PBAF
Partnership for Biodiversity Accounting Financials

Biodiversity Footprinting Standard: Financed Impact

Assessment of financed biodiversity impact through model-based biodiversity footprinting

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Partnership for Biodiversity Accounting Financials

The Partnership for Biodiversity Accounting Financials (PBAF) is an industry-led initiative enabling financial institutions to measure and disclose the financed biodiversity impact of loans and investments.

Biodiversity Footprinting Standard: Financed Impact

Assessment of financed biodiversity impact through model-based biodiversity footprinting

Through the Biodiversity Footprinting Standard: Financed Impact (hereafter 'the Biodiversity Footprinting Standard' or 'the Standard'), we share the results of discussions between PBAF partners (financial institutions), data providers and other experts on biodiversity impact and dependency assessment.

We encourage financial institutions to adopt biodiversity impact assessment and the assessment of dependencies on ecosystem services as a positive step towards a nature inclusive way of operating. We encourage methodology developers, data providers and financial institutions to align approaches, meeting the PBAF requirements and recommendations presented.

PBAF is an independent foundation based in the Netherlands and is supported and co-funded by PBAF partners, PBAF supporters, and the Ministry of Agriculture, Fisheries, Food Security and Nature of the Netherlands. An overview of PBAF partners and supporters is available on the PBAF website.

We welcome financial institutions to join the PBAF initiative. For more information, visit the PBAF website (www.pbafglobal.com) or contact us (info@pbafglobal.com).

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About this document

Through their investments, financial institutions can play an important role in the conservation and sustainable use of biodiversity, contributing not only to the Kunming–Montreal Global Biodiversity Framework (GBF)[1], but also to the reduction of investment risks and identification of investment opportunities. For financial institutions to take up their role, the availability of science based, reliable data on the (positive and negative) impacts on biodiversity is an important precondition.

It is against this background that the Partnership for Biodiversity Accounting Financials (PBAF), initiated in 2019, develops the 'PBAF Standard'. The PBAF Standard contributes to the quality, mainstreaming and harmonisation of biodiversity impact and dependency assessment in the financial sector.

>> *The focus of this PBAF Standard is on model-based Biodiversity Footprinting.*

Using the Standard equips financial institutions with a harmonized approach to:

- Assess biodiversity–related impacts in line with the Taskforce on Nature–related Financial Disclosures (TNFD).
- Work with harmonized and standardized impact data that is science based, robust, consistent, transparent and fit for purpose.
- Develop science–based targets (SBTs) using the guidance developed by the Science Based Targets Network (SBTN).
- Report to stakeholders like the Carbon Disclosure Project (CDP).
- Inform nature strategies and actions to support the transition towards a nature positive future.

In the development of the Standard, PBAF aligns and cooperates with other key initiatives including, but not limited to, the Partnership Carbon Accounting Financials (PCAF), the Taskforce on Nature Related Financial Disclosures (TNFD), the Science Based Targets Network (SBTN), the Finance for Biodiversity Foundation, and the European Align project.

PBAF would like to thank all initiatives and experts in the finance and biodiversity and impact assessment space for the constructive cooperation leading up to the Biodiversity Footprinting Standard v2024.

Value of a model–based biodiversity footprint

A biodiversity footprint can provide valuable insights into the potential impact of loans and investments and the impact drivers responsible for this impact. On the level of a portfolio, but also on the level of a company or project. The result can be used to zoom in on potential impact hotspots, to inform biodiversity policies and to engage with investees. However, a biodiversity footprint should also be handled with care. Understanding how methodological choices and data used may affect a quantified model–based biodiversity footprint is key to enable a correct interpretation of footprint results and ask the right questions to, for example, data providers and companies.

1 https://www.cbd.int/gbf

In practice, a biodiversity footprint will often be combined with other impact assessment approaches, like a screening of loans and investments using geospatial biodiversity data or on the ground measurement of changes in state.

Guidance, requirements and recommendations

The four main steps in a 'biodiversity footprint' are (1) Understand the investment, (2) Analysis of the impact drivers/pressures of economic activities, (3) Analysis of the impact on biodiversity, and (4) Interpretation of the footprint result. For each step, the Standard provides updated guidance on methodological choices and data quality issues and formulates footprinting requirements and recommendations.

Updated descriptions are provided of footprinting approaches for different asset classes, including Sovereign debt, Sub-sovereign debt and Supranational debt, Listed Equity and Corporate Bonds, Business loans and Unlisted Equity, Project finance, Mortgages, Commercial Real Estate, Investments in renewable energy, Motor vehicle loans and Indirect investments. This information can be used by tool developers, data providers and financial institutions to decide on the footprinting approach for a specific asset class. The approaches for different asset classes are aligned with the approaches in the PCAF Standard as much as possible (e.g., definitions of asset classes, attribution rules).

MOST NOTABLE CHANGES COMPARED TO THE PBAF STANDARD V2022

- **Explanation of the scope of the Biodiversity Footprinting Standard: model-based biodiversity footprinting (section 2.1).**
- **A more detailed definition of the different Scopes in a biodiversity footprint (section 3.2)**
- **Additional information regarding the potential importance of Scope 3 downstream impacts (section 3.2)**
- **Basic concepts regarding a biodiversity footprint, previously only referenced in the Footprinting standard, have now been included in the standard to prevent going from one document to another.**
- **Updated explanation of baseline, reference state and cut-off date (section 4.3).**
- **For Sovereign debt, the 'government spending approach' is replaced with a 'PPP adjusted GDP approach' to align with the update in the PCAF standard (section 7).**
- **Sub-sovereign debt and Supranational debt have been added to the asset class 'Sovereign debt, Sub-sovereign debt and Supranational debt' (section 7). However, the approaches for sub-sovereign debt and supranational debt have not been fully included yet, awaiting a PCAF update of this asset class.**
- **'Business loans and Unlisted equity' and 'Commercial Real Estate' have been added as asset classes, in line with the PCAF Standard (section 7).**
- **An update of references to related initiatives and projects such as the TNFD, SBTN and Align (throughout the document).**

Guidance on 'Positive impact' in 2025

The topic of 'positive impact' is an important topic for model-based biodiversity footprinting: How is positive impact or 'nature positive' defined, how is positive impact calculated, what are the requirements and recommendations for claiming positive impact and how should impact assessment results be reported? Several international initiatives, including the 'Nature Positive Initiative', are currently working on definitions and approaches for corporates and financial institutions to contribute to nature positive. To enable alignment of the Biodiversity Footprinting Standard with the results of these initiatives and following PBAF Sounding Board recommendations, PBAF has decided not to included guidance on positive impact in this 2024 update yet. PBAF aims to publish guidance, requirements and recommendations on positive impact and model-based biodiversity footprinting in 2025.

1 Introduction

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1.1 The Partnership for Biodiversity Accounting Financials

Background

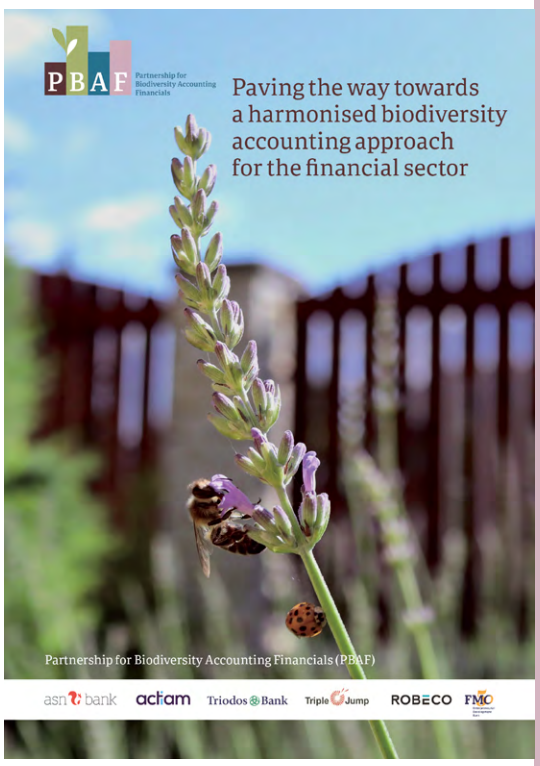
There is growing awareness among financial institutions that impacts and dependencies on biodiversity are highly relevant, both from a risk and an opportunity perspective. All economic activities have impact and depend on biodiversity, sometimes directly and always indirectly through their value chains. The services they depend on are increasingly at risk because of biodiversity loss. This loss presents financial institutions with increased risk, but also opportunities.

Through their investments, financial institutions can play an important role in reversing the loss of biodiversity and restoring ecosystems, contributing to the 2030 targets of the Convention on Biological Diversity (CBD)[2] as laid down in the Kunming–Montreal Global Biodiversity Framework[3], thereby also contributing to a reduction of the growing financial risk resulting from the physical, transition and systemic risks following the loss of biodiversity.

The key role of the financial sector is not only acknowledged by the sector itself but also emphasized by nature organisations and governments. Interaction with and between these actors is key to ensure that biodiversity related government policies, advocacy, field research and investment policies and procedures reinforce each other, creating synergies.

For financial institutions to take up their role, the availability of science–based, reliable data on the impacts on biodiversity is an important precondition.

The Partnership for Biodiversity Accounting Financials (PBAF) was initiated in 2019 by founding partners ASN Bank (part of de Volksbank), ACTIAM (now Cardano), FMO, Robeco, Triodos Bank, and Triple Jump. Discussions by this group, building on previous work, including work by the Partnership for Carbon Accounting Financials (PCAF), resulted in the 2020 publication 'Paving the way towards a harmonised biodiversity accounting approach for the financial sector'.[4] This publication was the first step towards a 'PBAF Standard'.



In the following three years the partnership has grown at a steady pace, accelerating in the run–up to, and following the biodiversity summit in Montreal, Canada, when 11 financial institutions joined the partnership, including pension funds and banks from Ireland, Iceland, South Korea, Denmark and Canada. In March 2023, PBAF welcomed its 50th PBAF signatory. As of September 2024, PBAF totals 71 partners and supporters from 20 countries.

2 **Convention on Biological Diversity**, Signed by 150 government leaders at the 1992 Rio Earth Summit, the Convention on Biological Diversity is dedicated to promoting sustainable development.
3 Convened under UN auspices, chaired by China, and hosted by Canada, the 15th Conference of Parties to the UN Convention on Biological Diversity adopted the **"Kunming–Montreal Global Biodiversity Framework" (GBF)**, including four goals and 23 targets for achievement by 2030.
4 PBAF, 'Paving the way towards a harmonised biodiversity accounting approach for the financial sector', 2020.

Scope of PBAF

PBAF focuses on all types of financial institutions, both private and public. The word 'Accounting' in PBAF refers to the fact that financial institutions should take into account (understand, manage, be accountable) their impact and dependencies on biodiversity and ecosystem services. PBAF supports financial institutions in the assessment of impacts and dependencies by providing guidance and the development of the PBAF Standard. This publication focusses on impact measurement through biodiversity footprinting. For the assessment of dependencies, the PBAF Standard v2023 – Assessment of Dependencies on ecosystem services[5] is available.

PBAF partners and supporters

In 2021, PBAF turned from a project into an independent foundation. As of September 2024 2023, the partnership has 71 partners and supporters from nineteen countries, with almost $15 trillion assets under management. PBAF partners share and discuss practical experiences, challenges, and solutions in PBAF Working groups, jointly deciding on topics that should be addressed in the PBAF Standard and co-developing the Standard's content.

PBAF Sounding Board

A PBAF Sounding Board with experts in the field of biodiversity impact and dependency assessment has been established to provide feedback on the draft guidance, requirements and recommendations included in the PBAF Standard. This feedback is taken into account to the extent possible in the PBAF Standard published. Feedback which cannot yet be taken into account feeds into the discussions in the PBAF Working groups. Outcomes of these working groups are taken up in future revisions of the PBAF Standard.

NB: All feedback by PBAF Sounding Board members is carefully considered, but not all feedback is integrated in the PBAF Standard. This also means that the PBAF Standard not necessarily reflect the opinion of the Sounding Board members.

1.2 PBAF Publications

PBAF publications include the PBAF Standard and guidance documents which can be freely downloaded from the PBAF website (pbafglobal.com):

PBAF Standard

- *Biodiversity Footprinting Standard: Financed Impact (2024, this document)*
  This document is an update of and replaces the PBAF Standard v2022– Biodiversity impact assessment – Footprinting.

- *PBAF Standard v2023 –Assessment of Dependencies on ecosystem services*
  This part of the PBAF Standard provides guidance on the steps in a dependency assessment and also includes PBAF requirements and recommendations.
  Target group: financial institutions planning to conduct a dependencies assessment & data providers offering dependency data to financial institutions.

The PBAF Standard is periodically updated to reflect the latest developments and insights in the area of impact and dependency assessment.

5 PBAF, Taking Biodiversity into account, PBAF Standard v2023 – Assessment of Dependencies on ecosystem services, June 2023.

PBAF guidance Biodiversity impact assessment

Besides the PBAF Standard with requirements and recommendations, PBAF also publishes guidance on impact and dependency assessment:

- *PBAF Q&A Introduction to Impacts on Ecosystem services and their monetary value (2024)*
  An introduction to the assessment of impacts on ecosystem services and the monetary value of ecosystem services in ten questions and answers.
  Target group: Financial institutions, with an emphasis on impact investors and project finance where location data is available.

- *Impact on Ecosystem Services – A Return on Investment; Assessing impacts on ecosystem services and the value of these services in the financial sector (2024)*
  A more in depth discussion of the assessment of impacts on ecosystem services, the monetary value of ecosystem services and the use of this information by financial institutions.
  Target group: Financial institutions, with an emphasis on impact investors and project finance where location data is available.

- *PBAF Q&A on biodiversity impact assessment (2022)*
  An introduction to biodiversity impact assessment for financial institutions in sixteen questions and answers.
  Target group: Financial institutions & impact investors that are just starting to orientate themselves on biodiversity impact assessment.

- *PBAF Standard v2022 – Biodiversity impact assessment – Overview of approaches (2022)*
  Provides an overview of different biodiversity impact assessment approaches that can be used by financial institutions and includes a chapter on 'Positive impact'.
  Target group: Financial institutions & impact investors that have limited knowledge and experience, to more experienced financial institutions & impact investors.

1.3 The Biodiversity Footprinting Standard: Financed Impact

Scope of the Standard

The Biodiversity Footprinting Standard applies to model-based biodiversity footprints on different levels, including portfolio level, asset classes, companies and projects. Since the challenges and opportunities of biodiversity footprinting on these different levels will differ (like the availability of primary and secondary data), the relevance of the guidance presented in this standard may also differ for footprinting on different levels.

The scope of the Standard is on biodiversity footprinting following a 'narrow' definition of a biodiversity footprint, focusing on a model-based, quantified potential impact assessment (see section 2.1). This narrow definition is necessary to be clear about the applicability of the guidance, requirements and recommendations included in the Standard.

Establishing a baseline: PBAF Requirements and Recommendations

To increase the chances that a model-based biodiversity footprint will result in the information financial institutions can use to manage their impacts on biodiversity, PBAF provides guidance on how footprinting works, *definitions* of important footprinting concepts (aligning with definitions by other leading initiatives), but also footprinting *requirements and recommendations* PBAF believes a biodiversity footprint should follow.

The Requirements cover methodological and data-related steps a footprint needs to comply with, indicated with an R + number and the words 'shall', 'needs to' or 'is required'. Recommendations cover methodological and data-related steps a footprint should preferably follow, indicated with an A + number, from Advice, and the word 'should'. In this way, developers of footprinting methodologies and data providers can assess and decide to what extent they can and want to be 'PBAF aligned' or not.

Understanding how methodological choices and data used can affect a quantified biodiversity footprint is key to enable a correct interpretation of footprint results and ask the right questions. In practice, a footprinting methodology may not (yet) be able to fulfil all requirements presented in the standard. If this is the case, this will need to be considered in the interpretation and use of the results, explicitly considering the level of (un)certainty. This is where the guidance comes in, i.e. explanations of the way footprinting works and how footprinting results may be affected by the methodology and data used.

In each footprinting step, methodological choices and data quality issues are discussed and footprinting requirements and recommendations are formulated. Note that this is not an exhaustive overview, but a selection of methodological and data quality issues frequently encountered in practice.

Balancing effectiveness, practicality and the end goal of biodiversity conservation

Many/all assessment approaches currently used do not yet result in a fully accurate picture of impacts and dependencies on biodiversity. The location specific nature of biodiversity is often only included partially, and incomplete data on impact drivers and supply chains constitute important challenges. Limited data and good but imperfect tools help prioritize, but with levels of uncertainty that need to be acknowledged. PBAF aims to balance the need for practical approaches that can be applied right now, with the need for results that help FIs move in the right direction: towards conservation and sustainable use of biodiversity. What is best available practice, knowing that the topic is (even) more challenging than climate change? What guidance is needed for financial institutions to understand the value and limitations of impact assessment methodologies and data currently available? The Biodiversity Footprinting Standard addresses these questions.

Footprinting approach per asset class

In addition to the explanation of the footprinting process and related guidance, requirements and recommendations, descriptions are provided of footprinting for different asset classes. These asset class specific descriptions build on the overarching guidance, requirements and recommendations, are aligned with the approaches for asset classes in the PCAF Standard to the extent possible, and can be used by tool developers, data providers and financial institutions to decide on the footprinting approach for asset classes.

The asset classes covered are:

- Sovereign debt, Sub-sovereign debt and Supranational debt
- Listed Equity and Corporate bonds
- Business loans and Unlisted equity
- Project finance
- Mortgages
- Commercial Real Estate
- Investments in renewable energy
- Motor vehicle loans
- Indirect investments

A living document

The Standard is *a living document*. The Biodiversity Footprinting Standard will be subject to change, building on the output of PBAF working groups, on publications of closely related initiatives, on changes in regulation and on the latest developments in the field of biodiversity impact assessment.

The guidance, definitions, requirements and recommendations presented here present PBAF's current thinking on the topic. Biodiversity footprinting is an evolving field, hence the definitions, requirements and recommendations may change over time as understanding changes and methodologies evolve. Moreover, guidance, definitions, requirements and recommendations may change dependent on context, such as changes in the availability of asset location data and supply chain data.

