilisation, for example.

The physical permanence of carbon removals from NbS interventions comes with higher uncertainties than other carbon dioxide removal technologies. To counteract the risk of reversal, it is critical to ensure that there are remedies for non-permanence risks, including framing the interventions within contracts that ensure long-term climate benefits, often defined as 100 years, as well as consequences of carbon removal reversals for direct or indirect causes.[128]

Neutralisation measures include the removal and permanent storage of CO_2 to a company's residual emissions. Both FLAG and non-FLAG companies could utilise removals – including purchased carbon credits to neutralise residual emissions in the interest of meeting long-term targets. In addition, companies should take responsibility for unabated and historical emissions by making climate contributions to support climate change mitigation beyond the value chain without making a neutralisation claim.[129] As mentioned above, current discussions are underway under the SBTi to determine the role of NbS for use in neutralising residual emissions.

The application of NbS for climate and nature-related impacts are interconnected. Companies should set nature-positive targets using guidance from SBTN to complement climate targets (*see* Box 5). Societal net zero and nature-positive goals require investments beyond operational and value chain mitigation to drive transformative change (see Section 4).

Box 7. Residual emissions[130]

According to scenarios that limit warming to 1.5°C with no, or limited, overshoot, most of the emissions our economy generates today will have to be eliminated by mid-century. However, some residual emissions will remain unabated when net zero is reached. Some of these emissions will continue to be reduced throughout the second half of the century. In contrast, others will likely remain unabated throughout the 21st century due to technical or economic constraints.

Determining the level of residual emissions allowable for different activities and from different sectors of the economy at different points in time is based on 1.5°C-aligned mitigation pathways.

4. Nature-based Solutions and societal net zero

Reaching a societal state of net zero by 2050 will require deep decarbonisation of all industries to reduce global emissions 91–97% below 2010 levels.[131] Although companies must prioritise emissions abatement, the SBTi Net-Zero Standard and other emerging guidance, including SBTN, states that companies should go further and invest in mitigation outside their value chains to contribute to reaching societal net zero and nature-positive outcomes (*see* Figure 8). Of particular importance are the investments to protect areas with irrecoverable carbon reserves and nature hotspots that provide key ecosystem services for local to global communities.[132,133]

Such investments in NbS outside of corporate net-zero efforts will be required and are increasingly being taken up by the private sector as BVCM activities – or what Corporate Climate Responsibility Monitor defines as 'climate contributions' – and engagement with NbS credits. There are several motivators and deterrents to investing in BVCM, which need to be addressed strategically to ensure scaled-up investment. The latest SBTi consultation on this sheds light on some of these actions, including demands from consumers, customers, investors and peer pressure.[134]

To ensure that achieving global net zero emissions stops global warming in line with the Paris Agreement goals, it is essential that carbon uptake from NbS is measured relative to a counter-factual baseline that includes carbon uptake that would occur on unmanaged land or oceans in response to past emissions, as a consequence of elevated and rising atmospheric CO_2 concentrations.[135] Based on this, the carbon flux that can be counted as a negative emission would be less than the observed carbon flux into a piece of land or ocean. Failure to take this into account would mean that a nominal net zero global CO_2 emissions would not actually be enough to stop global temperatures from rising.

4.1. Nature-based Solutions in beyond value chain mitigation

BVCM refers to climate mitigation activities financed by a company but taking place outside its value chain. These are often investments into mitigation activities where the resulting emission reductions are not reflected in a company's inventory or net-zero target but instead count as a contribution to a global net-zero goal.[136] These can include activities that avoid or reduce GHG emissions or enable removals and are expected to be employed by companies in all sectors, including those with and without residual emissions (*see* Figure 8).[137]

While corporates must remain focused on value chain abatement, implementing BVCM is also essential for protecting ecosystems and enhancing ecosystem services. BVCM can, for example, include investments in and/or the purchase of carbon credits from NbS interventions that avoid or reduce emissions from deforestation and forest degradation and capture and store CO_2 via restoration of natural forest and non-forest ecosystems. Importantly, BVCM investments in NbS should not only focus on removals but prioritise immediately available mitigation actions that can be taken to protect, conserve and manage existing carbon sinks.

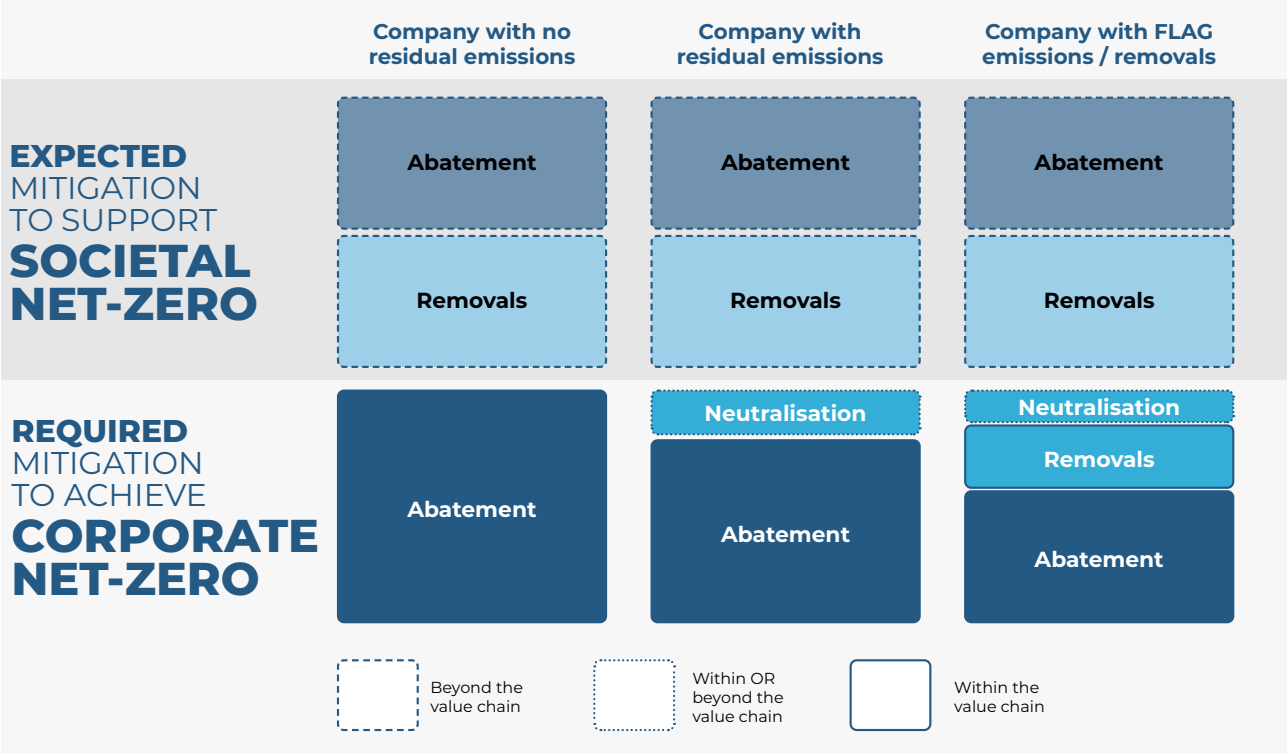


Figure 8. Use of removals and neutralisation to meet societal and corporate net zero.
Source: SBTi. (2021). Beyond value chain mitigation FAQ (Version 1.0). https://sciencebasedtargets.org/resources/files/Beyond-Value-Chain-Mitigation-FAQ.pdf

There is not a widely accepted list of activities that falls under BVCM, but the term generally includes investments that drive climate finance towards NbS (*see* Table 3). For example, landscape finance, jurisdictional programmes and result-based payments could all count, focusing on interventions across different ecosystems.[138] BVCM can also include carbon removals stemming from restoration efforts or from the management and enhancement of carbon sinks (terrestrial, coastal and marine). Examples include conserving high integrity in tropical forests and peatlands to contribute to avoiding global emissions since intact and healthy ecosystems can act as significant carbon sinks.[139] The latest SBTi BVCM draft guidelines present six principles to guide private sector investment decisions, including prioritising activities with short-term high-mitigation potential, contributing to avoid tipping points (therefore investing in the protection and restoration of natural ecosystems, for instance), supporting the achievement of the SDGs, addressing inequality with strategic investments and transparency in benefit-sharing, among others.[140]

Further guidance from SBTi details BVCM approaches and how they align with other targets and guidelines.[141] BVCM that adhere to a holistic nature-positive approach would ensure high-quality, equitable interventions that embrace the principles of NbS.

Table 3. The use of NbS in corporate and societal net zero

	Corporate net zero			Societal net zero
	Within value chain			Beyond the value chain
	Near-term target	Long-term target	At net-zero point	
Non-FLAG Company			Neutralisation of residual emissions through permanent removals (under discussion within the SBTi BVCM upcoming guidance)	Investment in, and/or the purchase of carbon credits from, interventions that avoid/reduce emissions, and sequester and store carbon
Examples			Improved forest management Afforestation and reforestation[142] Agroforestry systems	Jurisdictional REDD+ initiatives and ecosystem conservation and restoration activities, such as peatland or mangrove conservation/ restoration
	Within value chain			Beyond the value chain
	Near-term target	Long-term target	At net-zero point	
FLAG Company	Reduce emissions in supply chain	Reduce emissions through NbS removals NbS insetting	Neutralisation of unabated emissions through permanent removals	Investment in, and/or the purchase of carbon credits from, interventions that avoid/reduce emissions, and sequester and store carbon
Examples	Improved forest management Afforestation and reforestation Agroforestry systems Improved agricultural practices Soil organic carbon and shifting to no-till management Biochar from crop residues Deforestation-free activities and restoration of tropical forests	Improved forest management Afforestation and reforestation Agroforestry systems Improved agricultural practices Soil organic carbon	Improved forest management Afforestation and reforestation[143] Agroforestry systems	Jurisdictional REDD+ initiatives and ecosystem conservation and restoration activities, such as peatland or mangrove conservation/ restoration

4.2. Nature-based Solutions and carbon credits

Carbon markets may unlock up to 10% of NbS climate mitigation potential by 2030,[144] by driving the development of projects or programmes that sequester and avoid GHG emissions, and the trade of carbon credits generated by those activities. Many of the credits available through the Voluntary Carbon Market (VCM) are reduction and removal credits (*see* Box 8), which encompass various activities and can be deployed throughout a company's decarbonisation pathway.

Companies may incorporate carbon credits into voluntary climate mitigation strategies to neutralise their unabated value chain emissions and BVCM. However, only carbon credits recognised for neutralisation claims by the SBTi are carbon removal credits. In addition, SBTN is expected to include a provision for using NbS for carbon credits.

Initial guidance developed by the WRI on the credible use of carbon credits from nature proposed two broad categories beyond a company's value chain:[145]

1. Carbon credits for **counterbalancing** the organisation's unabated emissions over a given period – or counterbalancing historical emissions – while on a science-based emissions reduction pathway; and
2. Carbon credits for **contributing** to mitigation in a specific jurisdiction, following 'supply-side' guardrails (see Section 4.3).

Carbon credits from nature offer an option for companies to counterbalance current emissions while progressing towards meeting short- and long-term targets and implementing low-carbon technologies. When designed correctly, some NbS credit-issuing activities provide rapid, scalable and cost-effective options that offer significant co-benefits.[146] NbS reduction and removal credit-issuing activities also provide increased finance for nature conservation and restoration, biodiversity protection and socio-economic development (*see* Box 10).[147]

The recent, rapid growth in the VCM is attributed mainly to the growing demand from companies for carbon credits from nature to contribute to their voluntary climate commitments. This has prompted increased scrutiny of the quality of credits being transacted in the market and of the social and environmental claims made by buyers, where demands persist to ensure robust and credible safeguard systems.

Box 8. Clarifying terminology related to climate removals

Several terms are used to describe BVCM and/or the neutralisation of residual emissions, including compensation, contribution and counterbalancing GHG emissions. A public consultation undertaken by SBTi in June of 2023 included these terms to discuss their use. The term 'beyond value chain mitigation' clarifies that carbon credits cannot replace emission reductions within a company's value chain. Further SBTi guidance on BVCM is forthcoming.

This publication uses these terms as other relevant initiatives and organisations, including SBTi, define them.

Additionally, there are real concerns that the overdependence on these credits dilutes the ambition of corporate climate strategies and compromises the environmental and social integrity of their net-zero commitments. Therefore, carbon credits from nature should be used to complement an emissions reduction strategy and strictly follow high-integrity carbon standards and guidelines[148] (e.g. the Global Standard for NbS™). Companies must avoid misleading claims and procure only high-quality credits that lead to an additional, permanent, and accurately quantified climate impact (*see* Table 4).

Recent guidance has been developed to inform procurement processes for high-quality carbon credits from nature.[149]

Table 4. Definitions of criteria for high-quality carbon credits[150]

Criteria	Definition
Real	Each carbon credit legitimately measures at least 1 tonne of CO_2 equivalent and is based on a credible and conservative baseline.
Verifiable	Carbon credits must be calculated based on robust scientific data using accurate quantification methods and must be expressed in quantitative terms using standardised GHG metrics.
Additional	Carbon credits must represent emission reductions or removals that would not have otherwise occurred without the added incentive resulting from the carbon market. The project/programme baseline must be set to represent the business-as-usual scenario, should represent no more than the emissions that would have occurred without the market incentive and should not include emission reductions intended to be achieved with other policies and measures. Because countries are expected to revise their Nationally Determined Contribution in 5-year cycles, the demonstration of additionality must be calibrated accordingly to reflect increases in ambition.
Permanent	Carbon credits must represent emission reductions or removals that will not be reversed after the issuance of that unit. If non-permanence is a material issue, proper provisions must be in place to both minimise that risk and account for reversals if they should occur, such as using a buffer pool of credits to replace reversed emission reductions and removals, or temporary units.
Avoid leakage	The generation of carbon credits should not lead to an increase in emissions elsewhere, or safeguards must be in place to monitor and mitigate any increase that occurs (e.g. leakage deductions from the emissions reductions measured).
Monitored, reported and verified	The underlying emissions reductions of carbon credits should be monitored and reported and must be verified by a credible third-party verification system.
Comply with social and environmental safeguards	The generation of carbon credits should not violate laws, regulations or treaties, or result in social or environmental grievances. Benefit-sharing rules need to be established and implemented, especially considering the contributions from Indigenous peoples and communities towards these efforts. Credits must show how emission units meet the international best-practice standard for social and environmental safeguards.

4.3. Responsible use of carbon credits and guardrails

If climate change mitigation is part of the societal challenges to be addressed by a particular NbS, such NbS should provide societal and environmental benefits alongside climate change mitigation and adaptation. However, for example, if done with only the purpose of mitigation (e.g. with no consultation with IPLCs or no consideration for other criteria), it will likely not be considered an NbS as it could potentially result in negative, unintended consequences for nature and society. For this reason, clear implementation criteria must be established to engage local stakeholders through all stages of these activities and to avoid unforeseen repercussions for local communities or ecosystems (see Section 2).

In addition to the criteria underpinning NbS, several organisations have laid out overarching principles and safeguards for the use of carbon credits that ensure 'supply-side' and 'demand-side' integrity:[151]

1. Carbon credits must ensure environmental integrity and be connected with actions that respect the rights and livelihoods of IPLCs while safeguarding biodiversity; and
2. The use of carbon credits must supplement a company's mitigation pathway aligned with limiting warming to 1.5°C and not undermine efforts to abate emissions in its operations and value chain (*see* Box 10).

Although carbon credits originated from a nature focus on climate mitigation outcomes, some also include adaptation and resilience objectives to fully contribute to the goals of the Paris Agreement. Carbon credits based on NbS must be based on interventions that are appropriate for their areas of implementation. The IUCN Global Standard for NbS™ can complement existing carbon measurement and verification standards and platforms to help improve and assure the ecosystem and social integrity of claimed NbS credit activities (*see* Box 9).[152] Organisations should differentiate NbS according to their impacts and risks for local communities, prioritise NbS interventions with higher benefits and lower risks, and be prepared to pay a price premium for carbon credits associated with higher positive impacts.[153]

Box 9. Positive outcomes for the people and the planet[154]

NbS offer a suite of benefits to address societal challenges in an integrated way. In fact, NbS help mitigate the risk of trade-offs inherent in NCS by addressing a suite of linked societal challenges through the protection, sustainable management and restoration of both natural and modified ecosystems, benefiting biodiversity, ecosystem degradation, land tenure and human well-being. NbS target major challenges like climate change, disaster risk reduction, food and water security, biodiversity loss and human health, and are critical to sustainable economic development.

To guarantee the social and ecosystem integrity of carbon credits from nature, companies should add an additional layer of assessment to ensure that the projects are issuing these credits aligned with the IUCN Global Standard for NbS™.

In response to ongoing quality concerns, several civil society or sector-led initiatives aim to increase VCM market integrity, from the supply and demand sides. Emerging guidance on the implementation and responsible use of carbon credits has been published by organisations including the University of Oxford, The Natural Climate Solutions Alliance, IC-VCM, the Carbon Credit Quality Initiative, Voluntary Carbon Markets Integrity and WRI. IC-VCM's recently published *Core Carbon Principles* (CCPs) Assessment Framework and Assessment Procedure aims to become the global benchmark to guide market actors towards high-quality carbon crediting programmes and methodologies. The 10 CCPs are built under governance, emission impact and sustainable development criteria.

As mentioned above, organisations issuing and purchasing NbS credits must strive to secure supply-side integrity, ensuring robust outcomes from the activities. This includes assessing and monitoring access and benefit-sharing, with transparency methods that disclose the allocation of carbon revenue to IPLCs. Some of the IUCN Global Standard for NbS™ criteria are currently addressed in existing methodologies, but full guidance is not yet available. **Even the most robust VCM standards do not provide adequate assurance that certified activities meet the threshold to be considered NbS.**

Critical criteria from the IUCN Global Standard for NbS™ are addressed by carbon market methodologies (*see* Annex A). This guidance acknowledges the various robust and credible methodologies for the design of carbon-issuing projects, including Verra's Verified Carbon Standard, Climate, Community & Biodiversity and Sustainable Development Verified Impact Standard and Gold Standard (*see* Box 11). IUCN is currently working with the Gold Standard to integrate the IUCN Global Standard for NbS™ with their certification process, and more detail on the integration and resulting certification criteria is forthcoming.