1.4 Reader

The structure of the document is as follows:

In Chapter 2, more information is provided on a model-based biodiversity footprint: what is it, how does it relate to other footprints and what do the steps in a biodiversity footprint look like?

In Chapters 3 to 6, each step in a model-based biodiversity footprint is briefly explained, key concepts are defined and requirements and recommendations are formulated that will contribute to a minimum level of standardisation of biodiversity footprinting.

Chapter 3: Step 1 Understand the investment
Chapter 4: Step 2 Analysis of impact drivers/pressures
Chapter 5: Step 3 Analysis of the impact on biodiversity
Chapter 6: Step 4 Interpretation of the footprint result

Chapter 6 includes an overview of information on the methodology and data used that needs to be disclosed with the footprinting results. This overview includes the transparency requirements defined in the first 3 steps.

In Chapter 7, footprinting approaches per asset class are presented, explaining the way in which biodiversity impact is assessed for each asset class, including attribution rules and data use.

Chapter 7 is followed by a Glossary of terms frequently used in biodiversity footprinting and a List of references.

Annex 1 includes an overview of the updated PBAF requirements and recommendations.
Annex 2 includes a comparison of the requirements and recommendations compared to the Footprinting Standard v2022.

2 A Biodiversity Footprint

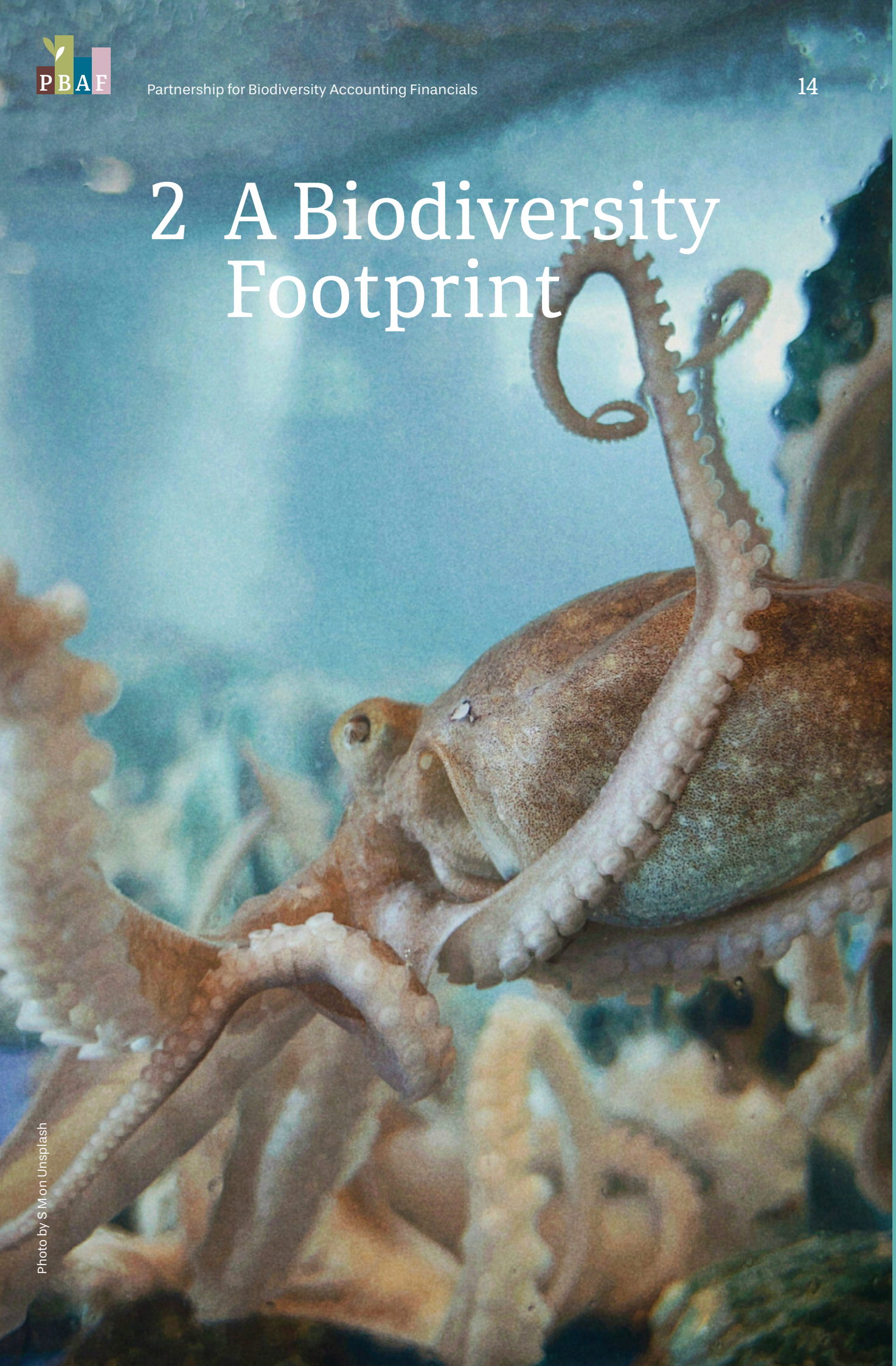


Photo by S M on Unsplash

2.1 What is a biodiversity footprint?

One way to assess the biodiversity impacts of a loan or investment is to conduct a biodiversity footprint. There is, however, not one agreed definition for a 'biodiversity footprint'. The Institute for European Environmental Policy (IIEP) defines a biodiversity footprint as *"The impact of a commodity, company, person or community on global biodiversity, measured in terms of biodiversity change as a result of production and consumption of particular goods and services"*[6]).

This definition of a biodiversity footprint leaves room for a variety of measurement approaches, including the on the ground measurement of changes in state of biodiversity, the use of spatial tools like the Integrated Biodiversity Assessment Tool (IBAT) and the use of LCA or model-based biodiversity footprinting tools.

The Biodiversity Footprinting Standard focuses on model-based biodiversity footprinting approaches, where a potential impact on biodiversity is quantified based on quantified changes in impact drivers/pressures and pressure-impact models.

This focus is in line with the Align project's *'model-based footprinting'* approaches in which: *"models quantify how the magnitude of different pressures affects the state of biodiversity. These are referred to as 'pressure-state' relationships and within corporate footprinting approaches are often based on global data"*.

By default the term 'biodiversity footprint' is used for a 'model-based biodiversity footprint' and 'impact' is used for 'potential impact' in this report.

There is a lot of guidance available on how to calculate a (LCA-based) footprint of products (ISO 14040 and ISO 14044 on life cycle assessment), of products and organisations (Product Environmental Footprint (PEF) and the Organization Environmental Footprint (OEF), and on specific environmental issues such as climate change (Greenhouse gas protocol standards at the product and organization levels), water scarcity (ISO 14046 on water footprinting) and many others. The Biodiversity Footprinting Standard builds on this vast body of knowledge on footprinting.

In the case of a biodiversity footprint for financial institutions, the footprint may focus on the potential impacts of the financial institution itself (e.g. impacts resulting from land use and energy use by a bank's buildings) and on the potential impacts of the economic activities the financial institution invests in, lends to or insures. The latter will generally be much larger. The Standard focuses on *the biodiversity footprint of the loans and investments of a financial institution*.

Basic concepts in a biodiversity footprint

Basic concepts/terminology playing a role in a biodiversity footprint include concepts like Scope, impact driver, driver of nature change, baseline and attribution. These concepts are defined and explained in chapter 3 in the different footprinting steps. A glossary is included at the end of the document. The overview below provides a selection of concepts/terms used and the location in the standard.

6 IEEP, 'Biodiversity footprints in policy and decision-making: Briefing on the state of play, needs and opportunities and future directions', Policy report, Institute for European Environmental Policy, 2021

CONCEPTS / TERMS USED	SECTION
Biodiversity focus of a biodiversity footprint	2.2
Steps in a biodiversity footprint	2.3
Metrics in a biodiversity footprint	2.4
Scopes	3.2
Drivers of nature change and impact drivers/pressures	4.1
Primary/secondary data, ex-ante/ex-post data	4.2
Baseline, reference state and cut-off date	4.3
Pressure-impact models	5.1
Actual impact and potential impact	5.2
Negative, avoided and positive impact	5.3
Net impact	5.4
Spatial and time dimension of impact	5.5
Attribution of impact	5.6
Reporting on methodology and data use	6.3
Impact intensity	6.4

2.2 Biodiversity focus of a biodiversity footprint

Biodiversity is defined in line with the Convention on Biological Diversity (1992), Article 2: *The variability among living organisms from all sources, including, inter alia, terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species, and of ecosystems.*

Biodiversity is valued as the life support system for society and its intrinsic value. There are several reasons why it makes sense to seek to protect all biodiversity (from terrestrial, marine and other aquatic ecosystems) and not just endangered species, charismatic species or species supporting specific ecosystem services:

- Biodiversity, as a whole, supports ecosystem resilience, thereby securing the future of current ecosystem services, and there are many unknown ecosystem services that have yet to be discovered or used.
- Ecological functionality depends on common as well as charismatic or endangered species. It is therefore necessary to assess the changes in the populations of common species to maintain these functions. Focusing only on species extinction risk overlooks rapid declines in the number of individuals of species that are not at risk of extinction.
- The intrinsic value of biodiversity prevents a focus on ecosystem services only.

This leads to the following requirement:

R1: *In case of a quantified biodiversity footprint, the focus shall be on biodiversity as a whole, not on specific species or ecosystems (like endangered ones) only.*

However, it is recognised that a focus on endangered species can be part of other types of biodiversity impact assessment and can be part of investment decisions aiming for a positive impact.

2.3 Steps in a biodiversity footprint

A biodiversity footprint can be conducted at the level of a single loan or investment, but also at the level of an asset class or an investment portfolio. The steps included in the footprint will be similar, but the detail of the input data may differ. For example, in case of a footprint on a portfolio level the feasibility of using primary, company specific data will be more limited than in case of an investment in a single project.

The four main steps of a biodiversity footprint for a loan or investment are as follows:

Step 1: Understand the investment.
Step 2: Analysis of impact drivers/pressures resulting from economic activities.
Step 3: Analysis of the impact on biodiversity.
Step 4: Interpretation of the footprint result and action.

Most of the biodiversity footprinting methodologies developed so far, like the Corporate Biodiversity Footprint (CBF), the Biodiversity Footprint Financial Institutions (BFFI), the Biodiversity Impact Analytics–Global Biodiversity Score (BIA–GBS) / Global Biodiversity Score–Financial Institutions (GBS FI), and the Global Impact Database (GID; Impact Institute) include these or similar steps (see figure 1).

The figure below shows the four steps generally included in a biodiversity footprint and the type of data used in each step.

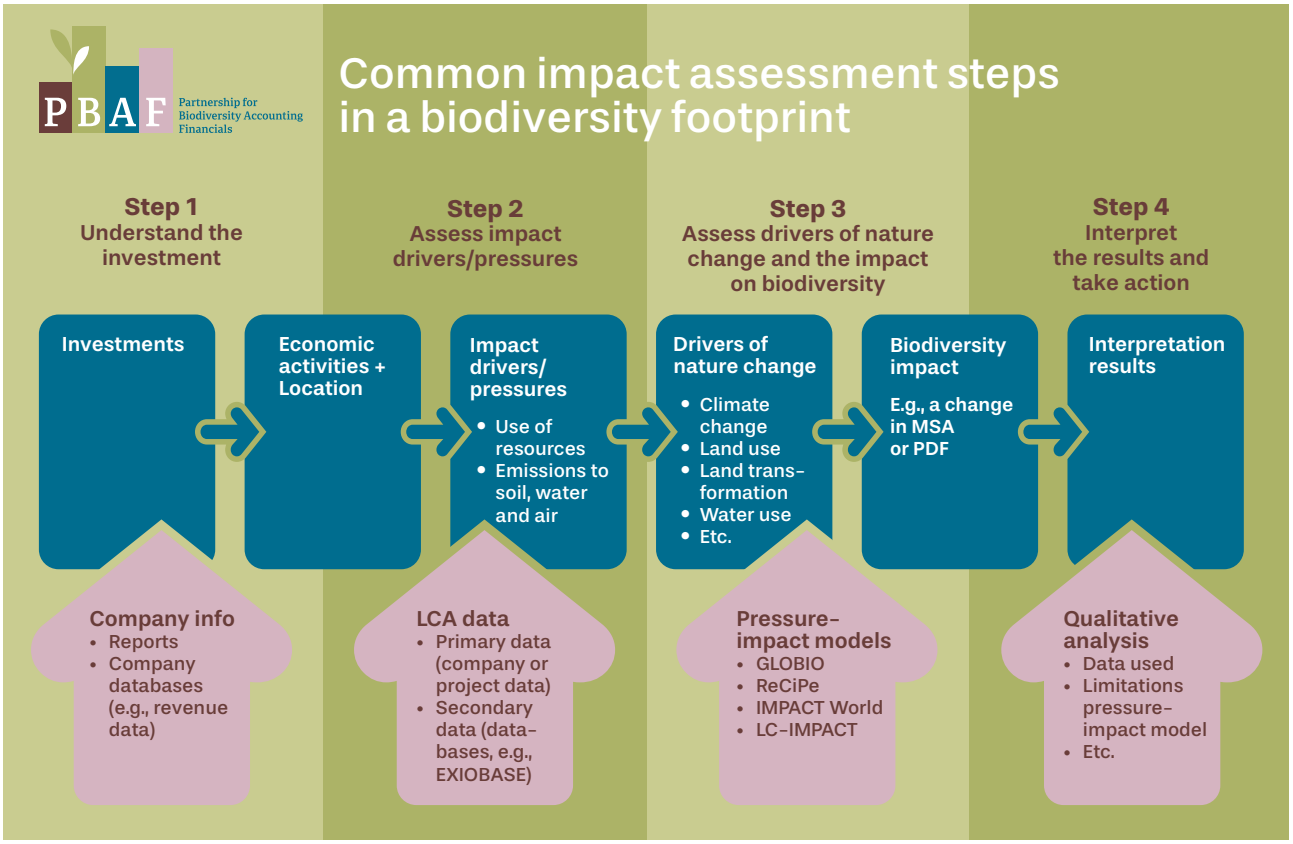


Figure 1: Common impact assessment steps in a biodiversity footprint

Each of the footprinting steps is further explained in the chapters 3–6, including guidance on methodological and data related challenges, requirements, and recommendations.

2.4 Metrics in a biodiversity footprint

To interpret a biodiversity footprint result in the right way, it is important to understand what a biodiversity footprint is trying to measure. In the publication 'Recommendations for a standard on corporate biodiversity measurement and valuation' by the Aligning Accounting Approaches for Nature project ('Align')[7] a description is provided of the different components of biodiversity (Ecosystem, Species and Genes), the different aspects for each component that can be measured (e.g. 'Ecosystem extent' and 'Ecosystem condition' for Ecosystem) and examples of indicators that can be used for each component and aspect.

A biodiversity footprint focuses on the potential impact on ecosystem condition therefore using ecosystem condition metrics. Widely used metrics include the 'Mean Species Abundance' (MSA) metric and the 'Potentially Disappeared Fraction of Species' (PDF) metric. MSA measures the remaining level of biodiversity in an area, ranging from 0 (completely destroyed ecosystem or without any original species) to 1 (all original species are present, and their abundance is unchanged relative to a fully intact or pristine state), whereas PDF measures the potential decline of species richness in an area ranging from 0 (pristine state) to 1 (all species are lost). These ecosystem condition metrics were designed to be applied for any ecosystem or (eco) region. They can be assessed globally based on pressure–impact relationships. Spatial granularity differs per model, per region and per pressure.

The PDF metric is used in the ReCiPe, IMPACT WORLD+, and LCIMPACT pressure–impact models (see also paragraph 3.4). The MSA is used in, for example, the GLOBIO pressure–impact model.

Impacts resulting from a footprint are described using ecosystem condition metrics like MSA or PDF combined with a spatial dimension to factor in the area where the impacts take place (for instance MSA.km^2). A time dimension can also be added to factor in the duration of the impact (for instance PDF.km^2.yr). There are also methodologies which focus on 'stocks' and 'flows' (see section 5.6 on time integration).

Overviews of biodiversity impact assessment metrics can be found in the Align Recommendations, in the 'Guide on biodiversity measurement approaches (2nd edition)' by the Finance for Biodiversity Foundation and the EU Business @ Biodiversity Platform (October 2022) and the 'Assessment of biodiversity measurement approaches for businesses and financial institutions; update report 4' by the EU Business @ Biodiversity Platform (December 2022).

2.5 Advantages of a biodiversity footprint

A biodiversity footprint can be used for different purposes, like gaining insight in biodiversity impact hotspots in an investment portfolio, to identify the main impact drivers in (the supply chains of) a project financed and to compare the biodiversity footprint of a company to the sector average. A biodiversity footprint can be used as a scoping step used to decide where to zoom in for better data and as valuable input to target setting and engagement.

Another advantage of a biodiversity footprint is the fact that the footprint can provide insight into potential trade–offs between policies addressing one or more of the underlying impact drivers. For example, the biodiversity footprint will show if the climate benefits of the use of biomass as an energy source leads to trade–offs with land use and water use. Of course, some limitations have to be considered when analysing those trade–offs, such as the relative

7 UNEP–WCMC, Capitals Coalition, Arcadis, ICF, WCMC Europe (2022) Recommendations for a standard on corporate biodiversity measurement and valuation, Aligning accounting approaches for nature

weightings of drivers of nature change that can differ from one approach to another or the fact cumulative effects of impact drivers are not factored in. In other words, if used carefully, a biodiversity footprint allows a financial institution to make more balanced policy and investment decisions considering several environmental issues.

TNFD and biodiversity footprinting

A biodiversity footprint can also be used as part of a TNFD disclosure, both as an input to the Locate step (impact screening, L2) and to the Evaluate step (identification of sectors, business processes, activities, impact drivers and impacts, E1–E4).

In TNFD's LEAP approach (Locate, Evaluate, Assess, Prepare), reference is made to the use of biodiversity footprinting in 'asset tagging', deepening a heatmap by using data specific to financial or corporate assets to determine the exposure to dependencies and impacts. Asset tagging helps identify individual portfolio companies or corporate assets with high impacts or dependencies on nature, which might be associated with nature-related risks[8]. Compared to a heatmap approach, the asset tagging approach offers the potential (1) to move from the sector level to the physical or financial asset level to provide a more granular and specific understanding of risk; and (2) towards the use of more quantitative data (at the process, product, geography and/or physical asset level), to improve understanding of the magnitude of risk.