Box 10. Double counting[155]

The Article 6 guidance of the Paris Agreement does not specify whether corresponding adjustments should be applied when companies use carbon credits for voluntary purposes. Thus, Article 6 creates a path – but not an obligation – for host countries to authorise and apply corresponding adjustments for the use of carbon credits in VCMs. This has led to considerable debate over whether and when corresponding adjustments should be required in the context of voluntary action and whether such a requirement would increase overall mitigation efforts and help to deliver a net climate benefit. Companies investing in verified credits must align their strategies with the requirements of host countries and adhere to reputable standards.[156]

In 2022, Papua New Guinea and Honduras suspended issuances of forest VCM credits, and Indonesia and India suspended issuances of all VCM credits while they determine how VCM activities will be authorised under Article 6 of the Paris Agreement. Other countries are also revising their approaches to VCM credits considering Article 6.[157,158,159,160,161]

Box 11. Carbon methodologies and standards

The **Verified Carbon Standard** was launched in 2005 by the Climate Group, International Emissions Trading Association and the World Economic Forum. The World Business Council for Sustainable Development has joined the initiative since its launch. In 2018, Verra took over ownership and management of the Verified Carbon Standard. Over time it has become the most widely used voluntary carbon standard worldwide, and the favoured standard for renewable energy and land-use-related activities, notably for the REDD+ programme. While most Clean Development Mechanisms (CDF) and Climate Action Reserve methodologies can be used under the Verified Carbon Standard, Verra has developed 42 proprietary methodologies.

The **Sustainable Development Verified Impact Standard** certifies social and environmental projects for their real-world, tangible benefits. These projects include economic development, clean energy, gender equality, and wildlife restoration. Through Verra, the Sustainable Development Verified Impact Standard: (a) sets the standard for projects to be accredited; (b) carries out independent, third-party assessments on projects; (c) offers guidance on the appropriate methodology to meet the standard's requirements; and (d) tracks and makes public all data on Sustainable Development Verified Impact Standard projects.

The **Climate, Community & Biodiversity Standards** were launched in 2005 by several non-governmental organisations including CARE, the Nature Conservancy and Rainforest Alliance. The standards do not certify emission reductions but foster the integration of best-practice and multiple-benefit approaches into project design and implementation. The Climate, Community & Biodiversity Standards aim to: (a) identify projects that simultaneously address climate change, support local communities and smallholders, and conserve biodiversity; (b) promote excellence and innovation in project design and implementation; and (c) mitigate risk for investors and offset buyers and increase funding opportunities.

The **Plan Vivo Standard** is a scheme for rural smallholders and communities dependent on natural resources for livelihoods. Developed in 1994 by the Edinburgh Centre for Carbon Management in partnership with El Colegio de la Frontera Sur (ECOSUR), the University of Edinburgh and other local organisations, a fully-fledged version of the standard was articulated under the Plan Vivo Foundation in 2008. Certificates are generated for afforestation and agroforestry, forest conservation, restoration and avoided deforestation. Communities decide which land use activities (e.g. woodlots, agroforestry, forest conservation) will best address threats to local ecosystems and are of interest and value to them.

The **Clean Development Mechanism** is the reference carbon standard developed by the UNFCCC. While initially intended for compliance with carbon markets, the carbon credits it delivers are also used on VCMs. The UNFCCC has developed more than 200 methodologies.

The **Climate Action Reserve** was created in 2001 as the California Climate Action Registry. Although it initially encouraged voluntary actions throughout the USA, it is actively used under the California cap-and-trade scheme. It has developed more than 20 methodologies (called protocols), focusing particularly on the USA and Mexico. It has a more standardised and higher-level approach to additionality focusing on coal mine methane, livestock, forestry, landfill gas and agriculture.

The **American Carbon Registry (ACR)** was launched in 1996 under the Environmental Resources Trust by the Environmental Defense Fund. In 2007, the newly branded ACR was launched, mostly focusing on US-based projects and based on ISO 14064.

The **Gold Standard** was launched in 2003 by the WWF, SouthSouthNorth and Helio International. Initially launched as a co-benefit certification standard for the Clean Development Mechanism, it was reshaped in 2006 to deliver its own carbon credits and align with the Millennium Development Goals. It has developed over 20 proprietary methodologies and is the favoured standard for community-oriented projects. It has developed partnerships with Fairtrade International and the Forest Stewardship Council and is supported by a network of non-governmental organisations. In 2017, the Gold Standard Foundation aligned its rules and principles with the Sustainable Development Goals and launched the Gold Standard for the Global Goals. Recently, Gold Standard has launched a new framework methodology for soil carbon credit assurance.

To ensure the integrity of NbS interventions used to generate carbon credits, criteria for sustainable development – especially *Sustainable Development Goals (SDGs) benefits and safeguards* – must be considered. This principle requires that projects issuing carbon credits assess and manage environmental and social risks, account for labour rights and working conditions, ensure resource efficiency and pollution prevention, and avoid involuntary resettlement. Aligned with the IUCN Global Standard for NbS™, it ensures biodiversity conservation and the sustainable management of living natural resources. Another critical requirement is safeguarding for IPLCs while respecting human rights and conducting robust stakeholder engagement. The Global Standard for NbS™ criteria should be simultaneously applied with the CCP for Sustainable Development to ensure biodiversity net gain and equitable NbS activities for climate mitigation (*see* Table 5).

Table 5. Core Carbon Principle sustainable development benefits and safeguards related to the themes of the IUCN Global Standard for NbS™ Criteria[162]

	Criteria of CCP Sustainable Development	IUCN Global Standard for NbS™ Criteria
7.1	Assessment and management of environmental and social risks	3; 6
7.2	Labour rights and working conditions	5; 4
7.3	Resource efficiency and pollution prevention	3; 6; 4
7.4	Land acquisition and involuntary resettlements	3; 5
7.5	Biodiversity conservation and sustainable management of living natural resources	3; 6; 4
7.6	Indigenous peoples, local communities and cultural heritage	5; 4
7.7	Respect for human rights, stakeholder engagement	1; 5
7.8	Gender equality	5
7.9	Robust benefit-sharing	5
7.10	Cancun safeguards	3; 5
7.11	Ensuring SDG impacts	1; 2; 3; 4; 5; 7; 8

In addition, an array of carbon credit rating agencies, such as BeZero, Calyx Global and Sylvera, among others, are arising with the aim to increase carbon credit transparency for buyers by assessing projects against quality criteria, creating the need to apply standardised quality assessment methodologies (see IC-VCM's).[163] To ensure demand-side integrity, the Voluntary Carbon Markets Integrity Initiative is working to provide guidelines for firms buying and making offset claims using carbon credits. The most widely recognised initiatives are listed in Annex B.

5. Conclusions and further discussion

1. The fundamental link between climate change and biodiversity loss means that the two crises cannot be addressed in silos and must be tackled immediately with maximum efforts in this decade to reduce emissions and initiate ecosystem recovery and restoration. This entails collective action of the public and private sectors, which must operate and make investments within and beyond their spheres of control to help advance society's goals towards climate change and biodiversity.

2. Corporate sector and financial sector leadership to decarbonise the world includes actions to reduce emissions from their supply chains, divest investments away from high-emitting industries and increase financing for climate-positive economic activities. The sector also aims to assess and respond to climate and biodiversity risks and contribute to global climate and biodiversity goals through investments in nature. Nature has arisen as a critical part of corporate sector investment for implementing climate change and net-zero strategies.

3. However, the use of nature to achieve climate change net-zero strategies must be done carefully, prioritising the protection of natural ecosystems, and being guided by the NbS definition, principles and Global Standard for NbS™ to ensure that actions in connection to nature benefit both human well-being and biodiversity. The bottom line regarding all NbS is that they (a) must either maintain or enhance biodiversity and ecosystem integrity; (b) can only be successful and strongly benefit with the inclusion of different knowledge systems and ensuring that groups directly or indirectly affected participate in their design and access their benefits, including IPLCs, women and youth; and (c) must consider the different outcomes of proposed interventions to minimise potential risks and trade-offs. To ensure that corporate sector investments are toward adequate NbS, they must follow the eight criteria of the Global Standard for NbS™.

4. Carbon emission removals and reductions from the land use sector represent an important part of the global strategies to achieve the temperature goals of the Paris Agreement. However, this will not generate sizeable impacts if the main efforts are not directed to decarbonising value chains, divesting investment from heavy-emitting industries and addressing climate and biodiversity risks of operations.

5. Science-based net-zero standards and guidance, carbon accounting methodologies and carbon market standards are essential in guiding corporate strategy in designing and implementing climate change strategies to achieve net zero. The guidance they offer regarding the use of nature should be complemented with the Global Standard for NbS™, which equips implementors and investors to design bottom-up solutions, ensuring quality control of the interventions and an adequate assessment and minimisation of risks to biodiversity and society. This is critical for the increasing demands for transparency

and credibility of climate action pledges and progress.

6. Under their climate change net-zero strategies, the corporate sector interested in investing in NbS will need to follow a stepwise approach that includes risk assessment and action plans to address these, establishing science-based short-, medium- and long-term emission reduction targets with comprehensive implementation action plans. Under this scenario, the use of carbon removals for neutralisation purposes is important.

7. BVCM should translate into investing in NbS for the protection, restoration and sustainable management of ecosystems. It should aim to safeguard and enhance biodiversity, which will generate different degrees of mitigation outcomes and benefits to people. Investment in BVCM is critical to close the emission gap that keeps us from achieving the 1.5°C temperature goal.

8. The flux of private investments in NbS in the context of climate change mitigation should consider different regulatory matters currently under development regarding market-based mechanisms under Article 6 of the Paris Agreement. They should also remember that investments in nature should not stop at the net-zero point but also look beyond 2050.