Moreover, reference is made to footprinting in TNFD's 'Additional guidance for financial institutions' in relation to additional disclosure metrics[9]:

"Metrics based on footprinting approaches, including ecological (area-based) footprints, biodiversity footprints and ecosystem service footprints. If disclosing footprint metrics, financial institutions should describe the inputs and assumptions in the analysis, and refer to the TNFD discussion paper on biodiversity footprinting approaches for financial institutions for further examples and guidance on the appropriate interpretation and use of these metrics."

It is important to realise that a biodiversity footprint also has certain limitations which will influence the way the results should and should not be used; see section 2.6 and the overview of limitations for each footprinting step in the sections 3–6. By understanding how a biodiversity footprint works and what the value and the limitations of a biodiversity footprint are, financial institutions can decide if, when and how they will use biodiversity footprinting in their biodiversity strategy.

2.6 Limitations of a biodiversity footprint

Conducting a quantified biodiversity footprint has some clear advantages, but also some clear limitations resulting from the methodologies and data used (see also chapters 3–6). A biodiversity footprint results in an assessment of potential impact, based on impact drivers (sometimes referred to as 'pressures', see also section 4.1) and 'pressure–impact models' or 'pressure–response models'. Especially where supply chains are concerned, a footprint needs to rely on secondary (often sector average) data from databases. Location specific ecosystem characteristics can only be taken into account to a limited extent. Better data can be added to make the analysis more specific, but it will never be perfect.

8 TNFD, Guidance on the identification and assessment of nature related issues: The LEAP approach, Version 1.0, September 2023
9 TNFD, Additional guidance for financial institutions, Version 2.0, June 2024

Characteristics of impact assessment approaches
In the 'Recommendations for a standard on corporate biodiversity measurement and valuation' by the Aligning Accounting Approaches for Nature project ('Align')[10], four characteristics are mentioned to consider when selecting an impact assessment methodology:

1. Spatial precision of state measurement
   Refers to whether the resulting measure considers the geographic location of the activity and the biodiversity within the area.
2. Accuracy of measurement
   Refers to how well the measurement reflects changes that are actually occurring 'on the ground'.
3. Responsiveness of measurement to mitigation
   Refers to whether the approach produces a metric that can change over time in response to changes in company management interventions.
4. Feasibility to apply at scale
   Refers to the relative feasibility of applying the approach over A) multiple sites within an organisation or B) across value chains or C) across portfolios of companies.

Based on the definition of footprinting in this Standard (resulting in a modelled potential impact), a biodiversity footprint typically scores:
- low on the accuracy as it estimates state change based on pressures;
- low to high on spatial precision of the changes in impact drivers or pressures, depending on data availability;
- moderate (eco-region level) at best for changes in state, as spatial precision is limited by the spatial precision of the pressure-impact relationships included in the pressure-impact model used;
- low to moderate for responsiveness, depending on the availability of primary (company specific) data;
- high on the feasibility to apply at scale.

Although model-based biodiversity footprinting has its limitations, these footprinting approaches can play an important role in identifying and prioritising pressure indicators at company or investment levels. In a next step, local pressure indicators should be evaluated at ecosystem level for all stakeholders, like water use by all stakeholders in the same landscape. Monitoring of actual changes in biodiversity can be used to evaluate the results of pressure-based strategies and to revise pressure-based targets.

Complementary qualitative analysis
A qualitative assessment shall complement a quantified footprint to address limitations such as drivers of nature change not yet covered by the footprinting methodology or impacts on specific realms (like marine impacts) not yet covered. The complementary use of both assessments enables a better interpretation of the footprinting results.

HANDLE WITH CARE

The limitations to a biodiversity footprint means that financial institutions should carefully consider how footprinting results are used in policy development, decision making and target setting. Combining a biodiversity footprint with other (location explicit) impact assessment approaches is recommended. Moreover, since impacts on biodiversity (and on the ecosystem services and stakeholders affected) are location specific, financial institutions should strive for an improved disclosure of spatially explicit information on all material assets and activities.

10 UNEP-WCMC, Capitals Coalition, Arcadis, ICF, WCMC Europe (2022) Recommendations for a standard on corporate biodiversity measurement and valuation, Aligning accounting approaches for nature

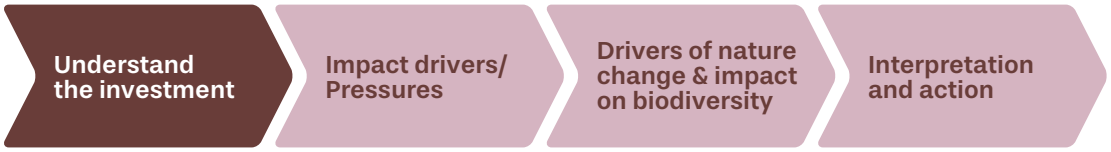
2.7 How does a biodiversity footprint relate to other footprints?

A biodiversity footprint is in some ways similar to carbon or water (LCA/model-based) footprinting. However, contrary to carbon footprinting, there is no broadly accepted metric for a biodiversity footprint yet; there is no equivalent of an Intergovernmental Panel on Climate Change (IPCC) endorsed carbon metric (Global Warming Potential expressed in CO_2-equivalents).

Since the impact on biodiversity is the result of several drivers of nature change, like climate change, land use, water use and pollution, financial institutions that have already gathered data or conducted a footprint for carbon, water or other drivers can and should use this data in the assessment of the impact on biodiversity to ensure consistency.

3 Step 1 Understand the investment

Photo by Yash Savla on Unsplash



>> *In the first step of a biodiversity footprint, loans and investments are linked to the economic activities financed.*

3.1 Investments to be defined in terms of economic activities

Each investment in a business, organization or project needs to be defined in terms of the economic activities linked to the investment and the region, country, or location where these activities take place. The range of activities of products can be small, e.g. in case of an investment in a mining company focussing on a few ore types. The range of activities can also be broader in case of an investment in a company producing or selling a wide range of products or services.

Linking an investment to economic activities can be based on information included in public reports of companies or projects financed, identifying the economic activities and the location where these activities take place. An alternative to this approach is the use of revenue data, specified per sector and country or region, offered by data providers. Combinations of the two approaches are also possible. The use and limitations of such data is described in the 'Data quality' section at the end of the paragraph. The activities of a company can also be modelled based on the production volume in physical units. In case more detailed information about the materials and services used by the company are available, more specific information should be used.

R2: ***Since the link between a loan or investment and economic activities determines what impact drivers (resource use and emissions) will be included in the footprint calculation, transparency about this step is required. If full transparency is not possible due to data related legal restrictions, the step and possible limitations needs to be explained.***

3.2 Scope: covering the entire value chain

An important question when calculating the biodiversity footprint of an investment is to what extent the financial institution takes responsibility for the impacts in the investees'/clients' value chain(s). For example, an investment in a sportswear brand selling sportwear, may be treated as an investment in a retailer when the sportswear brand does not produce the products itself. However, one might also argue that by investing in the brand, the financial institution is indirectly also responsible for the production of the sportswear products and the materials used in these products.

Though one could argue that the decision which Scopes to include in a biodiversity footprint is up to a financial institution, gaining insight in impacts in Scopes 1, 2 and 3 is key from the viewpoint of the conservation and sustainable use of biodiversity and the viewpoint of nature-related financial risks and opportunities. For this reason, inclusion of Scopes 1, 2 and 3 in a biodiversity footprint is currently the accepted approach in the market. This approach is supported by PBAF.

SCOPE 1, 2 AND 3: DIRECT OPERATIONS AND UPSTREAM/DOWNSTREAM VALUE CHAINS

The Biodiversity Footprinting Standard refers to 'Scope 1, Scope 2, Scope 3 upstream and Scope 3 downstream. This terminology is also used in carbon footprinting following the PCAF Standard and the Greenhouse Gas (GHG) Protocol.

Note that TNFD and SBTN refer to 'Direct operations' and 'Upstream and Downstream value chains.

SBTN uses the following definitions[11]:

- **Direct operations: All activities and sites (e.g., buildings, farms, mines, retail stores) over which the enterprise has operational or financial control. This includes majority-owned subsidiaries.**
- **Downstream: All activities that are linked to the sale of products and services produced by the company setting targets. This includes the use and re-use of the product and its end of life, including recovery, recycling, and final disposal.**
- **Upstream: All activities associated with suppliers, e.g., production or cultivation, sourcing of commodities of goods, as well as transportation of commodities to manufacturing facilities.**

The link with Scopes is as follows:

- **Direct operations = Scope 1**
- **Upstream value chains = Scope 2 (energy purchased) and Scope 3 upstream**
- **Downstream value chains = Scope 3 downstream**

R3: *In a biodiversity footprint, the full Scope 1 ('Direct operations'), Scope 2 (energy purchased, part of 'Upstream value chains') and Scope 3 ('Upstream value chains' and 'Downstream value chains') shall be included. Impacts per Scope shall be reported separately.*

The Scopes are defined in line with the Greenhouse Gas Protocol.

Scope 1: Impacts associated with activities over which the business holds ownership or control
In the GHG protocol, Scope 1 activities are categorized in the following way:

- production of goods and services
- company facilities
- company vehicles

Scope 2: Impacts associated with energy use:
In the GHG protocol, Scope 2 is defined as:
GHG emissions from the generation of purchased or acquired electricity, steam, heat, or cooling consumed by the reporting company. Scope 2 includes indirect emissions from generation only; other upstream emissions associated with the production and processing of upstream fuels, or transmission or distribution of energy within a grid, are tracked in scope 3, category 3 (fuel- and energy related emissions not included in scope 1 or scope 2).

Scope 3 upstream: Impacts associated with activities of suppliers:
In the GHG protocol, Scope 3 upstream activities are categorized using the following categories (GHG Protocol category numbers between brackets)[12]:

- purchased goods and services (1)
- capital goods (2)
- fuel and energy-related activities (3)

11 Science Based Targets Network (2023). Technical Guidance: Step 1: Assess.
12 Greenhouse Gas Protocol, Technical Guidance for Calculating Scope 3 Emissions (version 1.0), Supplement to the Corporate Value Chain (Scope 3) Accounting & Reporting Standard, 2013.

- upstream transportation and distribution (4)
- waste generated in operations (5)
- business travel (6)
- employee commuting (7)
- leased assets (8)

Scope 3 downstream: Impacts associated with activities linked to the purchase, use, reuse, recovery, recycling, and final disposal of the business's products and services
In the GHG protocol, Scope 3 downstream activities are categorized using the following categories (GHG Protocol category numbers between brackets):

- downstream transportation and distribution (9)
- processing of sold products (10)
- use of sold products (11)
- end-of-life treatment of sold products (12)
- downstream leased assets (13)
- franchises (14)
- investments (15)

These definitions are most applicable to companies and the link with investment in (un)listed equity, corporate bonds, and business loans is straightforward. For investments in other asset classes, such as government bonds or mortgages, the general definition needs to be adapted to the specific asset class. More guidance can be found in chapter 7, Footprinting approach per asset class.

Inclusion of ***Scope 3 upstream*** is important since the impact on biodiversity is typically highest upstream in the supply chain: raw material production and processing, like agriculture and mining, mainly due to land use intensity and land use changes. Data on the upstream resource use and emissions (often country specific sector averages) is readily available in databases.

Inclusion of ***Scope 3 downstream*** (processing of products sold, use phase and end-of life) can be complex since the processing of products sold, and the use and disposal of products and services can vary widely and cannot always be controlled. However, including Scope 3 downstream impacts is particularly important for sectors like the agrochemical sector. Pesticide use in agriculture is recognized as a major driver of biodiversity loss globally. When an input-output database is used to calculate a biodiversity footprint of chemicals, only the associated extraction of raw materials and their processing are usually considered. Since inclusion of the downstream impacts does lead to a more complete biodiversity footprint it is recommended to also include this Scope to the extent possible.

R4: *Transparency is required regarding the inclusion of the different Scopes and the potential consequences for the footprinting results of not (fully) including one or more of the Scopes.*

Identifying indirect activities (activities in the value chain) can be a challenge, depending on the data made available by investees. When data on value chains is lacking, sourcing countries and locations will not be known. If this is the case, footprinting methodologies may use databases with trade-flow data between sectors and countries to model 'average' value chains (see EXIOBASE textbox).

CASE STUDY: THE BIODIVERSITY FOOTPRINT OF CRUDE OIL USING THE BIODIVERSITY FOOTPRINT FINANCIAL INSTITUTIONS (BFFI)

The following chart shows the biodiversity footprint of the production, use, and end-of-life of 1 ton of crude oil in the Unites States. For this particular case the EXIOBASE database was used to identify the Scope 1, 2 and 3 upstream emissions and resource use. The biodiversity impact was calculated using the pressure-impact model IMPACT WORLD+[13]. In order to include the use and end-of-life phase, the distribution of oil fractions per barrel of oil in a refinery was used to link emissions to the use and end-of-life phase of each fraction. Some of the fractions, like gasoline and aviation fuel are burned, while others, like plastic, are disposed after end-of-life treatment or recycled.

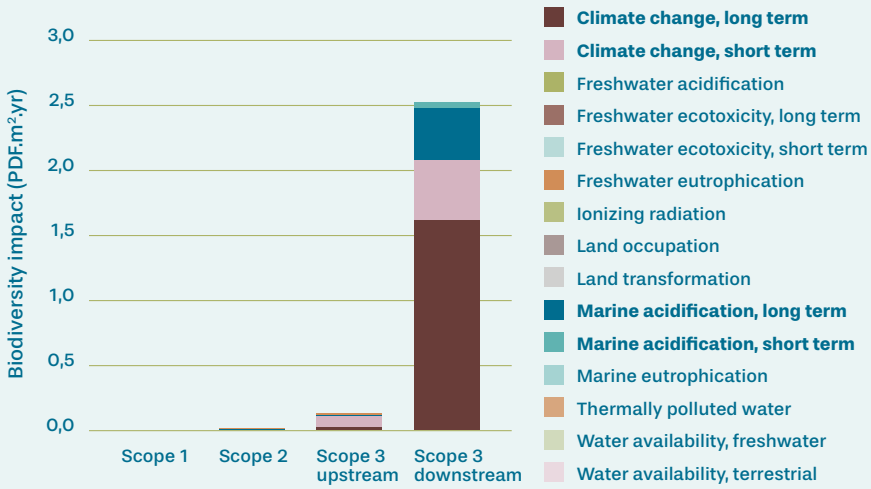


Figure 2: Biodiversity footprint of production, use and end-of-life of 1 ton of crude oil in the US (PRé Sustainability, 2023)

The results show that Scope 3 downstream impacts (use phase and end-of-life) generate most of the impact. Scope 1 accounts for 0.001% of the impact; Scope 2 covers 0,5%; Scope 3 upstream leads to 4.7% of the footprint and the majority of the loss in biodiversity finds its origin in the Scope 3 downstream impacts. This is when the fuel is burned, resulting in greenhouse gas emissions and climate change, but also in the emission of nitrogen and (marine) acidification. Both lead to biodiversity loss and stand out as the most important impact drivers.

Note that the Scope 3 downstream impact of fossil fuel consumption in air travel is a Scope 1 impact for the aviation industry. This means that including Scope 3 downstream impact will lead to double counting of impacts taking place in other sectors. However, by including Scope 3 downstream impacts, the resulting data can be used to hold fossil fuel producers accountable for the (downstream) emissions of their products.

13 Bulle, C., Margni, M., Patouillard, L., Boulay, A., Bourgault, G., De Bruille, V., ... Jolliet, O. (2019). IMPACT World+: a globally regionalized life cycle impact assessment method. The International Journal of Life Cycle Assessment. https://doi.org/10.1007/s11367-019-01583-0

3.3 Data quality and footprint result

To understand what type of economic activities an investee is involved in, a footprint may rely on data from data providers showing in what sectors and what countries a company is generating its revenue. In a next step, this data can be linked to country/sector-specific impact drivers or pressures (see step 2). Such databases with revenue data rely on the data published by companies in annual reports and questionnaires. The level of granularity and accuracy of this revenue data varies and will influence the footprint result. The same issues apply to using databases with production volumes and when data is entered manually for individual cases.

DATA QUALITY ISSUE	HOW CAN THIS AFFECT A FOOTPRINT RESULT?
Division of revenue across countries When a company is reporting on revenue in regions (e.g. 'Europe') rather than countries, this revenue may need to be divided across countries manually in order to enable a link to country/sector-specific environmental input and output data. Different data providers will make different decisions in the way revenue is divided.	A different division of revenue across countries will lead to different environmental inputs and outputs attributed to the company, resulting in a different footprint.
Division of revenue across sectors Reporting of the revenue per sector can take place using different sector classifications, like NACE, ICB, ISIC or GICS[14] codes. Data providers will bring the data together in one sector classification using a crosswalk table (or 'concordance' table), translating one classification into another. Different data providers will use different tables and different classifications, resulting in different divisions of revenue across sectors.	A different division of revenue across sectors will lead to different environmental inputs and outputs attributed to the company, resulting in a different footprint.

The EC has published a crosswalk table linking NACE codes used by the EU Taxonomy to other classifications[15]. SBTN's Materiality Screening Tool (MST) provides a crosswalk table for ISIC-NACE-GICS[16]. TNFD has published a crosswalk table linking GICS ICB, NACE and ISIC[17]. ENCORE has published a crosswalk table for EXIOBASE, NACE and ISIC[18].
Note that the underlying methodology for the creation of these crosswalk tables should be made available to understand how the connections were made.

14 NACE: National Classification of Economic Activities; ICB: Industry Classification Benchmark; ISIC: International Standard Industrial Classification; GICS: Global Industry Classification Standard
15 https://finance.ec.europa.eu/system/files/2022-03/sustainable-finance-taxonomy-nace-alternate-classification-mapping_en.xlsx
16 SBTN (2021),SBTN Sectoral Materiality Tool for Step 1a (version 2 - July 2021) - Overview
17 https://tnfd.global/wp-content/uploads/2023/08/Guidance_for_Financial_Institutions_v1.pdf , Annex 1
18 https://encorenature.org/en/data-and-methodology/methodology

4 Step 2 Analysis of impact drivers/ pressures

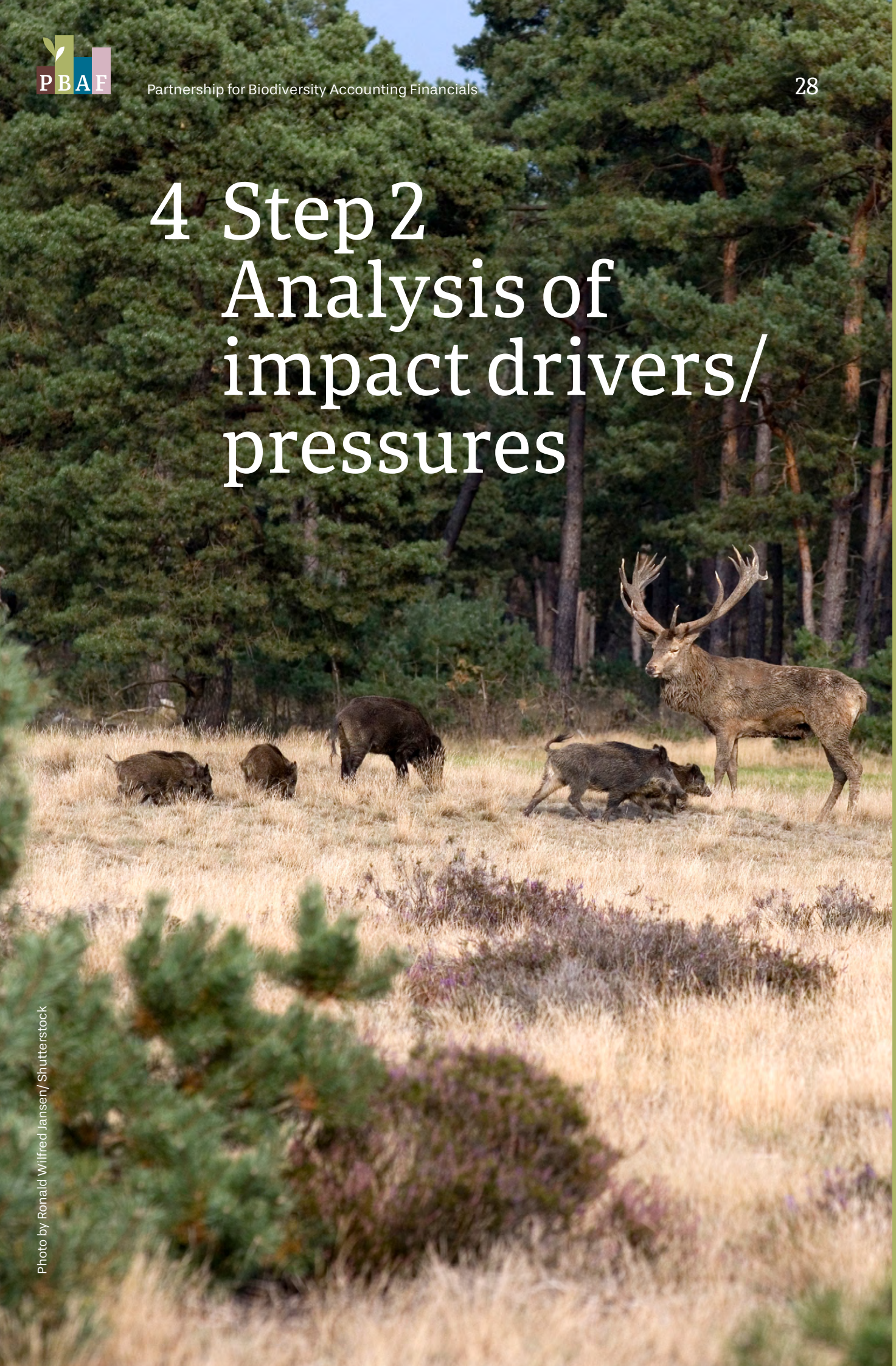


Photo by Ronald Wilfred Jansen/ Shutterstock

>> *In the second step of a biodiversity footprint, the impact drivers or pressures resulting from the economic activities financed are assessed.*

4.1 Drivers of nature change and impact drivers/pressures covered

Impact drivers or pressures of an economic activity (like the use of resources and emissions) will contribute to drivers of nature change, like climate change, which may result in an impact on biodiversity. In order for a biodiversity footprint to be relevant it is key that the most important impact drivers linked to the main drivers of nature change are covered.

According to IPBES the main direct drivers of biodiversity and ecosystem change are (IPBES, 2019)[19]:

- Land- and sea-use change
- Direct exploitation (also referred to as 'Resource extraction' and 'Resource exploitation')
- Climate change
- Pollution
- Invasive alien species

In the TNFD 'Guidance on the identification and assessment of nature related issues: The LEAP approach' (Version 1.0, September 2023), these drivers are adapted as follows:

- Land/ freshwater/ocean use change
- Resource use/replenishment
- Climate change
- Pollution/pollution removal
- Invasive alien species Introduction/removal

These adapted 'drivers of nature change' reflect drivers of both positive and negative impacts on nature.

NB: Terminology varies
TNFD and the Natural Capital Protocol do not speak of 'environmental inputs and outputs', as included in the 2022 version of the Biodiversity Footprinting Standard, but define impact drivers as:
"measurable quantities of a natural resource that are used as an input to production and measurable non-product outputs of a business activity that affects nature".
And:
"Impact drivers are categorised into the five drivers of nature change. Impacts can be positive or negative. A single impact driver may be associated with multiple impacts (changes to the state of nature). For example, greenhouse gas emissions affect multiple ecosystems."

In other words, use of the term 'impact drivers' instead of 'environmental inputs and outputs' and the use of 'drivers of nature change' instead of 'direct drivers of biodiversity and ecosystem change'.

19 Díaz S. et al., IPBES, 'Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services', 2019.

In the SBTN Guidance, 'impact drivers' are called 'pressures', while IPBES refers to 'pressures' as another word for 'direct drivers'.

In order to align as much as possible with other initiatives and frameworks, the Biodiversity Footprinting Standard follows the terminology followed by TNFD, the Natural Capital Protocol and Align:

- **'Impact drivers' or 'Pressures' instead of 'Environmental inputs and outputs'.**
- **'Drivers of nature change' instead of 'Direct drivers'.**

R5: *For the biodiversity footprint to be relevant, the main drivers of nature change shall be covered in the impact assessment / footprint, as well as the most important impact drivers/ pressures linked to these drivers of nature change. Drivers of nature change and related key impact drivers/pressures that cannot be included in the quantitative impact assessment shall be covered by means of a complementary qualitative analysis.*

R6: *A biodiversity footprint shall cover terrestrial, freshwater and marine impacts on biodiversity. Realms that cannot (yet) be fully included in the quantitative impact assessment shall be covered by means of a complementary qualitative analysis.*

The relation between impact drivers/pressures, drivers of nature change, and biodiversity is illustrated in figure 3 for the ReCiPe pressure–impact model.

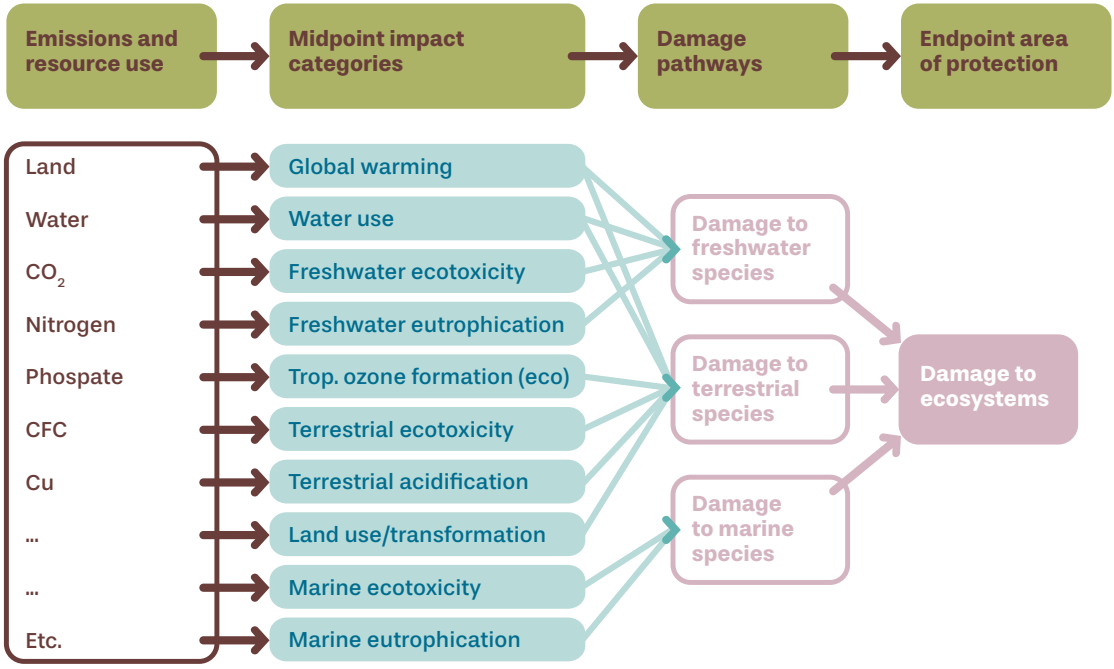


Figure 3: Impact drivers/pressures ('emissions and resource use'), drivers of nature change ('midpoint impact categories') and the impact on biodiversity ('damage to ecosystems') in the ReCiPe model

An overview of drivers of nature change covered by different pressure–impact models is included in paragraph 5.1.

COMPONENTS OF NATURE - TNFD

The TNFD distinguishes land, ocean, freshwater and atmosphere as "major components of the natural world that differ fundamentally in their organisation and function". Atmosphere was added "to reflect the close association between climate- and nature-related risks and opportunities, while also acknowledging that links with climate mitigation and adaptation occur across all realms". According to the TNFD, "The four realms provide an entry point for understanding how organisations and people depend, and have impacts, on nature".[20] In footprinting methods, atmosphere is not added as a separate realm. Impacts of climate change are included within the three realms.

4.2 Use of data

Primary and secondary data

To link economic activities to the drivers of nature change, the resource use and the non-product output (emissions, waste) of these economic activities and related value chains need to be identified. In practice, a footprint will often combine 'primary' data (also referred to as 'foreground' or 'company specific' data) and 'secondary' data (also referred to as 'background' data) from inventory databases.

Primary and secondary data can be defined as follows (SBTN, 2020)[21]:

- *Primary data:*
  Data collected specifically for the assessment being undertaken. For example, collected from site-level assessments on a specific impact driver through the use of direct measurement (e.g., volume of freshwater used to irrigate a wheat field each month).
- *Secondary data:*
  Data that were originally collected and published for another purpose or a different assessment. Derived from modelled or proxy data. This could include data averaged from commodity sourcing (e.g., kg of pollutants emitted for a given volume of leather purchased, hectares of land use per tons of timber purchased) at the national or regional level, or the use of input-output data models to provide estimates of impact-drivers. Uncertainties in the quality of data used will need to be considered and disclosed.

Gathering primary data may be time consuming and costly (e.g., in the case of a biodiversity footprint at the level of an investment portfolio) or detailed primary data may simply not be available. Newly released reporting frameworks (CSRD, TNFD, the GRI Biodiversity standard) mainly focus on primary data and are likely to improve primary data access in the coming years. When primary data is not available, an assessment of biodiversity impact may rely on secondary environmental data from databases. Two types of inventory databases can be used in this step: (1) environmentally extended multiregional input-output databases with sector data, or (2) life cycle inventory (LCI) databases with data on specific products, processes and services. The choice depends on the goal of the analysis and the necessary granularity of the input data.

Other sources of secondary data include data from literature on (for example) different types of land use and related impacts on biodiversity.

20 TNFD, Recommendations of the Taskforce on Nature-related Financial Disclosures, September 2023.
21 Science Based Targets Network, 'Science-Based Targets for Nature, Initial Guidance for Business', September 2020.

Ex-ante versus ex-post data

A distinction can also be made between 'ex-ante' data and 'ex-post' data:

Ex-ante data

Ex-ante impact data, i.e. the estimated future impact of an investment, is collected or calculated before an activity or intervention takes place, e.g. to support funding decisions in case of project finance. Such data may include both primary data and secondary data.

Ex-post data

Ex-post measurement involves actual impact data collected following an activity/intervention. In general, an ex-post measurement of actual changes in biodiversity can be more accurate than the ex-ante calculation of potential impacts, provided a monitoring system is in place and the data is collected by trained staff. Ex post data could, for example, be used to verify if the estimated/calculated impact using a footprint is in line with actual impacts measured on the ground (see also section 3.4).

N.B.: The use of ex-post biodiversity data in an impact assessment will require an *attribution of the changes observed to the intervention* for which the loan or investment was provided. Such an attribution can be quite complex when the changes in biodiversity are potentially the result of multiple impacts (e.g., other companies operating in the same impact area; see 'cumulative impact').

In practice, a footprint will almost always combine primary data and secondary data. The secondary (pr 'background') data can be country specific sector average data (see the example of the EXIOBASE database below, frequently used by existing tools[22]), or more granular life cycle inventory data. The results yield an overview of all emissions (GHG, excess nutrients, toxic substances etc.) and resource use (water use, land use, etc.) linked to financed activities and their supply chains. This environmental data will serve as input for the impact assessment model used in step 3.

EXIOBASE

The EXIOBASE database (https://www.exiobase.eu/) is a public database covering 44 countries, that together represent 90% of the World's economy and 5 'Rest of the World' regions that cover the remaining 10% of the economy. It has collected data for all 48 regions on economic activities, environmental inputs (like resource use, land use) and outputs (like emissions) and some social aspects. The database distinguishes 163 industrial and service sectors. The trade flows between these sectors are also specified, which leads to millions of trade flows. There are also some special categories, like the activities caused by the total consumption in a country and the impacts of government expenditure and purchases.

EXIOBASE can be used to assess the environmental inputs and outputs of an investment in a sector, in a specific country. Since the trade flows of the sector are included in the database, the indirect impacts of supply chains (linked to this sector) can be included. This also means that if a company is defined by the revenue it realises in different sectors, the environmental impact of the company can be calculated.

There are some important limitations to this approach. First, EXIOBASE provides average input/output data for a sector in a country, not for individual companies. Secondly, dividing an economy in 163 sectors provides a rather coarse classification of economic activities. If an investment is made in a specific industrial activity, it may not always be clear to which sector it belongs. For companies active in sectors with very heterogeneous products, the EXIOBASE dataset might not be very representative for the products manufactured by the company under assessment.

Although the EXIOBASE database has its limitations, it can be used in a footprint calculation to identify potentially most impactful investments in a portfolio. Based on the result, the next step could be a more detailed assessment for these impact hotspots, based on more specific, primary data (when available).

22 Examples of such tools include the Corporate Biodiversity Footprint (CBF), the Biodiversity Footprint Financial Institutions (BFFI) and the Global Biodiversity Score Financial Institutions.

4.3 Baseline, reference state and cut-off date

A key concept in a biodiversity footprint is the 'baseline' used: impact compared to what? Related concepts are the 'reference state' and 'cut-off date'. These concepts are briefly explained below.

Baseline
To assess the impact on biodiversity of an investment in an economic activity or 'intervention' (an action that is expected to lead to an impact on biodiversity), a 'baseline' needs to be defined: a negative, avoided or positive impact compared to what? The Align project ('Aligning accounting approaches for nature') defines a baseline as "*a minimum or starting point with which to compare other information (e.g. for comparisons between past and present or before and after an intervention)*"[23]. The choice of the baseline will directly influence the assessment of the impact and can be different for negative impacts, avoided negative impacts or positive impacts (see section 5.2).

Reference state
A related but different concept is the 'reference state' which is defined by Align as "*a previous state or desired state (of nature) which a target aims to recover or achieve*". For ecosystem condition metrics (see section 2.8) a fully 'intact' or pristine state is used as a reference state to calibrate relative declines in condition. Similarly, the SBTN targets differentiate between a 'baseline'—the value of an indicator at a specific time—and a 'reference state'—the desired state of nature to which a target refers.

Cut-off date
A cut-off date can be used to define a reference state in the past, for instance the year 1750 for the 'pre-industrial state'.

PBAF does not yet take position in the choice of a baseline, reference state and cut-off date. It is however key to be consistent in these choices when footprinting results are used for comparison between, for example, companies and sectors. Moreover, transparency regarding baseline, reference state and cutoff date used in footprinting calculations is key to allow a correct interpretation of the result.

R7: *The choice of baseline(s), reference state(s) and cutoff date(s) used in footprint calculations shall be transparent and disclosed.*

4.4 Data quality and footprint result

A. Use of primary data

In case of an impact assessment for a specific company, environmental data from sustainability reports can be used or data directly requested from a company by means of questionnaires. This primary data will normally be more accurate than secondary data from databases, like sector averages. However, also the accuracy of primary data should be verified.

23 UNEP-WCMC, Capitals Coalition, Arcadis, ICF, WCMC Europe (2022) Recommendations for a standard on corporate biodiversity measurement and valuation, Aligning accounting approaches for nature.

DATA QUALITY ISSUE	HOW CAN THIS AFFECT A FOOTPRINT RESULT?
Accuracy of primary data Primary data from companies tends to be more accurate than data from background databases. However, the level of accuracy of primary data may be reduced for several reasons, including a lack of clarity why specific data needs to be collected, mistakes in data gathering and a lack of verification of the data provided. Moreover, it must be realised that data provided by companies can (partly) be modelled/calculated instead of measured, resulting in data-limitations which are similar to the limitations of secondary data.	The use of inaccurate primary data can lead to the misconception that the footprint is relatively accurate since primary data was used instead of data from databases. The use of inaccurate data will result in a footprint result which is too high or too low for the drivers of biodiversity linked to this data.

B. Use of secondary data: sector average data from databases

Primary environmental data from companies will need to be combined with environmental data from databases, for example when looking at supply chains. This is often (country specific) sector average data from a specific year in case of input-output databases. When using life cycle inventory databases, it can be sector average data, data of a specific producer, data from scientific research, or data from other sources. It is important to report on the type of data that is used, as the characteristics of the database (including its limitations) will affect the way the results should be interpreted.