6. Annexes

6.1. Annex A – Core Carbon Principles for high-integrity carbon credits

Category	Criteria	Description
Governance	Effective governance	Programme shall have effective governance to ensure transparency, accountability, continuous improvement and the overall quality of carbon credits.
	Tracking	Operate or make use of a registry to uniquely identify, record and track mitigation activities and carbon credits issued to ensure credits can be identified securely and unambiguously.
	Transparency	Provide comprehensive and transparent information on all credited mitigation activities. The information shall be publicly available in electronic format and shall be accessible to non-specialist audiences, to enable scrutiny of mitigation activities.
	Third-party validation and verification	Have programme-level requirements for robust independent third-party validation and verification of mitigation activities.
Emission impact	Additionality	Emission reductions or removals would not have occurred in the absence of the incentive created by carbon credit revenues.
	Permanence	Reductions or removals from the mitigation activity shall be permanent or, where there is a risk of reversal, there shall be measures in place to address those risks and compensate reversals.
	GHG quantification	Emission reductions or removals from the mitigation activity shall be robustly quantified, based on conservative approaches, completeness and scientific methods.
	No double counting	Mitigation activity shall not be double counted; they shall only be counted once towards achieving mitigation targets or goals.
Sustainable development	SDG benefits and safeguards	Programme shall have clear guidance, tools and compliance procedures to ensure mitigation activities conform with or go beyond widely established industry best practices on social and environmental safeguards while delivering positive sustainable development impacts.
	Contribution towards net zero	Avoid locking-in levels of GHG emissions, technologies or carbon-intensive practices that are incompatible with the objective of achieving net zero GHG emissions by mid-century.

Source: IC-VCM. (2023). Section 2: Core carbon principles. In The Core Carbon Principles. https://icvcm.org/wp-content/uploads/2023/03/CCP-Section-2-FINAL-27Mar23.pdf

6.2. Annex B – Emerging guidance on responsible use of Nature-based Solutions

Publication	Focus	Role of NbS	Key elements for responsible use of NbS
The Oxford Principles for Net-Zero Aligned Carbon Offsetting	Outlines how offsetting needs to be approached	Discusses the sensitivities and benefits of NbS	Defines criteria for high integrity and quality offsetting
The Nature-based Solutions Initiative (University of Oxford)	Promotes understanding of the potential of NbS	Informs responsible use of NbS	Maps current and future in-country opportunities for NbS
New Climate Institute *Corporate Climate Responsibility Monitor*[164]	Assesses transparency and integrity of companies' net zero and emission reduction targets	Assesses use for climate contributions (no neutralisation claim) and in offsetting claims	Defines criteria for transparent, constructive, and robust corporate climate strategies, which include four focus areas: (a) tracking and disclosure of emissions; (b) setting specific and credible targets; (c) reducing own emissions; (d) climate contributions and offsetting
Voluntary Carbon Markets Integrity Initiative *Provisional Claims Code of Practice*[165]	Aims to operationalise a suite of claims that ensure that companies do not use carbon credits to substitute science-aligned emission reductions in their value chains	Not mentioned specifically	Helps identify prerequisites, claims to make high-quality credits and transparent reporting criteria
IC-VCM *CCP*[166]	Provides threshold standards for high-quality carbon credits	Not mentioned specifically	Informs responsible use of NbS
Gold Standard Claims Guidelines[167]	Provides guidelines to assist project developers, fund managers, partners, supporters, purchasers and claimants of certificates/ credits and investors in communicating accurately and appropriately about the certification status of projects and funds as well as climate and development impacts derived from Gold Standard-certified projects, programmes and funds	Not mentioned specifically	Specifies claims guidance for buyers, funds and project developer

WRI Working paper: *Consideration of Nature-Based Solutions as Offsets in Corporate Climate Change Mitigation Strategies*[168]	Describes the opportunities and risks associated with using NbS as offsets, focusing on the environmental and social integrity of demand-side purchases and supply-side emissions reductions and removals	Informs responsible use of NbS	Outlines actions that companies can take now to ensure integrity when investing in NbS
WRI Working paper: *Guidance on Responsible Use of NbS Credits through 2040*[169]	Provides guardrails for supply- and demand-side integrity on use of NbS	Informs responsible use of NbS	Defines overarching principles and criteria for responsible use of NbS
SBTi BVCM *FAQ*[170]	Provides guidance for BVCM	Describes options for using NbS in BVCM	Defines beyond the value chain approaches to mitigation, offsets and climate contributions
WWF–Boston Consulting Group *Climate Blueprint*[171]	Lays out actions that can underpin a truly effective corporate strategy for mitigating the effects of climate change and protecting nature	Informs responsible use of NbS	Defines criteria for responsible investment in NbS

Endnotes

1 Science Based Targets initiative (SBTi). (2023). *Science Based Targets initiative public consultation on beyond value chain mitigation (BVCM)* (Version 1.0). https://sciencebasedtargets.org/resources/files/SBTi-Public-Consultation-on-Beyond-Value-Chain-Mitigation.pdf

2 SBTi. (2023). *SBTi corporate net-zero standard criteria* (Version 1.1). https://sciencebasedtargets.org/resources/files/Net-Zero-Standard-Criteria.pdf

3 SBTi. (2021). *Beyond value chain mitigation FAQ* (Version 1.0). https://sciencebasedtargets.org/resources/files/Beyond-Value-Chain-Mitigation-FAQ.pdf

4 SBTi. (2023). *Science Based Targets Initiative public consultation on beyond value chain mitigation (BVCM)* (Version 1.0). https://sciencebasedtargets.org/resources/files/SBTi-Public-Consultation-on-Beyond-Value-Chain-Mitigation.pdf

5 SBTi. (2023). *SBTi corporate net-zero standard criteria* (Version 1.1). https://sciencebasedtargets.org/resources/files/Net-Zero-Standard-Criteria.pdf

6 Matthews, J. B. R. [Ed.]. (2018). Annex I: Glossary. In IPCC, *Special report: Global warming of 1.5°C*. https://ipcc.ch/sr15/

7 United Nations Framework Convention on Climate Change (UNFCCC). (2021). *Race to Zero Lexicon*. https://racetozero.unfccc.int/wp-content/uploads/2021/04/Race-to-Zero-Lexicon.pdf

8 SBTi. (2023). *SBTi corporate net-zero standard criteria* (Version 1.1). https://sciencebasedtargets.org/resources/files/Net-Zero-Standard-Criteria.pdf

9 UNFCCC. (2021). *Race to Zero Lexicon*. https://racetozero.unfccc.int/wp-content/uploads/2021/04/Race-to-Zero-Lexicon.pdf

10 Dyck, M., Streck C., & Trouwloon, D. (2021). *The Voluntary Carbon Market Explained.* Climate and Land Use Alliance. https://vcmprimer.org

11 UNFCCC. (2021). *Climate Neutral Now: Guidelines for Participation.* https://unfccc.int/sites/default/files/resource/CNN%20Guidelines.pdf

12 World Resources Institute. (n.d.). *Carbon Removal.* World Resources Institute. https://www.wri.org/initiatives/carbon-removal

13 United Nations Environment Programme (UNEP). (2022). *Resolution adopted by the United Nations Environment Assembly on 2 March 2022. 5/5. Nature-based solutions for supporting sustainable development*. https://wedocs.unep.org/handle/20.500.11822/39864

14 The Nature Conservancy. (n.d.). *Natural climate solutions.* https://www.nature.org/en-us/what-we-do/our-insights/perspectives/natural-climate-solutions/

15 International Union for Conservation of Nature (IUCN). (2022). *Towards an IUCN nature-positive approach: A working paper. Summary highlights*. https://www.iucn.org/sites/default/files/2022-10/nature-positive-summary-highlights-oct-2022.pdf

16 SBTi. (2023). *SBTi corporate net-zero standard criteria* (Version 1.1). https://sciencebasedtargets.org/resources/files/Net-Zero-Standard-Criteria.pdf

17 Intergovernmental Panel on Climate Change (IPCC). (2002). Annex B: Glossary of terms. In *Synthesis report of the Third Assessment Report.* https://archive.ipcc.ch/pdf/glossary/tar-ipcc-terms-en.pdf

18 SBTi. (2023). *Science Based Targets Initiative public consultation on beyond value chain mitigation (BVCM)* (Version 1.0). https://sciencebasedtargets.org/resources/files/SBTi-Public-Consultation-on-Beyond-Value-Chain-Mitigation.pdf

19 SBTi. (2023). *Science Based Targets Initiative public consultation on beyond value chain mitigation (BVCM)* (Version 1.0). https://sciencebasedtargets.org/resources/files/SBTi-Public-Consultation-on-Beyond-Value-Chain-Mitigation.pdf

20 Dyck, M., Streck C., & Trouwloon, D. (2021). *The Voluntary Carbon Market Explained.* Climate and Land Use Alliance. https://vcmprimer.org

21 Dyck, M., Streck C., & Trouwloon, D. (2021). *The Voluntary Carbon Market Explained.* Climate and Land Use Alliance. https://vcmprimer.org

22 Andersen, I., Ishii, N., Brooks, T., Cummis, C., Fonseca, G., Hillers, A., ... Zimm, C. (2021). Defining 'science-based targets'. *National Science Review, 8*(7). https://doi.org/10.1093/nsr/nwaa186

23 SBTi. (2023). *SBTi corporate net-zero standard criteria* (Version 1.1). https://sciencebasedtargets.org/resources/files/Net-Zero-Standard-Criteria.pdf