DATA QUALITY ISSUE	HOW CAN THIS AFFECT A FOOTPRINT RESULT?
Responsiveness to company action and the use of investment criteria The use of sector averages affects the responsiveness of a footprint. Best in class companies from a biodiversity point of view will score the same as underperforming companies in the same sector. It also means that investment criteria addressing drivers of biodiversity loss or gain, filtering out worst in class performers in sectors or only including best in class performers, are not reflected in the footprint calculation. Sector average data used in a footprint can be replaced by company-specific data, for example when carbon data on a company level is available. Some methodologies will also adjust sector average data when a company has (biodiversity relevant) certifications in place or has implemented specific biodiversity relevant best practices.	The use of sector averages may lead to a footprint which is too high or too low, when the company invested in actually performs better or worse than the sector average. In the case of financial institutions that have strict biodiversity related investment criteria, the footprint result may be more negative than the actual impact. This means that such investment criteria are not rewarded via the footprint.
Responsiveness to technological development and innovation The use of 'outdated' data may result in environmental inputs and outputs which are not in line anymore with current company/sector practices, especially in sectors where the innovation rate is high.	The use of old data may lead to a footprint result which is either too high (innovation has contributed to a reduction in resource use and emissions) or too low (innovation has resulted in an increase in resource use and emissions).

Data from databases with 'rest of the world regions' Databases offering data on environmental inputs (like land-use and water use) and environmental outputs (emissions) are often based on environmental statistics from different countries around the world. Not all countries offer the same quality of data where it comes to such statistics. For this reason, databases may use a 'rest of the world' category with very rough data, not differentiating between the countries in this category.	The accuracy of data from 'rest of the world regions' will be quite limited. This will affect the accuracy of the footprint, depending on the significance of this data in the total footprint.
Limited granularity of sectors in databases The level of granularity of the sectors in background databases may differ. For example, a sector 'textiles' does not differentiate between textiles from cotton or textiles from polyester or other fibres.	The lower the granularity of the sector differentiation, the less accurate the data will be when this data is used to calculate the footprint of a specific sub-sector or company. This means that the actual impact may be higher or lower than calculated. Usually, LCI databases offer more granular data than Input-output databases. The granularity preferably matches with the granularity of the input data. This is further explained in the case study below.

C. Supply chain modelling of Scope 3 upstream

Data on the suppliers to a company (Scope 3 upstream) and their locations is often not available even though data should become more and more available with the mainstreaming of voluntary (TNFD, GRI) and regulatory reporting frameworks (CSRD). Data from databases can alternatively be used in footprint calculations. An example is the use of trade flow data from the EXIOBASE database showing what trade is taking place between sectors and between countries. This data can be used to model the *average supply chains* of a company in a specific country. This modelling of supply chains enables the identification of impact drivers/pressures linked to a company through its supply chains.

DATA QUALITY ISSUE	HOW CAN THIS AFFECT A FOOTPRINT RESULT?
Responsiveness to companies' procurement policies and investment criteria The use of 'average supply chain' data affects the responsiveness to supply chain actions implemented by a company. Best in class companies from a supply chain policy point of view (e.g. the company has a no-deforestation sourcing policy in place) will score the same as underperforming companies in the same sector and country.	The use of sector average supply chains may lead to a footprint which is too high or too low, when the companies invested in actually perform better or worse in their supply chains than the sector average. Especially in case of financial institutions that have strict biodiversity related investment criteria, filtering out worst in class performers in sectors, the footprint result may be worse than the actual performance of the companies invested in.
Identification of countries sourced from Modelling of the average supply chains for companies in a specific sector also means that the countries in those supply chains will be the average countries, not the actual countries a company is sourcing from.	A footprint based on modelled supply chains will show in what countries the potential impacts on biodiversity on average take place. Since this is not necessarily in line with the reality for a specific company, the options to act on the geographic spread of impacts is limited.

D. Value chain data Scope 3 downstream

Data on the environmental pressures downstream are often difficult to gather or model. An important reason is the fact that many products and services can be used in a variety of ways by manufacturers/processors and consumers. This is one of the reasons why Scope 3 in a biodiversity footprint is sometimes limited to Scope 3 upstream or only includes part of Scope 3 downstream.

DATA QUALITY ISSUE	HOW CAN THIS AFFECT A FOOTPRINT RESULT?
Limited accuracy or exclusion of Scope 3 downstream data Data on the impact drivers in Scope 3 downstream is sometimes left out of a biodiversity footprint or needs to be modelled affecting the level of accuracy.	Exclusion of Scope 3 downstream from a footprint can have a significant effect on the footprint result. When a large part of the environmental pressures materialise in Scope 3 downstream (e.g. through energy use), the total footprint result will be too low and miss out on important drivers of biodiversity loss. Similarly, total avoided or positive impacts may be underestimated if they take place in Scope 3 downstream.

E. Reflecting the use of certification standards

Many financial institutions refer to the use of certification standards in their investment criteria. Some of the certification standards are widely considered to be potentially beneficial to biodiversity, like the FSC certification standard. The way certifications standards address the topic of biodiversity differs per standard and a number of initiatives have developed overviews of the ways in which specific certification standards include biodiversity related certification criteria. Examples include the work of the Global Nature Fund (GNF) on biodiversity in standards and labels for the food industry[24] and work by the International Institute for Sustainable Development (IISD) on the criteria of 15 major agricultural voluntary sustainability standards[25].

The use of these certification standards is preferably reflected in a biodiversity footprint. However, data on the impact of certification standards is often still limited or lacking. Moreover, impact assessments can be based on sector average impact driver data (like data from the EXIOBASE database), not reflecting the use of certification standards by individual companies (the sector average of the environmental inputs and outputs will be based on the combination of certified and non-certified companies).

There are three ways to deal with this:

1. *Calculate a more detailed footprint with additional primary data.*
   The expected better performance of investments in companies or projects outperforming the sector average can best be dealt with by using more primary data on direct emissions, resource use and supply chain data. For example, in case of certified organic farming, a reduced use (or no use at all) of fertilizers and pesticides is expected. In this case, sector average input data can be adjusted with the company specific fertilizer use and pesticide input data. The same holds for other inputs such as water use and energy use. Including this data will show the reduction in potential biodiversity impact compared to the sector average.

2. *Calculate a proxy for specific certifications*
   This proxy can be based on company specific footprints as described in option 1, assuming that companies with the same certification have a comparable (reduction in) footprint. The

24 GNF et al, 'Biodiversity in standards and labels for the food sector, Baseline report', 2017.
25 Jason Potts, Vivek Voora, Matthew Lynch, Aynur Mammadova, 'Standards and Biodiversity: Thematic review', June 2017.

proxy can be based on the average emissions and average resource use of farms with, in this example, organic farming certification. The drawback of this approach is that there are many certifications on the market, and not all certification schemes have data available on average (reductions in) inputs and emissions.

3. *Estimate the biodiversity impact*
   If the integration of certification standards in a footprint calculation based on primary data (option 1) or a proxy based on company specific footprints (option 2) is not possible, the impact from certification standards (the reduction in impact for a certified company compared to the sector average) can be estimated. For this option, the following requirements apply:

R8: *If a certification standard includes measures, captured in certification criteria, aimed at reducing specific environmental pressures compared to standard (sector average) practices, these reductions in pressures may be translated into one or more 'impact correction factors' to correct a footprint based on sector average environmental data, provided that:*

a) The certification standard is a voluntary, criteria based, third-party assessed program, based on life cycle considerations.
b) There is no evidence of net negative impacts associated with the certification.
c) The certification standard includes criteria which explicitly address one or more drivers of biodiversity loss and/or the enhancement of biodiversity. Special attention should be given to uncaptured trade-offs when estimating a correction factor without all drivers being addressed.
d) The impact correction factor takes into account potential differences in the certification criteria in different countries.
e) The impact correction factor is limited to the criteria mentioned under (c) and to those criteria that need to be implemented before certification can be obtained. No voluntary criteria or criteria which can, but do not have to be selected from a long list of criteria and no criteria with a non-compliance.
f) The impact correction factor is preferably based on quantified changes in impact drivers required by and specified in the certification standard.
g) The impact correction factor takes into account the percentage of produce which has been certified according to the certification standard when applying the correction factor to assess the impact of a production company.
h) The impact correction factor takes into account the effect the certification standard already has on the sector average which is adjusted.
i) The certifications for which correction factors have been applied are disclosed with the result of the footprint. The correction factors shall be available to the financial institution using the footprint, e.g. in a public methodology report.
j) A footprint without the use of correction factors shall be disclosed separately to show the effect of using correction factors.

The development of a set of agreed correction factors for certification standards, to be used by all footprinting methodologies, could be an important next step for PBAF.

FSC CERTIFICATION AND LAND USE

In case of FSC (Forest Stewardship Council) certification, average impact data for forestry-related land use can be replaced by impact data reflecting the type of forest management required by FSC certification. To do this, data can be used from the publication 'Impact of Forest Management on Species Richness' from Chaudhary et al[26].

26 Chaudhary et al., 'Impact of Forest Management on Species Richness', 2016.

5 Step 3 Analysis of the impact on biodiversity

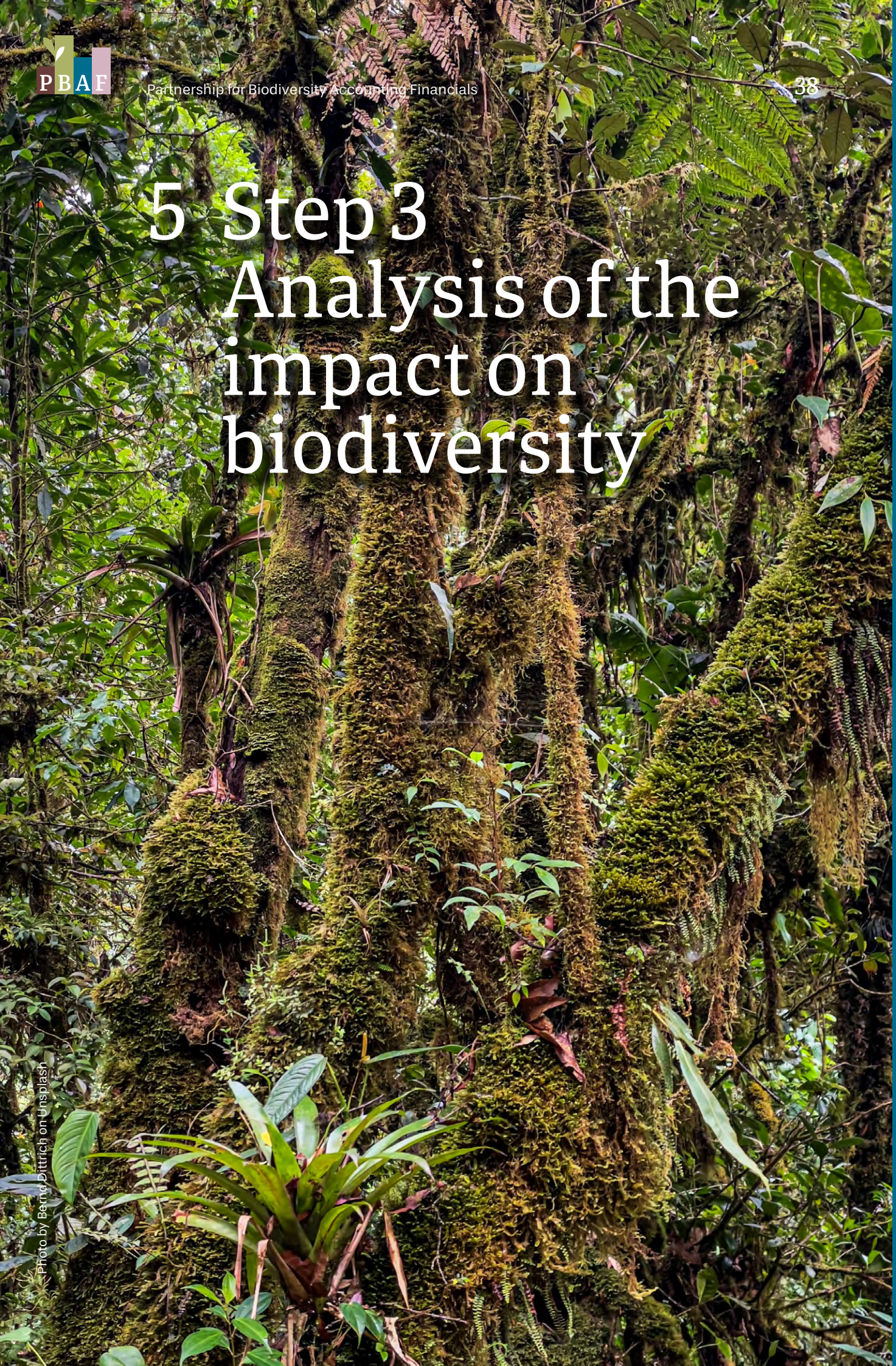


Photo by Bernd Dittrich on Unsplash

>> *In the third step of a biodiversity footprint, the impact drivers/pressures identified in step 2 are translated into drivers of nature change and a potential impact on biodiversity.*

5.1 From impact drivers to impact

Quantifying potential impact

An important characteristic of a biodiversity footprint is the fact that the link between impact drivers/pressures and drivers of nature change, as well as the link between drivers of nature change and a potential impact on biodiversity is quantified. At the same time, it is important to recognise that a quantification of potential impact may not yet be possible for all drivers of nature change. This limitation will need to be addressed in a qualitative way, for example in the interpretation of the footprinting results (see step 4).

R9: *In the quantified part of a biodiversity footprint, changes in drivers of nature change need to be translated into an impact on biodiversity and the linkages need to be explicit, quantitative, transparent and science based. This ensures that the impact assessment is responsive to change, results are replicable, and results are relevant to companies and investors.*

Pressure–impact models

To translate impact drivers and drivers of nature change into an expected or potential impact on biodiversity or ecosystem quality (potential, since the impact is calculated/modelled and not measured), footprinting methodologies use 'pressure–impact' models (the term 'pressure–response' model is also used). These models include modelled relations between impact drivers/pressures and impact, based on scientific data from field studies. A number of different models is currently used, including (but not limited to) ReCiPe 2016, GLOBIO, IMPACT WORLD+ and LCIMPACT. The impact drivers covered by these models varies. Examples of pressure–impact models and drivers covered are included in table 1.

The table shows that the number of impact drivers included in the models varies and invasive alien species is not (yet) covered by any of these models. Moreover, the marine environment is still largely missing from the models. This also means that footprinting methodologies will often combine one or more of these models with a qualitative assessment in order to cover the five main drivers of nature change and terrestrial, freshwater and marine impacts.

Table 1: Pressure-impact models and impact drivers covered

IMPACT DRIVER (IPBES)	RECIPE2016	GLOBIO TERRESTRIAL*	GLOBIO AQUATIC*	GLOBIO SPECIES*	IMPACT WORLD+	LCIMPACT
Land- / Sea-use change	Land use Land use change	Direct Land use Road disturbance Fragmentation	Land use in the upstream catchment Streamflow alteration (due to dams)	Habitat loss and fragmentation	Land use Land use change	Land use Land use change
Resource extraction / Over-exploitation	Water scarcity	Hunting		Hunting	Water availability	Water stress
Invasive alien species	-	-	-	-	-	-
Pollution	Acidification Ecotoxicity Eutrophication Photochemical ozone formation	Atmospheric nitrogen deposition	Eutrophication from agricultural and urban sources		Acidification Ecotoxicity Eutrophication Photochemical ozone formation Ionizing radiation	Acidification Ecotoxicity Eutrophication Photochemical ozone formation
Climate change	Climate change	Climate change	Water temperature (as influenced by climate change) Streamflow alteration (due to climate change)	Climate change	Climate change	Climate change
Indicator	PDF.ha.yr	MSA or MSA.ha.yr (in LCA) BIF	MSA or MSA.m3.yr (in LCA)	Changes in species distributions and population sizes Area of habitat LPI Red List Index	PDF.m2.yr	PDF

Direct impact and indirect impact

With respect to the impacts on nature, the TNFD distinguishes between[27]:

- Direct impacts: a change in the state of nature caused by a business activity with a direct causal link (like land-use).
- Indirect impacts: a change in the state of nature caused by a business activity with an indirect causal link (e.g. a change indirectly caused by climate change, to which an organisation's greenhouse gas emissions contributed).

27 TNFD, Glossary, Version 1.0, September 2023

Both type of impacts are covered by the pressure–impact models used in biodiversity foot-printing.
Note that, as with 'impact drivers', definitions may vary. For example, the term 'indirect impacts' is also used for impacts in the value chain, whereas 'direct impacts' may also refer to the impacts occurring on a company's operational sites (direct operations).

5.2 Actual impact versus potential impact

A biodiversity footprint results in an assessment of potential impact, mainly based on pressures/ impact drivers and 'pressure–impact models' which translate the pressures into impact.

Actual impact
Actual impacts on ecosystems are impacts measured by monitoring actual changes in the state of biodiversity on the ground (ex–post monitoring data). Attributing actual changes in biodiversity to the economic activities under investigation may prove to be a challenge as impact drivers from other activities may also contribute to the changes observed. For this reason, a pressure–based approach will always be needed to attribute impact to pressures and activities (impact allocation).

When an economic activity is the only activity impacting an ecosystem, the actual impact of the activity can be reported, without the need for attribution. However, it must be realised that all ecosystems are at minimum also impacted by climate change.

Using actual impact data in relation to footprinting
If measurements of actual changes in biodiversity (ex–post monitoring data) are available and expressed in metrics similar to footprint metrics, this data can be compared with the potential impact resulting from the footprint (ex–ante data). Significant differences could be the result of other stakeholders also impacting on biodiversity, other factors influencing the state of biodiver-sity (climate change, flooding, etc.), of footprint limitations (pressure–impact model and data used), and of the way the actual changes in biodiversity were monitored (measurement on the ground). In case of significant differences and depending of the analysis of the reasons behind these differences, financial institutions can decide to adjust the potential impact calculated, e.g. for reporting purposes, to assess in the exit phase of project finance if the loan or investment has delivered an agreed impact target and/or to evaluate the way of monitoring actual impact.