24 Science Based Targets Network (SBTN). (2023). *SBTN glossary of terms.* https://sciencebasedtargetsnetwork.org/wp-content/uploads/2023/05/SBTN-Steps-1-3-Glossary_2023.docx-1.pdf

25 Greenhouse Gas Protocol. (2022). *Greenhouse Gas Protocol Land Sector and Removals Initiative: Project overview*. https://ghgprotocol.org/sites/default/files/standards_supporting/LSR_Overview.pdf

26 IPCC. (2023). *Synthesis report of the Sixth Assessment Report*. https://ipcc.ch/ar6-syr/

27 World Economic Forum. (2022). *The global risks report 2022.* https://www.weforum.org/reports/global-risks-report-2022/

28 Pulgar-Vidal, M. (2022, July 15). Applying the lessons of climate change to halting biodiversity loss. *Crossroads Blog*. https://www.iucn.org/crossroads-blog/202207/applying-lessons-climate-change-halting-biodiversity-loss

29 Pulgar-Vidal, M. (2022, July 15). Applying the lessons of climate change to halting biodiversity loss. *Crossroads Blog*. https://www.iucn.org/crossroads-blog/202207/applying-lessons-climate-change-halting-biodiversity-loss

30 United Nations. (n.d.). *Biodiversity: Our strongest natural defense against climate change.* United Nations Climate Action. https://www.un.org/en/climatechange/science/climate-issues/biodiversity

31 Song, S., Ding, Y., Li, W., Meng, Y. Zhou, J., Gou, R., ... Lin, G. (2023). Mangrove reforestation provides greater blue carbon benefit than afforestation for mitigating global climate change. *Nature Communications, 14*(1), 756. https://doi.org/10.1038/s41467-023-36477-1

32 Carugati, L., Gatto, B., Rastelli, E., Lo Martire, M., Coral, C., Greco, S., & Danovaro, R. (2018). Impact of mangrove forests degradation on biodiversity and ecosystem functioning. *Scientific Reports*, *8*(1), 13298. https://doi.org/10.1038/s41598-018-31683-0

33 UNFCCC. (2016). *Paris Agreement*. https://unfccc.int/files/meetings/paris_nov_2015/application/pdf/paris_agreement_english_.pdf

34 Naran, B., Connolly, J., Rosane, P., Wignarajah, D., Wakaba, E., & Buchner, B. (2022). *Global landscape of climate finance: A decade of data 2011–2020.* Climate Policy Initiative. https://www.climatepolicyinitiative.org/wp-content/uploads/2022/10/Global-Landscape-of-Climate-Finance-A-Decade-of-Data.pdf

35 Naran, B., Connolly, J., Rosane, P., Wignarajah, D., Wakaba, E., & Buchner, B. (2022). *Global landscape of climate finance: A decade of data 2011–2020.* Climate Policy Initiative. https://www.climatepolicyinitiative.org/wp-content/uploads/2022/10/Global-Landscape-of-Climate-Finance-A-Decade-of-Data.pdf

36 Aminetzah, D., Claes, J., De Vit, C., Erben, I., Hopman, D., Jayaram, K., ... Yang, D. (2022). *Nature in the balance: What companies can do to restore natural capital*. McKinsey & Company. https://mckinsey.com/capabilities/sustainability/our-insights/nature-in-the-balance-what-companies-can-do-to-restore-natural-capital

37 Costanza, R., De Groot, R., Sutton P., Van Der Ploeg, S., Anderson, S. J., ... Turner, R. K. (2014). Changes in the global value of ecosystem services. *Global Environmental Change, 26*, 152–158. https ://doi.org/10.1016/j.gloenvcha.2014.04.002

38 Cohen-Shacham, E., Andrade, A., Dalton, J., Dudley, N., Jones, M., Kumar, C., ... Walters, G. (2019). Core principles for successfully implementing and upscaling Nature-based Solutions. *Environmental Science & Policy 98*, 20–29. https://doi.org/10.1016/j.envsci.2019.04.014

39 McKinsey Global Institute. (2022). *The net-zero transition: What it would cost, what it could bring*. McKinsey & Company. https://www.mckinsey.com/capabilities/sustainability/our-insights/the-net-zero-transition-what-it-would-cost-what-it-could-bring

40 Soto-Navarro, C., Ravilious, C., Arnell, A., de Lamo, X., Harfoot, M., Hill, S. L. L., Wearn, O. R., Santoro, M., Bouvet, A., Mermoz, S., Le Toan, T., Xia, J., Liu, S., Yuan, W., Spawn, S. A., Gibbs, H. K., Ferrier, S., Harwood, T., Alkemade, R., ... Kapos, V. (2020). Mapping co-benefits for carbon storage and biodiversity to inform conservation policy and action. *Philosophical Transactions of the Royal Society B: Biological Sciences, 375*(1794), 20190128. https://doi.org/10.1098/rstb.2019.0128

41 United Nations Environment Programme (UNEP). (2022). *Resolution adopted by the United Nations Environment Assembly on 2 March 2022. 5/5. Nature-based solutions for supporting sustainable development*. https://wedocs.unep.org/handle/20.500.11822/39864

42 Cohen-Shacham, E., Walters, G., Janzen, C., & Maginnis, S. (Eds.). (2016). *Nature-based Solutions to address global societal challenges.* IUCN. http://doi.org/10.2305/IUCN.CH.2016.13.en

43 IUCN. (n.d.). *Nature-based solutions. IUCN Website.* https ://www.iucn.org/our-work/nature-based-solutions

44 Cohen-Shacham, E., Andrade, A., Dalton, J., Dudley, N., Jones, M., Kumar, C., ... Walters, G. (2019). Core principles for successfully implementing and upscaling Nature-based Solutions. *Environmental Science & Policy 98*, 20-29. https://doi.org/10.1016/j.envsci.2019.04.014

45 Watson, J. E. M., Evans, T., Venter, O., Williams, B., Tulloch, A., Stewart, C., Thompson, I., Ray, J. C., Murray, K., Salazar, A., McAlpine, C., Potapov, P., Walston, J., Robinson, J. G., Painter, M., Wilkie, D., Filardi, C., Laurance, W. F., Houghton, R. A., ... Lindenmayer, D. (2018). The exceptional value of intact forest ecosystems. *Nature Ecology & Evolution 2*(4), 599–610. https://doi.org/10.1038/s41559-018-0490-x

46 Hobbie, S.E., & Grimm, N. B. (2020). Nature-based approaches to managing climate change impacts in cities. *Philosophical Transactions of the Royal Society B: Biological Sciences 375*(1794), 20190124. https://doi.org/10.1098/rstb.2019.0124

47 Mbaabu, P. R., Olago, D., Gichaba, M., Eckert, S., Eschen R., Oriaso, S., ... Schaffner, U. (2020). Restoration of degraded grasslands, but not invasion by *Prosopis juliflora*, avoids trade-offs between climate change mitigation and other ecosystem services. *Scientific Reports 10*(1), 20391. https://doi.org/10.1038/s41598-020-77126-7

48 Rice, R. A. (2008). Agricultural intensification within agroforestry: The case of coffee and wood products. *Agriculture, Ecosystems & Environment 128*(4), 212–218. https://doi.org/10.1016/j.agee.2008.06.007

49 Cohen-Shacham, E., Andrade, A., Dalton, J., Dudley, N., Jones, M., Kumar, C., ... Walters, G. (2019). Core principles for successfully implementing and upscaling Nature-based Solutions. *Environmental Science & Policy* 98, 20–29. https://doi.org/10.1016/j.envsci.2019.04.014

50 IUCN. (2020). *Guidance for using the IUCN Global Standard for Nature-based Solutions: A user-friendly framework for the verification, design and scaling up of Nature-based Solutions* (1st ed.). https://doi.org/10.2305/IUCN.CH.2020.09.en

51 IUCN. (2020). *Guidance for using the IUCN Global Standard for Nature-based Solutions: A user-friendly framework for the verification, design and scaling up of Nature-based Solutions* (1st ed.). https://doi.org/10.2305/IUCN.CH.2020.09.en

52 IUCN. (2020). *Guidance for using the IUCN Global Standard for Nature-based Solutions: A user-friendly framework for the verification, design and scaling up of Nature-based Solutions* (1st ed.). https://doi.org/10.2305/IUCN.CH.2020.09.en

53 IUCN. (2020). *Guidance for using the IUCN Global Standard for Nature-based Solutions: A user-friendly framework for the verification, design and scaling up of Nature-based Solutions* (1st ed.). https://doi.org/10.2305/IUCN.CH.2020.09.en

54 IUCN. (2020). *Guidance for using the IUCN Global Standard for Nature-based Solutions: A user-friendly framework for the verification, design and scaling up of Nature-based Solutions* (1st ed.). https://doi.org/10.2305/IUCN.CH.2020.09.en

55 IUCN. (2020). *Guidance for using the IUCN Global Standard for Nature-based Solutions: A user-friendly framework for the verification, design and scaling up of Nature-based Solutions* (1st ed.). https://doi.org/10.2305/IUCN.CH.2020.09.en

56 Forgues, K. (2022) A comparison of carbon offsets between four reforestation designs in a community context [Doctoral thesis] McGill University. https://escholarship.mcgill.ca/concern/theses/v405sh09c

57 Forgues, K. (2022) A comparison of carbon offsets between four reforestation designs in a community context [Doctoral thesis] McGill University. https://escholarship.mcgill.ca/concern/theses/v405sh09c

58 Portugal Del Pino, D., & Marquez, J. (2023). Complementary ideas for the implementation of nature-based solutions. *Environmental Science and Policy 141*, 146–157. https://doi.org/10.1016/j.envsci.2023.01.008

59 Pörtner, H. O., Scholes, R. J., Agard, J., Archer, E., Arneth, A., Bai, X., Barnes, D., Burrows, M., Chan, L., Cheung, W. L., Diamond, S., Donatti, C., Duarte, C., Eisenhauer, N., Foden, W., Gasalla, M. A., Handa, C., Hickler, T., Hoegh-Guldberg, O., … Ngo, H. T. (2021). *IPBES-IPCC co-sponsored workshop report on biodiversity and climate change*. IPBES and IPCC. https://doi.org/10.5281/zenodo.4782538

60 de Coninck, H., Revi, A., Babiker, M., Bertoldi, P., Buckeridge, M., Cartwright, A., … Sugiyama, T. (2018). Strengthening and implementing the global response. In IPCC, *Special report: Global warming of 1.5°C*. https://ipcc.ch/sr15/

61 UNEP & IUCN. (2021). *Nature-based Solutions for climate change mitigation*. https://unep.org/resources/report/nature-based-solutions-climate-change-mitigation

62 These estimates assume sufficient safeguards for meeting human needs for food or fibre (i.e. no reduction of cropland area), assuming that grazing lands in forested ecoregions can be reforested and excluding conversion of native non-forest ecosystems, among others.

63 De Coninck, H., Revi, A., Babiker, M., Bertoldi, P., Buckeridge, M., Cartwright, A., … Sugiyama, T. (2018). Strengthening and implementing the global response. In IPCC, *Special report: Global warming of 1.5°C*. https://ipcc.ch/sr15/

64 IPCC. (2023). *Synthesis report of the Sixth Assessment Report*. https://ipcc.ch/ar6-syr/

65 Roe, S., Streck, C., Obersteiner, M., Frank, S., Griscom, B., Drouet, L., … Lawrence, D. (2019). Contribution of the land sector to a 1.5°C world. *Nature Climate Change, 9*(11), 817–828. https://doi.org/10.1038/s41558-019-0591-9

66 IPBES. (2019). *The global assessment report on biodiversity and ecosystem services: Summary for policymakers*. https://www.ipbes.net/sites/default/files/inline/files/ipbes_global_assessment_report_summary_for_policymakers.pdf

67 UNEP & IUCN. (2021). *Nature-based Solutions for climate change mitigation*. https://unep.org/resources/report/nature-based-solutions-climate-change-mitigation

68 Pörtner, H. O., Scholes, R. J., Agard, J., Archer, E., Arneth, A., Bai, X., Barnes, D., Burrows, M., Chan, L., Cheung, W. L., Diamond, S., Donatti, C., Duarte, C., Eisenhauer, N., Foden, W., Gasalla, M. A., Handa, C., Hickler, T., Hoegh-Guldberg, O., … Ngo, H. T. (2021). *IPBES-IPCC co-sponsored workshop report on biodiversity and climate change*. IPBES and IPCC. https://doi.org/10.5281/zenodo.4782538

69 IPCC. (2022). *Climate change 2022: Impacts, adaptation and vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. https://ipcc.ch/report/ar6/wg2/

70 World Economic Forum & McKinsey & Company. (2021). *Nature and net zero*. https://weforum.org/reports/nature-and-net-zero

71 Girardin, C. A. J., Jenkins, S., Seddon, N., Allen, M., Lewis, S. L., Wheeler, C. E., … Malhi, Y. (2021). Natural climate solutions. *Proceedings of the National Academy of Sciences 114*(44), 11645–11650. https://doi.org/10.1073/pnas.1710465114

72 Girardin, C. A. J., Jenkins, S., Seddon, N., Allen, M., Lewis, S. L., Wheeler, C. E., Griscom, B. W., & Malhi, Y. (2021). Nature-based solutions can help cool the planet – if we act now. *Nature, 593*(7858), 191–194. https://doi.org/10.1038/d41586-021-01241-2

73 Seddon, N., Smith, A., Smith, P., Key, I., Chausson, A., Girardin, C., H., … Turner, B. (2021). Getting the message right on nature-based solutions to climate change. *Global Change Biology*, *27*(8), 1518–1546. https://doi.org/10.1111/gcb.15513

74 Girardin, C. A. J., Jenkins, S., Seddon, N., Allen, M., Lewis, S. L., Wheeler, C. E., … Malhi, Y. (2021). Nature-based solutions can help cool the planet – if we act now. *Nature 593*(7858), 191–194. https://doi.org/10.1038/d41586-021-01241-2

75 Seddon, N., Smith, A., Smith, P., Key, I., Chausson, A., Girardin, C., H.,… Turner, B. (2021). Getting the message right on nature-based solutions to climate change. *Global Change Biology, 27*(8), 1518–1546. https://doi.org/10.1111/gcb.15513

76 SBTi. (2022). *Forest, land and agriculture science based target-setting guidance*. https://sciencebasedtargets.org/resources/files/SBTiFLAGGuidance.pdf

77 *Nature-based Insights (n.d.). Nature-based Insetting*. https://naturebasedinsetting.com/nature-based-insetting/

78 Cohen-Shacham, E., Andrade, A., Dalton, J., Dudley, N., Jones, M., Kumar, C., … Walters, G. (2019). Core principles for successfully implementing and upscaling Nature-based Solutions. *Environmental Science & Policy* 98, 20–29. https://doi.org/10.1016/j.envsci.2019.04.014

79 Integrity Council for the Voluntary Carbon Market. (n.d.). *The Core Carbon Principles plus the Program-Level Assessment Framework and Assessment Procedure*. https://icvcm.org/the-core-carbon-principles/

80 The Carbon Credit Quality Initiative. (n.d.). *The Carbon Credit Quality Initiative: Transparent scores for carbon credit quality*. https://carboncreditquality.org

81 Voluntary Carbon Markets Integrity Initiative (VCMI). *Provisional claims code of practice*. https://vcmintegrity.org/wp-content/uploads/2022/06/VCMI-Provisional-Claims-Code-of-Practice.pdf

82 Burns, D., Langer, P., Seymour, F., Taylor, R., Czebiniak, R., Hanson, C., & Ranganathan, J. (2022). *Guidance on Voluntary Use of Nature-based Solution Carbon Credits Through 2040*. World Resources Institute Technical Perspective. https://www.wri.org/technical-perspectives/guidance-voluntary-use-nature-based-solution-carbon-credits-through-2040

83 #TogetherWithNature. (n.d.). *We Stand #TogetherWithNature*. https://www.togetherwithnature.com

84 UNFCCC. (n.d.). Race To Zero Campaign. *United Nations Climate Change*. https://unfccc.int/climate-action/race-to-zero-campaign

85 Climate Champions. (2021). Race to Resilience. *UN Climate Change High-Level Champions*. https://climatechampions.unfccc.int/race-to-resilience-launches/

86 UNFCCC. (2023). *Message to Parties and Observers: UNFCCC Secretariat Recognition and Accountability Framework for non-Party stakeholder climate action*. https://unfccc.int/documents/629136

87 United Nations. (2022). *Integrity matters: Net zero commitments by businesses, financial institutions, cities and regions. Report from the United Nations' High-Level Expert Group on the Net Zero Emissions Commitments of Non-State Entities*. United Nations. https://www.un.org/sites/un2.un.org/files/high-levelexpertgroupupdate7.pdf

88 IUCN. (2020). *Guidance for using the IUCN Global Standard for Nature-based Solutions: A user-friendly framework for the verification, design and scaling up of Nature-based Solutions* (1st ed.). https://doi.org/10.2305/IUCN.CH.2020.09.en

89 New Climate Institute. (2022). *Corporate climate responsibility monitor 2022: Assessing the transparency and integrity of companies' emission reduction and net-zero targets*. https://newclimate.org/sites/default/files/2022-06/CorporateClimateResponsibilityMonitor2022.pdf

90 IHE Delft Institute for Water Education. (2023). *Reducing risks caused by extreme weather with nature-based solutions*. https://www.un-ihe.org/reducing-risks-caused-extreme-weather-nature-based-solutions

91 PWC. (2022). *Time to get serious about the realities of climate risk*. https://www.pwc.com/gx/en/issues/reinventing-the-future/take-on-tomorrow/download/SBpwc_2022-05-16-Climate-r2.pdf

92 Deloitte. (n.d.). *TNFD and nature-related financial disclosures: The new framework for ESG risks*. https://www2.deloitte.com/lt/en/pages/consulting/topics/TNFD-and-nature-related-financial-disclosures.html

93 Taskforce on Nature-related Financial Disclosures (TNFD). *Recommendations of the Taskforce on Nature-related Financial Disclosures*. https://tnfd.global/wp-content/uploads/2023/08/Recommendations_of_the_Taskforce_on_Nature-related_Financial_Disclosures_September_2023.pdf?v=1695118661

94 TNFD. (n.d.). *About us*. https://tnfd.global/about/

95 Convention on Biological Diversity. (2023). *Kunming-Montreal Global Biodiversity Framework*. https://www.cbd.int/gbf/

96 Martinez, L., & Frank, A. (2023, February 8). *What companies need to know about the new 'Paris Agreement for Nature'*. Penguin Perspectives Blog. https://www.southpole.com/blog/what-companies-need-to-know-about-the-new-paris-agreement-for-nature

97 Greenhouse gas (GHG) Protocol. (n.d.). *Greenhouse Gas Protocol*. https://ghgprotocol.org/

98 The GHG Protocol's Scope 3 Standard identifies 15 distinct reporting categories for scope 3 emission sources and requires companies to quantify and report scope 3 emissions from each category. Companies must disclose data or provide an explanation for all 15 categories.