A1: *When ex–post monitoring data of actual changes in biodiversity become available (e.g. during the implementation of a project), this data should be compared with the ex–ante data on estima-ted/potential impact. In case of significant differences between actual impact and estimated/ potential impact, these differences should be analysed. The result can be used to adjust the potential impact calculated using ex–ante data, e.g. for reporting purposes, and/or to monitor impact targets and/or to identify options to improve the quality of monitoring of actual impact.*

5.3 Negative, avoided and positive impact

A biodiversity footprint can be used to assess (potential) negative impacts, avoided negative impacts and positive impacts.

Negative impact
A negative impact means a loss of biodiversity resulting from an intervention (like economic activities or changes in economic activities) compared to a baseline. To assess negative impact, the baseline is the situation without the intervention, and its associated change in impact drivers. As mentioned in section 4.3, the baseline used in a footprint calculation shall be transparent and disclosed.

Avoided (negative) impact
The avoidance of negative impact on biodiversity refers to the prevention of negative impacts resulting from interventions, like better management practices, compared to a baseline. The baseline in case of an avoided impact is an alternative scenario, often the situation without the intervention ('business as usual'). This approach is similar to the calculation of the carbon footprint of green/renewable energy, which is calculated using energy from an energy mix as the reference, resulting in avoided emissions.

In order to limit the chances of overstating an avoided impact, it is important to be conservative in the choice of the baseline, i.e. the impact drivers and level of biodiversity in the business-as-usual scenario. Moreover, the choice of the business-as-usual scenario needs to be transparent and supported with sufficient evidence to prevent unjustified claims.

R10: *To claim, based on a biodiversity footprint, an avoided negative impact on biodiversity, the business-as-usual scenario used in the footprint calculations shall be transparent and supported with sufficient evidence. Avoided negative impacts shall be reported separately.*

Positive impact
The concept of 'positive impact' (and 'nature-positive, 'positive-outcome', 'net-gain') is being discussed internationally by a variety of initiatives and organisations, like the Nature Positive Initiative, IUCN, UNEP-FI, the Finance for Biodiversity Foundation and others. The (interim) results of these discussions will affect the way in which positive impact needs to be defined and when positive impact can be claimed.

To make sure that the Biodiversity Footprinting Standard aligns with the (interim) results of these initiatives and following feedback from the PBAF Sounding Board, PBAF has decided not to include positive impact in the PBAF Footprinting Standard as yet and to publish an addendum on positive impact in biodiversity footprinting in 2025 building on the results of these initiatives.

Topics that are likely to be addressed when discussing 'positive impact' include (among others):
- **The definition of positive impact**
- **The need for location data**
- **Baseline, reference state and cut-off date**
- **The role of value chain impacts in positive impact**
- **Time integration and dynamic/static impact approaches**
- **The permanence of positive impact**
- **Disclosure of positive impact**

5.4 Disclosure of impact

Summing positive and negative impacts to calculate a 'net impact' is highly debatable, since impacts often take place at different locations and even in different regions and may involve different ecosystems, species and genes (no 'ecological equivalence'). This means that negative and positive impact need to be reported separately. As avoided negative impacts are of a different nature (hypothetical impacts relative to a business-as-usual scenario), they also need to be reported separately.

R11: *Negative, avoided negative and positive impacts shall be reported separately.*

Although negative and positive impacts cannot just be added up to calculate a net impact, in practice the calculation of a net impact is sometimes used as a way to compare investments in different companies, projects or asset classes.

R12: *Even when a net impact is calculated or communicated for specific purposes, negative and positive impact shall (also) be reported separately. Moreover, when a net impact is communicated by a financial institution, the use and interpretation of this net impact by the financial institution shall be explained.*

5.5 The spatial dimension and time dimension of impact

5.5.1 Spatial dimension of impact

Biodiversity impact assessment has a spatial dimension in the sense that emissions and resource use take place in a specific area and the impact can be local, regional or global.

- Local
  An example of a localised effect is the emission of excess nutrients such as nitrogen. An emission of 1 kg of a nitrogen compound has a different effect in ecosystems with taxa that require low nutrient levels than ecosystems with vegetation that flourishes with high nutrient levels. This means that is important to know where emissions take place and where the emission ends up.
- Regional
  The emission of non-persistent toxic substances may have a localised effect, while toxic impacts of more persistent substances may spread over a wider area and have a regional impact.
- Global
  Emissions contributing to climate change will have a global effect: it does not matter where on earth a kg of CO_2 is emitted.

This spatial dimension of impact means that, in order to assess the impact on biodiversity of a specific impact driver, knowledge of the impact area is needed. However, although this may be feasible for Scope 1 environmental inputs and outputs (like emissions at site level), this will be much more challenging for impacts taking place upstream or downstream in value chains. Moreover, monitoring actual impact can be time consuming and costly. For this reason, biodiversity impacts with varying spatial dimensions are often included in a biodiversity footprint by means of pressure-impact models in which this spatial dimension is modelled.

5.5.2 Time dimension of impact

Time plays a role in two different ways in a biodiversity footprint: the time period covered by the impact assessment (the assessment period) and the impact pattern over time (magnitude and duration). The assessment period is often a one year period to allow reporting of an annual footprint. For a financial institution, this annual footprint will be based on the impacts resulting from the financed economic activities during one year of a company's operations or a project.

The impact pattern over time will vary depending on the impact drivers. For example, land use may take place during a certain period of time (land occupation) and the converted land may at some point gradually return to its natural state. Impacts resulting from a pollutant emission will last a certain time until the substance eventually vanishes or is converted in a less harmful substance. For instance, a methane emission will be converted into CO_2 after one or two decades, and this CO_2 will be absorbed by plants and oceans in one or two centuries. Likewise, many toxic substances will often have an impact during a few days or weeks before they break down. This shows that it is important to keep in mind that an impact is a dynamic process over time.

Time integration

This time dimension of impact can be dealt with in different ways, influencing the footprint result. The mainstream approach in life cycle assessment to deal with future impacts of emissions is 'time integration', an approach which is also used by the IPCC. In the case of time integration,

future impacts caused by today's pressures are treated like they are taking place at the time the footprint is calculated: the impacts are added up and included in the footprint. Because future impacts are immediately accounted for, an incentive is created to address these future impacts.

Dynamic and static impacts
Another approach to deal with impacts over time in biodiversity footprinting is the dynamic and static impacts' approach, e.g. used by the Global Biodiversity Score. Static impacts represent the accumulated negative impacts until the assessment period (e.g. until the start of reporting year X) while dynamic impacts represent periodic biodiversity gains or losses over the assessment period (during reporting year X). Unlike the time integration approach, the dynamic/static framework aims to answer the following question: what is the current state of remaining biodiversity and how much damage is being caused during the period assessed? Dynamic and static impacts should be accounted separately.

Both approaches highlight different aspects, can serve different purposes and have their own benefits and limitations. A detailed discussion of both approaches will be very technical and is beyond the scope of the Biodiversity Footprinting Standard. However, more detailed guidance on both approaches may be developed for future updates. As the two approaches will lead to different footprinting results, it means that the approach used should be clear and disclosed.

R13: *Since the choice to use time integration or alternative approaches to deal with the time dimension of impacts will influence the footprint result, this choice needs to be explained and reported with the footprint result.*

5.6 Attribution of impact

The impacts on biodiversity of the economic activities identified will need to be attributed to the financial institution investing or providing a loan. The rules for this attribution are similar to the rules applied in the PCAF Financed Emissions Standard and are based on the 'follow the money' principle. The same general attribution principles are applied across all asset classes. Note that for a biodiversity footprint, 'emissions' is replaced by 'ímpact'.

R14: *The following applies to the attribution of impacts on biodiversity, based on the PCAF attribution principles (PCAF, 2022)[28]:*

1. *Financed impact is always calculated by multiplying an attribution factor (specific to that asset class) by the impact of the borrower or investee.*
2. *The attribution factor is defined as the share of total impact of the loans and investments of a financial institution over the total equity and debt of the company, project, etc. to which the financial institution has lent money or in which it has invested capital.*

The use of this common denominator, including both equity and debt funding, also called 'enterprise value', is important for three reasons (PCAF, 2022):

1. It ensures the use of one common denominator across all asset classes, which is in line with leading practices in the financial sector.
2. It does not differentiate between equity and debt. Both contribute to the total financing of the borrower or investee (and indirectly their emissions/impact) and are therefore deemed equally important.
3. It ensures 100% attribution of the impact over equity and debt providers and avoids double counting of impact between equity and debt providers as much as possible. This is specifically important for financial institutions that hold both equity and debt positions within the same companies or projects."

28 PCAF (2022). The Global GHG Accounting and Reporting Standard Part A: Financed Emissions. Second Edition.

NB: The investment duration needs to be considered when calculating the attribution factor. For example, if an investor owns shares of a company during 1 month, the investor is accountable for 1/12th of the annual impact attributed to the shares of this company.

5.7 Data quality and footprint result

Three important limitations of the pressure–impact models commonly used are:
A. Calculation of potential impact instead of actual impact
B. Not all drivers of biodiversity loss or gain may be included in a pressure–impact model
C. Threshold effects are not captured by the pressure–impact models
D. Limited responsiveness to local characteristics of ecosystems
E. Cumulative impacts are not captured by a footprint.

These limitations are briefly explained below.

A. Potential impact versus actual impact
As discussed in section 5.2, a biodiversity footprint results in a calculation of the potential impact on biodiversity resulting from changes in impact drivers. When actual impact data is available, this data can be used to verify and replace potential impact data to support decision making and reporting.

B. Drivers of biodiversity loss not (yet) included in pressure impact models
Not all drivers of biodiversity loss are fully covered by current pressure–impact models (see also table 1). Examples are the introduction of invasive species, disturbance and over-exploitation. For these drivers, a quantitative footprint will need to be complemented by quantitative pressure based indicators (e.g. tonnes of fish caught, km of (farm) fences in KBAs, etc) or by a qualitative or semi-quantitative (like a scoring system) analysis.

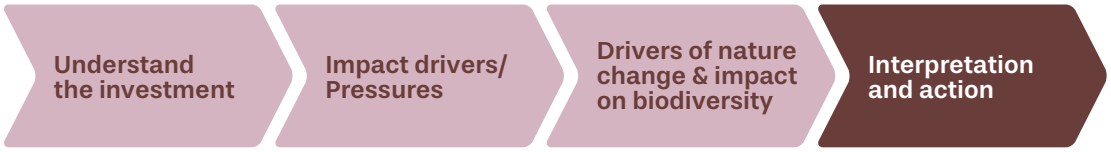
C. Threshold effects not included in the models
The concept of thresholds in ecology refers to the local maximum level of impact beyond which an ecosystem will not be able to regenerate. Footprinting models mostly do not include thresholds primarily because they are very difficult to assess. This is a limitation as additional impacts leading to a threshold overpass cannot be identified.

D. No or limited responsiveness to location specific characteristics of ecosystems
The same impact drivers can lead to different impacts in different locations. The ability of footprinting methodologies to take into account location specific ecosystem characteristics will vary between methodologies and is often limited to country, watershed, or ecoregion level. This means that the potential impact calculated must be interpreted with care. At the same time it must be realised that, although the actual impact on biodiversity will depend on the impact location, from a precautionary perspective the reduction of drivers of (potential) negative impact is always a good idea. For this reason, knowledge of the impact drivers of potential impact can be used by financial institutions to zoom in and, for example, gather more data and engage with companies.

E. Cumulative impacts are not captured
A biodiversity footprint will show how different impact drivers result in an impact on biodiversity. However, cumulative impacts resulting from different impact drivers occurring at the same time (1+1=3) are not captured. The same is true for cumulative impacts resulting from different economic activities in the same landscape.

6 Step 4 Interpretation of the footprint result

Photo by Philip Veater on Unsplash



>> *In the fourth step of a biodiversity footprint, the footprint results are interpreted and translated into action.*

6.1 Two important questions

In the interpretation step of the footprint results, two important questions need to be answered:

1. What is the level of accuracy of the footprint result and how does this influence the interpretation and use?
2. What reference or benchmark can be used to put the result in perspective? Is the result acceptable or (too) high and compared to what?

Complementary qualitative analysis

Any quantitative biodiversity footprint will have its limitations from the viewpoint of the characterisation of the economic activities financed, the data available to assess the impact drivers/pressures and the pressure–impact models used to calculate the impact on biodiversity. A qualitative analysis serves to complement a quantitative analysis to address all impact related issues which cannot (yet) be covered by the quantitative footprint. Examples of topics for a qualitative assessment are specific drivers of nature change or Scopes not yet included or the use of biodiversity-relevant certification standards not yet reflected by the quantitative footprint. Moreover, a qualitative analysis can be used to put the quantitative results into perspective, discuss methodological limitations and provide an assessment of uncertainty.

R15: *A qualitative analysis shall accompany a quantitative footprint in order to complement impact assessment results, to recognise and report on limitations (see also disclosure requirements in R26) and to take these limitations into consideration in the interpretation and use of the footprint results.*

CASE STUDY: ASN BANK: A QUANTITATIVE AND QUALITATIVE ASSESSMENT OF BIODIVERSITY IMPACT ON PORTFOLIO LEVEL

ASN Bank has used the Biodiversity Footprint Financial Institutions (BFFI) to calculate the biodiversity impact of the bank's investment portfolio since 2015. This methodology uses the ReCiPe pressure–impact model. When the first biodiversity footprint was executed in 2016, a qualitative analysis was conducted of the methodology, including an analysis of the limitations of the pressure–impact model used (ReCiPe), the effect these limitations could have on the footprint results, the relevance/significance of this effect for the bank's investments and how these limitations could be addressed.

An example of the limitations discussed is the fact that the introduction of exotic invasive species is not included in the ReCiPe model. Because the introduction of invasive species can be an important driver of biodiversity loss, an analysis was made of the relevance/significance of this limitation looking at the sectors ASN Bank invests in. For example, sectors like aquaculture, agriculture and forestry are high-risk sectors from the viewpoint of invasive species, meaning that the footprint result (the calculated potential impact) of direct or indirect investments in these sectors could be an underestimation of the actual impact.

In a next step an analysis was made of how this limitation can be addressed. One option that was explored is to see if this driver of biodiversity loss can be taken 'out of the footprint equation' through the use of an invasive species related policy and investment criteria for companies in or linked to high risk sectors. By requiring proper management of the risk of introducing invasive species or by requiring certification with a sustainability standard that addresses the intro-

duction of invasive species. For example, in case of forestry related sectors (like the paper industry), an investment criterion requiring FSC certification of forest or plantation will mitigate the risk. Since FSC certification is included in ASN Bank's sustainability policy and investment criteria, the introduction of invasive species is expected to play a limited role in the bank's investments in forestry related sectors (realising that international transport of forestry related products also needs attention from an invasive species point of view).

Other limitations of the ReCiPe pressure-impact model and the data used were analysed in a similar way, resulting in insight in the footprint limitations and ways to deal with these limitations.

More information is available in the publication 'Towards ASN Bank's Biodiversity footprint; A pilot project', CREM, PRé and ASN Bank, 2016. (available through ASN Bank)

6.2 Data use and data transparency

The type of data used (e.g. primary versus secondary data) will influence the way a footprint result should be interpreted. Transparency on data use is therefore key. The following general requirements and recommendations apply with regard to data use:

R16: *Regardless of the type of data that is being used to assess the impact on biodiversity, data use (including data sources and their limitations) shall be fully transparent to allow for a traceable and replicable assessment and to allow for correct interpretation of the impact assessment results.*

R17: *Financial institutions and data providers shall use the most recent data available to them. Any deviations shall be reported explicitly, including the reasons why. PBAF recognizes there is often a lag between financial reporting and required environmental data, such as borrower or investee environmental data. In these instances, it is acceptable that the data represent different years, as long as the years are expected to be broadly comparable. If this is not the case, the differences must be explained and taken into account in the data used.*

A2: *Financial institutions and data providers should use the highest quality data available for each asset class for calculations and, where relevant, improve the quality of the data over time. This includes the use of primary data instead of secondary data when (part of) such data is available.*

However, data limitations should not deter financial institutions from taking the first steps towards assessing their impacts and dependencies, as even estimated or proxy data can help to identify biodiversity impact hot-spots in portfolios, which can inform biodiversity strategies. Where data quality is low, financial institutions can design approaches to improve it over time.

A3: *Since it is the responsibility of the investee to provide the data required to assess the impact on biodiversity, it is recommended to always ask investees for biodiversity impact data and provide support in identifying the data need and the tools available to gather this data.*

6.3 Reporting on methodology and data use

In order to enable a correct interpretation of the footprint results, transparency regarding the methodology and data is essential (and can be included in a discussion of the results in a qualitative analysis). The way in which this transparency is provided may differ, but information needs to be provided on, for example, Scopes included in the footprint, the modelling of economic activities, the use of primary or secondary data, etc. The table below provides an overview of the information that needs to be provided. This information can be provided in different forms, like a separate explanation of the methodology used, an annex explaining the assumptions used per asset class and/or a data quality score for different asset classes (explaining how this score is calculated).

Key is that it is also made clear how the methodology and data used might affect the footprint result and what this means for the use of the footprint results.

R18: *The following information on the methodology and data used to calculate the footprint shall be reported, where relevant per asset class:*

Table R18: PBAF template for description of the method and data, main limitations, and how they affect the footprint result.

FOOTPRINT APPROACH AND DATA QUALITY	DESCRIPTION	LIMITATIONS	HOW COULD THIS AFFECT THE FOOTPRINT RESULT?
1. Scopes included			
Scope 1			
Scope 2			
Scope 3 upstream			
Scope 3 downstream			
2. Expected impacts covered in the footprint Qualitative description of the main impacts expected and how these are included in the footprint: quantitatively or qualitatively			
3. Modelling of economic activities Description of the way the economic activities of companies have been identified/assessed, including sector classifications used			
4. Impacts in supply chains Description of how data on supply chains have been included in the footprint, including potential modelling			
5. Environmental data used			
Primary data: Reported impact drivers/pressures, including source(s), year(s) and means of verification			
Secondary data: Physical activity–based (⋆) impact drivers/ pressures, including source(s), year(s) and level of consistency with the primary business activity (⋆⋆)			
Secondary data: Economic activity–based (⋆) impact drivers/pressures, including source(s), year(s) and level of consistency with the primary business activity (⋆⋆)			
Responsiveness of data to company action (⋆⋆⋆)			
6. Baselines, reference states and cutoff dates used in the footprinting calculations			

7. Pressure - impact model used			
Name of the pressure–impact model and its associated output metric(s)			
Drivers of nature change included in the model			
Drivers of nature change not included in the model and how these drivers are addressed			
Extent to which local biodiversity data and ecosystem characteristics were taken into account in the impact calculation			
Was time integration used to account for future impacts? If not, what other approach was used regarding the time dimension of impacts and why?			
8. Main limitations of the footprint and what this means for the footprint result and its use			

(⋆): Financial institutions and data providers should use environmental data as consistent as possible with the primary business activity. For example, for a business loan to a paddy rice farmer, the financial institution / data provider should seek to find and use sector-specific average environmental factors for the paddy rice sector and not environmental factors for the agricultural sector in general.