99 Finlay, H., Sengupta, S., Rosa da Conceicao, H., & McBreen, J. (2021). *Disclosing nature's potential: corporate responses and the need for greater ambition*. CDP and IUCN. https://portals.iucn.org/library/node/49834

100 The SBTi is a collaboration between CDP, the United Nations Global Compact, World Resources Institute and WWF.

101 CDP. (2020). *Foundations for science-based net-zero target setting in the corporate sector* (Version 1.0). SBTi. https://sciencebasedtargets.org/resources/files/foundations-for-net-zero-full-paper.pdf

102 SBTi. (2023). *SBTi corporate net zero standard* (Version 1.1). https://sciencebasedtargets.org/resources/files/Net-Zero-Standard.pdf

103 Hausfather, Z. (2021, 10 August). Analysis: What the new IPCC report says about when world may pass 1.5C and 2C. Carbon Brief. https://www.carbonbrief.org/analysis-what-the-new-ipcc-report-says-about-when-world-may-pass-1-5c-and-2c/

104 SBTi. (2021). *Pathways to net-zero: SBTi technical summary*. https://sciencebasedtargets.org/resources/files/Pathway-to-Net-Zero.pdf

105 SBTi. (2023). *SBTi corporate net-zero standard* (Version 1.1). https://sciencebasedtargets.org/resources/files/Net-Zero-Standard.pdf

106 SBTi (n.d.). *Forest, land and agriculture (FLAG)*. Science Based Targets. https://sciencebasedtargets.org/sectors/forest-land-and-agriculture

107 SBTi notes that land-intensive activities are likely to be relevant in the GHG inventories of companies from the following sectors: retailing; containers and packaging; hotels, restaurants, leisure and tourism services; textiles manufacturing, spinning, weaving and apparel; textiles, apparel, footwear and luxury goods; consumer durables; household and personal products; tyres; building products; home building; and construction materials. Other sectors may also be relevant for FLAG targets, including construction and maintenance, infrastructure development, mining, road building and resource extraction.

108 SBTN. (2023). *Science based targets for land* (Version 1.0, draft for public consultation). https://sciencebasedtargetsnetwork.org/wp-content/uploads/2023/02/SBTN-Land-Guidance-Draft-for-Public-Consultation.pdf

109 The Food and Agriculture Organization of the United Nations (FAO) & UNEP. (2020). *The State of the World's Forests 2020: Forests, biodiversity and people*. https://doi.org/10.4060/ca8642en

110 FAO (2020). *Land use in agriculture by the numbers*. https://www.fao.org/sustainability/news/detail/en/c/1274219/

111 Ritchie, H., & Roser, M. (2019). *Land use*. Our World in Data. https://ourworldindata.org/land-use

112 IPCC. (2019). *Special report: Climate change and land*. https://ipcc.ch/srccl/

113 Accountability Framework Initiative (n.d.). *Report progress*. Accountability Framework Initiative. https://accountability-framework.org/use-the-accountability-framework/for-companies/report-progress/

114 The *GHG Protocol Land Sector and Removals Guidance* defines biogenic carbon derived from living organisms or biological processes, but not fossilised materials or from fossil sources. It also defines biogenic sinks, primarily photosynthesis, that remove CO_2 from the atmosphere.

115 GHG Protocol. (2022). *Land sector and removals guidance part 1: Accounting and reporting requirements and guidance – draft for pilot testing and review*. https://ghgprotocol.org/sites/default/files/2022-12/Land-Sector-and-Removals-Guidance-Pilot-Testing-and-Review-Draft-Part-1.pdf

116 SBTi. (2022). *Forest, land and agriculture science based target setting guidance*. https://sciencebasedtargets.org/resources/files/SBTiFLAGGuidance.pdf

117 The FLAG sector includes forest and paper products, food production (agricultural, animal), food and beverage processing, food and staples retailing and tobacco. The guidance also extends to companies in any other SBTi sector that have FLAG-related emissions that total more than 20% of overall emissions across scopes 1–3. *See* SBTi. (2023). *Forest, Land and Agriculture (FLAG) Project FAQs* (Version 4.0). https://sciencebasedtargets.org/resources/files/FLAG-FAQ.pdf

118 SBTi. (2022). *Forest, land and agriculture science based target setting guidance*. https://sciencebasedtargets.org/resources/files/SBTiFLAGGuidance.pdf

119 SBTi provides two approaches to FLAG target setting to enable companies to calculate GHG reduction targets in line with the Paris Agreement: the FLAG sector approach for companies with diversified FLAG emissions, and the FLAG commodity approach that includes 10 commodity pathways (beef, chicken, dairy, corn/maize, palm oil, pork, rice, soy, wheat, and timber and wood fibre).

120 SBTi defines a FLAG company as company with land-intensive activities in their value chain from the following FLAG-designated sectors: forest and paper products – forestry, timber, pulp and paper, rubber; food production – agricultural production; food production – animal source; food and beverage processing; food and staples retailing; and tobacco; or companies in any other SBTi-designated sector that have (a) more than 20% of revenues coming from forests, land or agriculture; or (b) companies with FLAG-related emissions that total more than 20% of overall emissions across scopes 1, 2 and 3.

121 Stevenson, M., Anderson, C., & Bicalho, T. (2022, September 12). *Carbon removals in forest, land and agriculture (FLAG) pathways*. Science Based Targets. https://sciencebasedtargets.org/blog/carbon-removals-in-forest-land-and-agriculture-flag-pathways

122 Nature-based Insights. (n.d.). *Insetting vs offsetting*. https://naturebasedinsetting.com/insetting-vs-offsetting/

123 Nature-based Insights. (n.d.). *Nature-based insetting*. https://naturebasedinsetting.com/nature-based-insetting/

124 Nature-based Insights. (n.d.). *Insetting vs offsetting*. https://naturebasedinsetting.com/insetting-vs-offsetting/

125 Stevenson, M., Anderson, C., & Bicalho, T. (2022, September 12). Carbon removals in forest, land and agriculture (FLAG) pathways. *Science Based Targets*. https://sciencebasedtargets.org/blog/carbon-removals-in-forest-land-and-agriculture-flag-pathways

126 GHG Protocol. (2022). *Land sector and removals guidance part 1: Accounting and reporting requirements and guidance—draft for pilot testing and review*. https://ghgprotocol.org/sites/default/files/2022-12/Land-Sector-and-Removals-Guidance-Pilot-Testing-and-Review-Draft-Part-1.pdf

127 Allen, M. R., Friedlingstein, P., Girardin, C. A., Jenkins, S., Malhi, Y., Mitchell-Larson, E., ... Rajamani, L. (2022). Net zero: Science, origins, and implications. *Annual Review of Environment and Resources*, *47*, 849–887. https://doi.org/10.1146/annurev-environ-112320-105050

128 University of Oxford. (2020). *The Oxford Principles for Net Zero Aligned Carbon Offsetting*. https://www.smithschool.ox.ac.uk/sites/default/files/2022-01/Oxford-Offsetting-Principles-2020.pdf

129 New Climate Institute. (2023). *Corporate climate responsibility monitor 2023: Assessing the transparency and integrity of companies' emission reduction and net-zero targets*. https://newclimate.org/sites/default/files/2023-04/NewClimate_CorporateClimateResponsibilityMonitor2023_Feb23.pdf

130 CDP. (2020). *Foundations for science-based net-zero target setting in the corporate sector* (Version 1.0). SBTi. https://sciencebasedtargets.org/resources/files/foundations-for-net-zero-full-paper.pdf

131 New Climate Institute. (2022). *Corporate climate responsibility monitor 2022: Assessing the transparency and integrity of companies' emission reduction and net-zero targets*. https://newclimate.org/sites/default/files/2022-06/CorporateClimateResponsibilityMonitor2022.pdf

132 Noon, M. L., Goldstein, A., Ledezma, J. C., Roehrdanz, P. R., Cook-Patton, S. C., Spawn-Lee, S. A., ... Turner, W. R. (2022). Mapping the irrecoverable carbon in Earth's ecosystems. *Nature Sustainability*, 5, 37–46. https://doi.org/10.1038/s41893-021-00803-6

133 Chaplin-Kramer, R., Neugarten, R., Sharp, R., Collins, P. M., Polasky, S., Hole, D., ... Watson, R. A., (2022). Mapping the planet's critical natural assets. *Nature Ecology and Evolution*, 7(1):1–11 http://dx.doi.org/10.1038/s41559-022-01934-5

134 SBTi. (2023). *Science Based Targets Initiative public consultation on beyond value chain mitigation (BVCM)* (Version 1.0). https://sciencebasedtargets.org/resources/files/SBTi-Public-Consultation-on-Beyond-Value-Chain-Mitigation.pdf

135 Allen, M. R., Friedlingstein, P., Girardin, C. A. J., Jenkins, S., Malhi, Y., Mitchell-Larson, E., ... Rajamani, L. (2022). Net zero: Science, origins, and implications. *Annual Review of Environment and Resources 2022, 47*(1), 849–887. https://doi.org/10.1146/annurev-environ-112320-105050