(⋆⋆): Physical activity–based environmental data are (secondary) environmental data on the actual physical activities a company is involved in; economic activity–based environmental data are environmental data on the sectors in which a company is creating its revenue.

(⋆⋆⋆): To what extent are actions by companies to mitigate negative impacts reflected in the data used in the footprint calculations? How is this effectuated (e.g. by taking into account a reduction in impact drivers required by certifications)?

6.4 Interpretation of the footprint score

The result of a quantified impact assessment or biodiversity footprint is often interpreted using a reference or benchmark, something to compare the results with. Ideally this benchmark is the 'safe operating space' at the impact location, the level of impact which does not yet affect the ecosystem's ability to provide the ecosystem services it provides (including ecological services supporting biodiversity). However, knowledge of this safe operating space requires knowledge of the impact location, the state of the ecosystem and other impacts in the area leading to a cumulative impact. As yet, this data is rarely available, resulting in the use of alternative benchmarks.

In the interpretation of a footprinting result, absolute impact scores are often translated in *impact intensity* to enable a comparison of companies and asset classes. For example, a comparison between companies can be made by looking at the impact 'per euro revenue' and a comparison of investments in different sectors and companies can be made by looking at the impact 'per euro invested'. This enables a comparison of the 'impact intensity' of companies and sectors, but does not answer the question whether the impact is acceptable from the viewpoint of ecosystem quality and resilience; is the impact still within the planetary boundaries and within the safe operating space?

The use of impact intensity to compare and interpret results needs to be done with care. For example, when biodiversity impact results are divided by a company's enterprise value or revenue to calculate the 'impact per euro enterprise value or revenue' in order to account for differences in company value or size, the result can be misleading. For instance, a high revenue can also be the result of high value products instead of company size. For this reason, calculating an impact intensity based on physical units (like the production of a ton of soy) instead of monetary units (like revenue or the market capitalisation of a company) can be a better choice.

SECTOR BENCHMARKS CDC BIODIVERSITÉ

To support the interpretation of a footprint result calculated using the Global Biodiversity Score (GBS), CDC Biodiversité developed a number of sector specific factsheets that companies can use to compare their impacts to the sector average or to estimate their impact and main pressures on biodiversity. Factsheets were developed for 'Agriculture and Agrifood'[29] and the 'Chemical sector'[30]

No detailed PBAF guidance and requirements on the use of references in the interpretation of footprinting results have been formulated yet and may be included in a future revision of the Biodiversity Footprinting Standard, based on continued discussions in the PBAF Working groups.

R19: *Transparency is required regarding the references/benchmarks used to interpret footprinting results, including potential limitations to these references/benchmarks.*

Science Based Targets for Nature

The Science Based Target Network (SBTN) uses the following definition of science-based targets[31]: "Measurable, actionable, and time-bound objectives, based on the best available science, that allow actors to align with Earth's limits and societal sustainability goals". As can be read from the objective, target ambition levels need to be tied to the Earth's limits. To achieve this, SBTN aims to build on the work by 'The Earth Commission', a group of leading social and natural scientists convened by Future Earth to provide a global-scale assessment of the conditions that define a stable and resilient planet. The translation of the science into targets will be jointly developed by the SBTN and the Earth Commission. Currently, SBTN has published guidance on target setting for a limited set of drivers leading to biodiversity loss: climate change, freshwater and land. For the latter the assessment method is still in development. SBTN is also developing a biodiversity approach[32] and is planning to publish financial sector guidance in 2024.

When the work of the Earth Commission and SBTN progresses, this can offer valuable input to the interpretation of biodiversity impact assessment results in the financial sector. However, it must be realised that these science based targets for nature will be 'spatially specific'; the location of impacts (and dependencies) must be known (SBTN states: "Location-specific or spatial data is at the core of understanding nature risk and impacts"). This need for location specific information is underlined by the TNFD in the TNFD Recommendations.

Target setting guidance by UNEP-FI PRB and Finance for Biodiversity Foundation

Both UNEP-FI PRB (Principles for Responsible Banking) and the Finance for Biodiversity Foundation have developed guidance for target setting on nature and finance[33]. Biodiversity footprinting can play a role in the process of developing these targets, for example by identifying priority

29 CDC Biodiversité, 'Factsheet: Agriculture and Agrifood', October 2021.
30 CDC Biodiversité, 'Factsheet: Chemical', October 2021.
31 Science Based Targets Network, 'Science-based targets for nature; Initial guidance for business', September 2020.
32 Science Based Targets Network, Biodiversity Short Paper. May 2023
33 UNEP-FI PRB, PRB Nature Target Setting, 2023, and Finance for Biodiversity Foundation, Nature Target Setting Framework for Asset Managers and Asset Owners, Beta-version guidance, November 2023.

sectors in a loan and investment portfolio from an impact perspective and to identify key impact drivers in these sectors for engagement purposes.

In summary
When science-based targets for nature and financial sector guidance become available, these targets are expected to play an important role in the interpretation of biodiversity impact assessments (and impact/dependency related risks), provided location specific information on the impacts (and dependencies) is available. The fact that access to location specific data is a key challenge for companies with complex value chains and financial institutions is recognized by both SBTN and TNFD[34]: *"The TNFD recognises that many important nature-related issues will occur upstream and downstream from an organisation's direct operations, but also recognises the complexities that have been experienced with Scope 3 climate-related reporting. There are also data constraints with nature-related reporting, with reliance on the provision of data across value chains. Corporates will need to rely on data from suppliers, while financial institutions will require data from their customers and investees."*

The availability of location specific data is likely to differ across asset classes and will be higher for loans and investments with a more direct relation to investees (see figure 4).

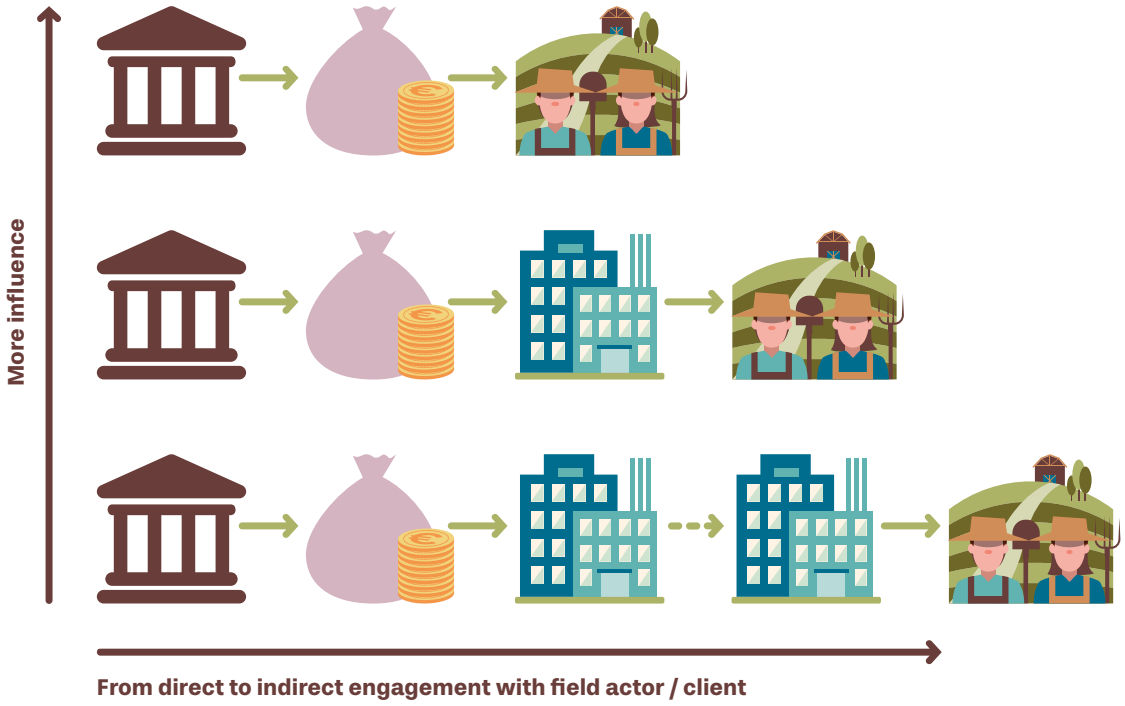


Figure 4: Financial institutions' direct and indirect engagement with clients (source: A Guideline on the use of Deforestation Risk Mitigation Solutions for Financial Institutions, Sustainable Finance Platform, 2021)

A4: *The importance of location specific data in the assessment of impact and dependency related (financial) risks stresses the need to ask clients/investees for such data and maybe even set targets for 'asset location transparency' and 'supply chains transparency' on the level of a loan and investment portfolio.*

34 TNFD, Recommendations of the Taskforce on Nature-related Financial Disclosures, September 2023

7 Footprinting approach per asset class

Photo by Signe Jukevica/Sutterstock

This annex describes the biodiversity footprinting approach for different asset classes. All approaches build on the guidance, requirements and recommendations outlined in the previous chapter. The asset classes covered are:

1. Sovereign debt, Sub-sovereign debt and Supranational debt.
2. Listed Equity, unlisted equity, business loans & corporate bonds
3. Project finance
4. Mortgages
5. Commercial real estate
6. Investments in renewable energy
7. Motor vehicle loans
8. Indirect investments

Each of the sections below covers an asset class and includes a table with a fixed format (see below). First, a definition of the asset class is provided. In the table, the footprinting requirements are outlined, enabling a direct comparison between asset classes. The included asset classes, and the approach followed, builds on the work done by the Partnership for Carbon Accounting Financials. More specifically the second edition of the Global GHG Accounting and Reporting Standard Part A: Financed Emissions[35].

	REQUIREMENT
Scopes covered	Decision on minimum requirements.
Portfolio coverage	Decision on minimum requirements.
Attribution	How is the investor's share of the total impact of the investee attributed?
Data	What data to use? What considerations are important for this decision?
Baselines	What are the different baselines recommended for the assessment of negative, avoided negative and positive impact?
Absolute potential impact vs. impact intensity	What type of impact metric needs to be presented and how should the reporting institution arrive at this? An example of an absolute potential impact metric is the impact of an investment expressed as the percentage or fraction of species that are no longer found due to a man-made impact of some kind (PDF = potentially disappeared fraction of species), calculated using surface area or water volume and the time. An example of an impact intensity is the impact on biodiversity per euro invested or per physical unit produced.
Avoided impact(⋆)	A description of how to account for avoided impact when applicable.
Asset class specific considerations	Room for additional, asset class-specific considerations.
Limitations	The limitations of the proposed methodology are briefly discussed.

Positive impact will be added in a future revision when the discussion around positive impact/ nature positive has matured (see section 5.3).

35 PCAF (2022). The Global GHG Accounting and Reporting Standard Part A: Financed Emissions. Second Edition.

7.1 Sovereign debt, sub sovereign debt and supranational debt

This asset class includes bonds and loans from various territorial entities, including national governments (sovereign), state, municipality or county (sub-sovereign) and supranational territorial entities such as the EU. A sovereign/sub-sovereign/supranational bond is a 'debt security' issued by the entities mentioned. The bonds can be denominated in a foreign currency or a government's domestic currency. The biodiversity footprinting requirements regarding this asset class are outlined below, starting with sovereign debt.

NB: For those debt structures where an explicit use of proceeds is formulated (like sustainability-linked bonds, see also 'Baseline' and 'Avoided impact' in the table below), the approach in the 'Project Finance' asset class can be used instead of the approaches described below.

Supranational debt linked to non-territorial entities (such as IMF) are currently not included in this asset class and may be added in future revisions.

Sovereign debt

1. *Debt structures where an explicit use of proceeds is formulated, like sustainability-linked bonds*
   Use of the approach for the 'Project Finance' asset class.
2. *Debt structures where no explicit use of proceeds is formulated*
   See the table below.

TOPIC	REQUIREMENT
Scopes covered	The GHG protocol and PCAF redefined the Scopes for government debt instruments. The Scopes are now defined more broadly compared to the previous approach. Previously, the emissions and resource use from sovereign debt was based on government spending. Now, a territorial consumption approach is used that includes the emissions and resource use resulting from all domestic consumption. Production emissions and resource use = Scope 1 Consumption emissions and resource use = Scope 1 + 2 +3 – Exported emissions and resource use + Imported emissions and resource use. The following Scopes are used: Scope 1: Domestic emissions/resource use from sources within the national territory Scope 2: Domestic energy use and emissions/resource use from sources outside the national territory Scope 3: Emissions/resource use attributable to non-energy imports because of activities taking place within the country territory. As for carbon emissions, consumption emissions and resource use reflect the demand side of sovereign impact and account for consumption patterns and trade effects. This approach provides a broader view of a sovereign's biodiversity impacts and tackles the issue of impact leakage that arises due to production shifts from countries where the goods and services are consumed. It is also an important metric in the context of broader sovereign responsibility for impacts caused.
Portfolio coverage	All government debt instruments should be covered.

Attribution	*1. Preferred approach* NB: This approach will replace the 'old' approach based on sovereign debt in the next update of the Biodiversity Footprinting Standard. The biodiversity impact that should be attributed to the financial institution shall be calculated in line with the PCAF recommendation on calculating financed emissions. The PCAF approach is based on Purchase Power Parity (PPP)-adjusted GDP (i.e., the value of a country's output as a proxy for the 'value of the country') adjusted by the PPP factor to improve the comparison between the actual economy sizes. Using government debt would be more in line with the approach for listed equity which used enterprise value (EVIC). The rationale behind using the PPP-adjusted GDP is that some countries have low debt (Brunei has only 2% debt compared to GDP) while others have very high debt (Japan has 237% debt compared to GDP). Using debt as the denominator makes the intensity indicator more dependent on the debt than on the biodiversity impact from government spending. Furthermore, government spending is mostly paid by taxes, most often not directly by debt. More detail on the rationale for using PPP-adjusted GDP can be found in chapter 5.7 of the PCAF standard.[36] *2. Alternative approach* NB: This approach is included to provide for a transitional period to the new approach. The approach will be removed in the next update of the Biodiversity Footprinting Standard. Attribution is proportional to the exposure of the financial institution (the sum invested in a sovereign bond) to the government debt plus equity. As government equity is often not disclosed and a financial institution cannot invest in government equity, only government debt can be used as a denominator.
Absolute potential impact vs. impact intensity	PBAF recommends the following intensity metrics for normalization and comparison of sovereign production and consumption impacts intensity, respectively: • for sovereign production intensity: Production Impacts / PPP-adjusted GDP; • for sovereign consumption intensity: Consumption Impacts / Capita. PBAF recommends considering both the production and consumption intensity metrics when comparing, monitoring, and engaging with sovereigns. For a comparison of production impacts intensity, using a GDP metric in the denominator appears straightforward, given the link between a country's production and industrial processes causing emissions and the country's output (GDP). The PPP adjustment of GDP allows for comparing the real sizes of the economies and the output by subtracting the exchange rate effect. This effect becomes relevant for countries with a relatively stronger exchange rate effect and allows for a fairer comparison of the countries. For consumption impacts, PBAF recommends using normalization per capita. Consumption impacts reflect the demand side of the economy, and normalization per capita is a logical step.

36 PCAF (2022). The Global GHG Accounting and Reporting Standard Part A: Financed Emissions. Second Edition.

Data	The World Bank provides up-to-date and credible data on a country's **PPP-adjusted GDP**. This dataset has global coverage, data is available for 2021. Some countries are not included (i.e. Andorra, French Polynesia, Northern Mariana Islands). By dividing a financial institution's investment in a country's sovereign bonds by the country's PPP-adjusted GDP, the attribution factor can be calculated. World Bank and International Monetary Fund (IMF) provide standard macro-economic metrics such as nominal GDP and population (for consumption intensity computation) The emissions and resource use of countries (Scope 1 + 2 + 3 and consumption) can be calculated using EXIOBASE data.
Baseline	The baseline in case of sovereign bonds is the situation in which the economic activities included in government debt calculation would not take place. When green bonds, blue bonds and other sustainability-linked bonds are issued by a government, with a use of proceeds targeted at less impactful economic activities, underlying projects may aim for avoided negative impacts or positive impacts. The impact of such projects can be assessed using a business-as-usual situation as a reference.
Avoided impact	Green bonds, blue bonds and other sustainability-linked bonds issued by a government could lead to avoided impact. How this should be accounted for will need to be assessed on a case-by-case basis (also see 'baseline').
Asset class specific considerations	
Limitations	Double counting occurs in two dimensions: 1. Double counting of impacts of non-sovereign sectors (e.g. corporates) due to accounting of emissions at sovereign territorial level. This represents a challenge for a financial institution with investment portfolios in multiple asset classes. However, double counting within the impact reports of financial institutions is not necessarily problematic as long as impact results of the different asset classes are clearly reported separately. Accounting for all impacts indirectly involved with loans and investments of the different asset classes does ensure that the right considerations are taken when making lending or investment decisions. 2. Double counting of impact of other sovereigns when accounting for impacts beyond Scope 1. The issue is not different from the one with corporate emissions and should be resolved/treated consistently, i.e. double-counting accepted when accounting for impact beyond Scope 1. Attribution factor: PPP-adjusted GDP has its limitations as the attribution factor: it is a flow metric, and the relationship between investments and GDP are not 1:1. There are however reasons as stated above that justify the use of this attribution factor. Alternative attribution factors might still emerge, and PBAF will review these.