136 WWF & Boston Consulting Group (BCG). (2020). *Beyond science-based targets: A blueprint for corporate action on climate and nature*. https://wwfint.awsassets.panda.org/downloads/beyond_science_based_targets___a_blueprint_for_corporate_action_on_climate_and_nature.pdf

137 Watson, E., & Czebiniak, R. P. (2022, September 13). *Net-zero: Urgent beyond value chain mitigation is essential.* Science Based Targets. https://sciencebasedtargets.org/blog/net-zero-urgent-beyond-value-chain-mitigation-is-essential

138 WWF & BCG. (2020). *Beyond science-based targets: A blueprint for corporate action on climate and nature*. https://wwfint.awsassets.panda.org/downloads/beyond_science_based_targets___a_blueprint_for_corporate_action_on_climate_and_nature.pdf

139 Roe, S., Streck, C., Obersteiner, M., Frank, S., Griscom, B., Drouet, L., ... Lawrence, D. (2019). Contribution of the land sector to a 1.5°C world. *Nature Climate Change, 9*(11), 817–828. https://doi.org/10.1038/s41558-019-0591-9

140 SBTi. (2023). *Science Based Targets Initiative public consultation on beyond value chain mitigation (BVCM)* (Version 1.0). https://sciencebasedtargets.org/resources/files/SBTi-Public-Consultation-on-Beyond-Value-Chain-Mitigation.pdf

141 SBTN. (n.d.). *Get ready to set science-based targets for nature.* https://sciencebasedtargetsnetwork.org/how-it-works/get-ready/

142 Assuming these activities are not achieved through monoculture planting.

143 Assuming these activities are not achieved through monoculture planting.

144 Landholm, D., Bravo, F., Palmegiani, I., Streck, C., Martinez de la Hoz, G., König, ... Mikolajczyk, S. (2022). *Unlocking nature-based solutions through carbon markets in the USA: Technical report*. Climate Focus. https://climatefocus.com/wp-content/uploads/2022/12/Unlocking-Nature-based-Solutions-USA-Technical-Report.pdf

145 Burns, D., Langer, P., Seymour, F., Taylor, R., Czebiniak, R., Hanson, C., & Ranganathan, J. (2022). *Guidance on voluntary use of nature-based solution carbon credits through 2040.* World Resources Institute Technical Perspective. https://www.wri.org/technical-perspectives/guidance-voluntary-use-nature-based-solution-carbon-credits-through-2040

146 Field, C. B., & Mach, K. J. (2017). Rightsizing carbon dioxide removal. *Science, 356*(6339), 706–707. https://doi.org/10.1126/science.aam9726

147 Seymour, F., & Langer, P. (2021). *Consideration of Nature-Based Solutions as Offsets in Corporate Climate Change Mitigation Strategies.* World Resources Institute. https://doi.org/10.46830/wriwp.20.00043

148 United Nations. (2022). *Integrity matters: Net zero commitments by businesses, financial institutions, cities and regions. Report from the United Nations' High-Level Expert Group on the Net Zero Emissions Commitments of Non-State Entities.* https://www.un.org/sites/un2.un.org/files/high-levelexpertgroupupdate7.pdf

149 Natural Climate Solutions Alliance. (2022) *A Buyer's Guide to Natural Climate Solutions Carbon Credits.* World Business Council for Sustainable Development. https://www.wbcsd.org/Programs/Climate-and-Energy/Climate/Natural-Climate-Solutions/The-Natural-Climate-Solutions-Alliance/Resources/A-Buyer-s-Guide-to-Natural-Climate-Solutions-Carbon-Credits

150 These definitions are obtained from the WWF Position and Guidance on Voluntary Purchase of Carbon Credits and mirror similar principles such as the International Carbon Reduction and Offset Alliance Code of Best Practice and the International Civil Aviation Organization's Carbon Offsetting and Reduction Scheme for International Aviation Emissions Unit Eligibility Criteria.

151 Burns, D., Langer, P., Seymour, F., Taylor, R., Czebiniak, R., Hanson, C., & Ranganathan, J. (2022). *Guidance on Voluntary Use of Nature-based Solution Carbon Credits Through 2040. World Resources Institute Technical Perspective.* World Resources Institute Technical Perspective. https://www.wri.org/technical-perspectives/guidance-voluntary-use-nature-based-solution-carbon-credits-through-2040

152 UNEP & IUCN. (2021). *Nature-based Solutions for climate change mitigation*. https://unep.org/resources/report/nature-based-solutions-climate-change-mitigation

153 Burns, D., Langer, P., Seymour, F., Taylor, R., Czebiniak, R., Hanson, C., & Ranganathan, J. (2022). *Guidance on Voluntary Use of Nature-based Solution Carbon Credits Through 2040.* World Resources Institute Technical Perspective. https://www.wri.org/technical-perspectives/guidance-voluntary-use-nature-based-solution-carbon-credits-through-2040

154 Nature-Based Solutions Initiative. (n.d.). *Nature-Based Solutions Initiative*. https://www.naturebasedsolutionsinitiative.org

155 UNFCCC. (2016). *Paris Agreement*. https://unfccc.int/files/meetings/paris_nov_2015/application/pdf/paris_agreement_english_.pdf

156 Granziera, B., Hamrick, K. and Verdieck, J. (2023). *Article 6 Explainer. Questions and Answers about the COP27 Decisions on Carbon Markets and what they mean for NDCs, Nature, and the Voluntary Carbon Markets.* https://www.nature.org/content/dam/tnc/nature/en/documents/TNC_Article_6_Explainer_260523.pdf

157 Hamrick, K., & Myers, K. (2023). *Offsets as ordered: Buyer due diligence to ensure carbon credit quality*. The Nature Conservancy. https://www.nature.org/content/dam/tnc/nature/en/documents/Offsets_as_Ordered_Buyer_Due_Diligence_to_Ensure_Credit_Quality.pdf

158 Mohanty, N. (2022, August 10). *A ban on exporting carbon credits and its impact on the domestic carbon market.* Ecosystem Marketplace. https://www.ecosystemmarketplace.com/articles/a-ban-on-exporting-carbon-credits-and-its-impact-on-the-domestic-carbon-market/

159 Donald, R. (2022, April 4). *PNG suspends new carbon deals, scrambles to write rules for the schemes.* Mongabay. https://news.mongabay.com/2022/04/png-suspends-new-carbon-deals-scrambles-to-write-rules-for-the-schemes/

160 Coalition for Rainforest Nations. (2022, June 21). *Honduras Imposes Moratorium on Voluntary Credits.* Country News. https://www.rainforestcoalition.org/country-news/honduras-imposes-moratorium-on-voluntary-credits/

161 Cross, S. (2022, May 31). *Comment: Carbon markets – how to stop worrying and COPe with change.* Carbon Pulse. https://carbon-pulse.com/161198/

162 Cross, S. (2022, May 31). *Comment: Carbon markets – how to stop worrying and COPe with change.* Carbon Pulse. https://carbon-pulse.com/161198/

163 Wawrzynowicz, I., Krey, and M., Samaniego, X. (2023). *Assessing and comparing carbon credit rating agencies, Report.* Perspectives Climate Group. https://carbonmarketwatch.org/publications/assessing-and-comparing-carbon-credit-rating-agencies/

164 New Climate Institute. (2022). *Corporate climate responsibility monitor 2022: Assessing the transparency and integrity of companies' emission reduction and net-zero targets.* https://newclimate.org/sites/default/files/2022-06/CorporateClimateResponsibilityMonitor2022.pdf

165 VCMI. (2022). *Provisional claims code of practice*. https://vcmintegrity.org/wp-content/uploads/2022/06/VCMI-Provisional-Claims-Code-of-Practice.pdf

166 Integrity Council for the Voluntary Carbon Market. (n.d.). *The Core Carbon Principles plus the Program-Level Assessment Framework and Assessment Procedure.* https://icvcm.org/the-core-carbon-principles/

167 Gold Standard. (2017). *Gold Standard for the Global Goals – claims guidelines.* https://www.goldstandard.org/sites/default/files/documents/claims_guidance_v6.pdf

168 Seymour, F., & Langer, P. (2021). Consideration of Nature-Based Solutions as Offsets in Corporate Climate Change Mitigation Strategies. World Resources Institute. https://doi.org/10.46830/wriwp.20.00043

169 Burns, D., Langer, P., Seymour, F., Taylor, R., Czebiniak, R., Hanson, C., ... Ranganathan, J. (2022). *Guidance on Voluntary Use of Nature-based Solution Carbon Credits Through 2040.* World Resources Institute Technical Perspective. https://www.wri.org/technical-perspectives/guidance-voluntary-use-nature-based-solution-carbon-credits-through-2040

170 SBTi. (2021). *Beyond value chain mitigation FAQ* (Version 1.0). https://sciencebasedtargets.org/resources/files/Beyond-Value-Chain-Mitigation-FAQ.pdf

171 WWF & BCG. (2020). *Beyond Science-Based Targets: A blueprint for corporate action on climate and nature*. https://wwfint.awsassets.panda.org/downloads/beyond_science_based_targets___a_blueprint_for_corporate_action_on_climate_and_nature.pdf

INTERNATIONAL UNION
FOR CONSERVATION OF NATURE

WORLD HEADQUARTERS
Rue Mauverney 28
1196 Gland
Switzerland
Tel +41 22 999 0000
Fax +41 22 999 0002
www.iucn.org
www.iucn.org/resources/publications