Sub sovereign debt

Sub-sovereign debt is not yet covered by the PCAF Standard on Financed emissions. An approach for sub-sovereign debt is being developed by PCAF and is expected to be published in 2025. In order to align with PCAF as much as possible, *PBAF intends to publish an addendum for sub-sovereign debt in 2025.*

In the meantime, in case of debt structures where an *explicit use of proceeds* is formulated (like sustainability-linked bonds), the approach for the 'Project Finance' asset class shall be used.

Supranational debt

Supranational debt is not yet covered by the PCAF Standard on Financed emissions. Since supranational debt can be an important part of an investment portfolio, the approach below should be used until more specific guidance becomes available.

1. *Debt structures where an explicit use of proceeds is formulated, like sustainability-linked bonds*
   The approach for the asset class 'Project Finance' shall be used.
2. *Debt structures where no explicit use of proceeds is formulated*
   Use of the approach for sovereign debt (impact, scopes and attribution rules) to calculate the impact of the underlying sovereign debt in supranational debt.

7.2 Listed Equity and corporate bonds

The asset class definition is aligned with the definition in the PCAF Standard[37] and includes all on-balance sheet listed corporate bonds and all on-balance sheet listed equity[38] that are traded on a market and are for general corporate purposes (i.e., unknown use of proceeds as defined by the GHG Protocol). These include all types of corporate bonds for general corporate purposes, common stock and preferred stock.

For indirect investments (e.g., investments in funds) that incorporate listed equity and bonds, the methodological approach is the same provided the information on the individual holdings is available.

Not covered are:

- Green bonds, sovereign debt, and derivative financial products (e.g., futures, options, swaps). The same holds for short and long positions or special cases of underwriting such as IPO underwriting.
- Assets held for short durations and designated as held for sale. These assets may include, but not be limited to, trading account assets and debt securities carried at fair value.

TOPIC	REQUIREMENT
Scopes covered	The biodiversity footprint should cover Scope 1, Scope 2 and Scope 3 upstream. Scope 3 downstream should be covered to the extent possible to include the impact of the use and end-of-life of products and services. The impacts should be reported separately. Including Scope 3 is important since many impacts on biodiversity will originate in primary production, like agriculture and mining. The impacts on biodiversity from the production of raw materials purchased, product or service use and the product end-of-life phase are often significant and higher than the direct impact of a company's direct operations. Assessing the impacts throughout the entire value chain is therefore critical to properly account for impacts and look for actions that can effectively reduce these impacts, like engagement and the use of biodiversity related investment criteria.

37 PCAF (2022). The Global GHG Accounting and Reporting Standard Part A: Financed Emissions. Second Edition.
38 Listed equity refers to equity that is traded on a stock exchange or another securities exchange

Portfolio coverage	Ideally, 100% of the investment portfolio is covered. If this is not feasible, at least the majority of the portfolio should be covered, and an indication should be provided for a pathway to full coverage. Provide an explanation of which financial product types (futures, ETFs, fund of funds, external mandates, prefs) were included or excluded and what the main method was for estimating missing portfolio data. Pure cash positions can be considered as having zero impact. Other forms of cash or cash-equivalent investments such as money market bonds should be approached as corporate bonds. Short positions can be ignored.
Attribution	Attribution is based on the ratio between the outstanding amount and the value of the financed company. The outstanding amount is the actual outstanding amount in listed equity or corporate bonds. The value of outstanding listed equity is defined based on its market value (i.e., market price times number of shares). The value of outstanding corporate bonds is defined based on the book value of the debt that the borrower owes to the lender. Financial institutions should either use the calendar or financial year-end outstanding amount, provided the approach is communicated clearly and used consistently. For listed companies, this is the enterprise value including cash (EVIC) of the respective company. For corporate bonds this is the sum of total company equity and debt, which can be found on the client's balance sheet. [39]
Absolute potential impact vs. impact intensity	The methodology results in an absolute impact on biodiversity for each company. The impact of all investments in companies in a portfolio can be aggregated as total impact for the listed equity and corporate bonds portfolio. The 'impact intensity' is the impact per euro invested/on loan and can be used to compare the impact intensity between different companies, sectors and asset classes, showing where impact hotspots in an investment portfolio are most likely located.
Baseline	The baseline in case of listed equity is the level of biodiversity when the economic activities linked to the equity would not have taken place. In those case where listed equity is focusing on business activities aiming to avoid negative impacts on biodiversity, the business-as-usual situation shall be used as a baseline to calculate the avoided impacts. For example, in case of listed equity of a company producing meat substitutes, the avoided impact on biodiversity is calculated using the impact of meat consumption in the business-as-usual situation. The net avoided impact is calculated by also taking into account the negative impacts of producing these substitutes.
Data	No preferred resource is recommended. Data should be transparent, consistent, fit for purpose and as much as possible broadly accepted by the scientific community. Actual, primary data provided by companies should be preferred over secondary, estimated, or averaged data from databases. If actual, primary data are not available or the use of primary data is not feasible (e.g., due to the amount of data needed in case of footprint on portfolio level), the use of secondary data is accepted if this is reported explicitly and taken into account in the interpretation of the footprint results.
Avoided impact	If the impact of a company includes avoided impacts, for example in case of the production of 'green energy' (avoided greenhouse gas emissions), the avoided impact can be included in the overall footprint on a portfolio level. This avoided impact should be reported separately from negative impacts and biodiversity positive impacts.

39 Using total enterprise value and total equity + debt is in line with the PCAF standard. More information about the reasoning can be found in paragraph 5.1 of PCAF (2022).The Global GHG Accounting and Reporting Standard Part A: Financed Emissions. Second Edition.

Other considerations	When it is clear that the companies invested in have taken specific measures to limit their impact on biodiversity, e.g., by sourcing certified raw materials/produce, such measures should be taken into account as much as possible. When secondary, estimated, or averaged data are used, impact correction factors may be considered to take account of these measures. The footprint should be fully transparent about the steps taken.
Limitations	In case of the use of secondary data from databases, the footprint will not be responsive to biodiversity action by the companies involved in the listed equity invested in. When the footprint shows that the listed equity invested in constitutes a potential biodiversity impact hotspot, it is advised to zoom in on the companies concerned and assess to what extent these companies have addressed the drivers of biodiversity loss responsible for the impact calculated. The result should be integrated in the footprint to the extent possible.

CASE STUDY: BIODIVERSITY FOOTPRINT OF AN INVESTMENT IN A METALS & MINING COMPANY USING THE CORPORATE BIODIVERSITY FOOTPRINT (CBF)

The Corporate Biodiversity Footprint (CBF) models the impact of corporates through four main environmental pressures on species and habitats and is based on the GLOBIO3 pressure–impact model. These pressures are calculated along the whole value chain of the corporate. In the case study below, the CBF is used to calculate the biodiversity impact of a listed metals & mining company, based on data reported externally by the company and data from publicly available datasets.

The first step is to assess the products purchased and sold by the company throughout its value chain, based on CBF's physical Input/Output model and to allocate these product flows to sectors and subsectors. The second step is to assess the environmental inputs/outputs and impact drivers resulting from these product flows. The impact drivers are translated into an impact on biodiversity using pressure–impact relations. The impact of each driver is expressed in the same biodiversity impact unit, which is Km^2.MSA.
The next step is to aggregate the different impacts into an overall absolute impact and calculate several 'ratios' or impact intensities, both physical and financial ones. This allows a comparison of the company to its peers in the same sector, ranked by intensity.

The result can be visualized by product, pressure and scope.

The split of the biodiversity footprint by the main products of the company reveals the weight of the different products in the footprint result (see figure 1). Iron ore represents the bulk of the volumes of the company but has a lower biodiversity footprint than the other non-

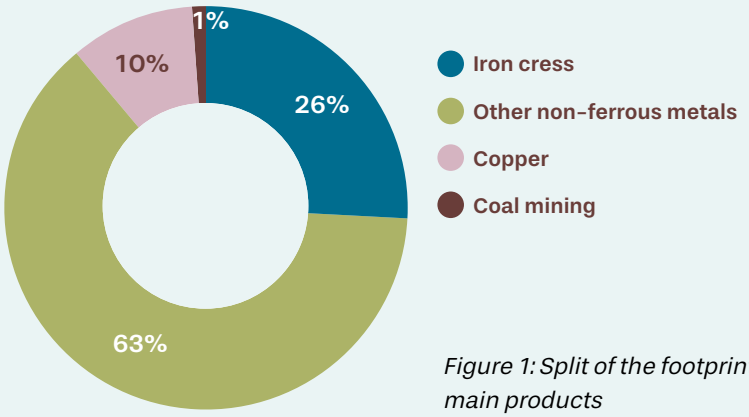


Figure 1: Split of the footprint by main products

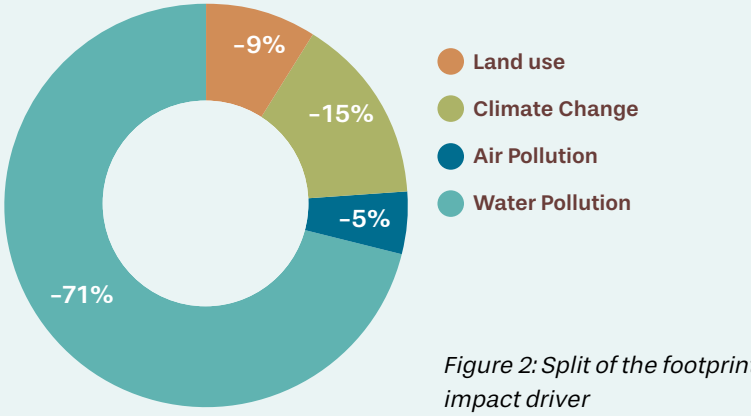


Figure 2: Split of the footprint by impact driver

ferrous metals. Coal has a significant downstream footprint related to its combustion.

The split of the biodiversity footprint by impact driver shows the significance of water pollution (more specifically the impact of 'ecotoxicity'), due to the emissions of substances having an impact on freshwater biodiversity, both at the mining and metal processing phase (see figure 6). Other significant pressures are land use, resulting from the mining process, and climate change, related to metal processing and the (downstream) combustion of coal.

The split of the biodiversity footprint by scope reveals the importance of scope 3 impacts downstream (see figure 3). This is especially true for climate change, resulting from the downstream processing phase of metallic ores and the downstream combustion of coal.

Note that all footprinting tools have certain limitations. One of the limitations of the CBF tool is the fact that the impact of invasive species and direct exploitation of species cannot be included yet in the footprint, since these impact drivers are not yet part of the GLOBIO 3 pressure-impact model.

Source: Case study CBF, Iceberg Data Lab, 2022.

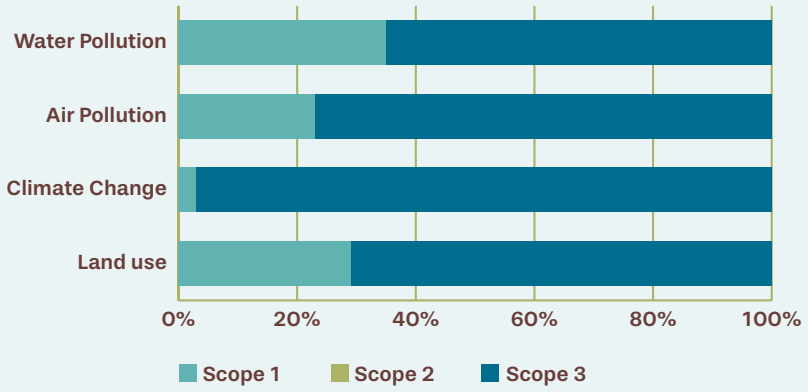


Figure 3: Split of the footprint by scope

7.3 Unlisted equity and business loans

The asset class definition is aligned with the definition in the PCAF Standard and includes:

Unlisted equity

Unlisted equity includes all on-balance sheet equity investments to businesses, nonprofits, and any other structure of organization that are not traded on a market and are for general corporate purposes, i.e., with unknown use of proceeds as defined by the GHG Protocol. Unlisted equity is also referred to as equity investments in private companies (i.e., the financial institution obtains shares of the company).

Private equity that refers to investment funds is not included in this asset class; guidance on such private equity may be developed at a later stage.

Business loans

Business loans include all on-balance sheet loans and lines of credit to businesses, nonprofits, and any other structure of organization that are not traded on a market and are for general corporate purposes, i.e., with unknown use of proceeds as defined by the GHG Protocol. Revolving credit facilities, overdraft facilities, and business loans secured by real estate such as CRE-secured lines of credit are also included. Any off-balance sheet loans and lines of credit are excluded.

For financing products such as revolving credit facilities, bridge loans, and letters of credit, which are commonly provided by financial institutions, only those loans outstanding on the year-end balance sheet of the financial institution are covered by this asset class. Business loans for specific corporate purposes (i.e., with known use of proceeds) are not included in this

asset class but are covered by the project finance asset class, even if they may not be structured as project finance per se. Business loans to finance commercial real estate or motor vehicles are also considered separate asset classes.

The biodiversity footprinting approach for unlisted equity and business loans follows the PCAF methodology and is largely the same as the approach for listed equity and corporate bonds.

TOPIC	REQUIREMENT
Scopes covered	The biodiversity footprint should cover Scope 1, Scope 2 and Scope 3 upstream. Scope 3 downstream should be covered to the extent possible to include the impact of the use and end-of-life of products and services. The impacts should be reported separately. Including Scope 3 is important since many impacts on biodiversity will originate in primary production, like agriculture and mining. The impacts on biodiversity from the production of raw materials purchased, product or service use and the product end-of-life phase are often significant and higher than the direct impact of a company's direct operations. Assessing the impacts throughout the entire value chain is therefore critical to properly account for impacts and look for actions that can effectively reduce these impacts, like engagement and the use of biodiversity related investment criteria.
Portfolio coverage	Ideally, 100% of the investment portfolio is covered. If this is not feasible, at least the majority of the portfolio should be covered, and an indication should be provided for a pathway to full coverage. Provide an explanation of which financial product types (equity, loans, etc.) were included or excluded and what the main method was for estimating missing portfolio data. Cash positions can be considered as having zero impact. Short positions can be ignored.
Attribution	The attribution is comparable to listed equity and corporate bonds. The attribution factor is the ratio between the outstanding amount and the value of the financed company. *Outstanding amount* For business loans, the outstanding amount is defined as the value of the debt that the borrower owes to the lender (i.e., disbursed debt minus any repayments). It will be adjusted annually to reflect the correct exposure, resulting in the attribution to decline to 0 at the end of the lifetime of the loan (i.e., when it is fully repaid). For unlisted equity (i.e., equity investments in private companies), the outstanding amount is the outstanding value of equity that the financial institution holds in the private company. It is calculated by multiplying the relative share of the financial institution in the respective investee by the total equity of the respective investee according to its balance sheet. Financial institutions should either use the calendar or financial year-end outstanding amount, provided the approach is communicated and used consistently. *Company value* For business loans and equity investments to/in private companies, the company value is the sum of total company equity and debt, which can be found on the client's balance sheet. For business loans to listed companies, this is the company enterprise value including cash (EVIC) of the respective client.

Absolute potential impact vs. impact intensity	The methodology results in an absolute impact on biodiversity for each company. The impact of all investments in, and loans to, companies in a portfolio, can be aggregated as total impact for the unlisted equity and business loans portfolio. The 'impact intensity' is the impact per euro invested (equity) or euro on loan (business loans) and can be used to compare the impact intensity between different companies, sectors and asset classes, showing where impact hotspots in an investment portfolio are most likely located.
Baseline	The baseline in case of unlisted equity and business loans is the level of biodiversity when the economic activities linked to the equity/loan would not have taken place. When the equity/loan is focusing on business activities aiming to avoid negative impacts on biodiversity, the business-as-usual situation shall be used as a baseline to calculate the avoided impacts. For example, in case of equity of a company producing meat substitutes, the avoided impact on biodiversity is calculated using the impact of meat consumption in the business-as-usual situation. The net avoided impact is calculated by also taking into account the negative impacts of producing these substitutes.
Data	No preferred resource is recommended. Data should be transparent, consistent, fit for purpose and as much as possible broadly accepted by the scientific community. Actual, primary data provided by companies should be preferred over secondary, estimated, or averaged data from databases. If actual, primary data are not available or the use of primary data is not feasible (e.g., due to the amount of data needed in case of footprint on portfolio level), the use of secondary data is accepted if this is reported explicitly and taken into account in the interpretation of the footprint results.
Avoided impact	If the impact of a company includes avoided impacts, for example in case of the production of 'green energy' (avoided greenhouse gas emissions), the avoided impact can be included in the overall footprint on a portfolio level. This avoided impact should be reported separately from negative impacts and biodiversity positive impacts.
Other considerations	When it is clear that the companies financed have taken specific measures to limit their impact on biodiversity, e.g., by sourcing certified raw materials/produce, such measures should be taken into account as much as possible. When secondary, estimated, or averaged data are used, impact correction factors may be considered to take account of these measures. The footprint should be fully transparent about the steps taken.
Limitations	In case of the use of secondary data from databases, the footprint will not be responsive to biodiversity action by the companies involved in the listed equity invested in. When the footprint shows that the equity/loan constitutes a potential biodiversity impact hotspot, it is advised to zoom in on the companies concerned and assess to what extent these companies have addressed the drivers of biodiversity loss responsible for the impact calculated. The result should be integrated in the footprint to the extent possible.

7.4 Project finance

The asset class definition for project finance is aligned with the definition in the PCAF Standard and includes all on-balance sheet loans or equities to projects or activities that are designated for specific purposes, i.e., with known use of proceeds as defined by the GHG Protocol. The financing is designated for a defined activity or set of activities, such as the construction and operation of a gas-fired power plant, a wind or solar project, or energy efficiency projects. To calculate impact, only the financed (ring-fenced) activities are included. Financials related to existing activities outside the financed project but within the financed organization are not considered.

The biodiversity footprinting requirements regarding project finance are outlined in the table below.

TOPIC	REQUIREMENT
Scopes covered	The biodiversity footprint should cover Scope 1, Scope 2 and Scope 3 upstream. Scope 3 downstream should be covered to the extent possible to include the impact of the use and end-of-life of products and services. The impacts should be reported separately. Including Scope 3 is important since many impacts on biodiversity will originate in primary production, like agriculture and mining. The impacts on biodiversity from the production of raw materials purchased, product or service use and the product end-of-life phase are often significant and higher than the direct impact of a company's direct operations. Assessing the impacts throughout the entire value chain is therefore critical to properly account for impacts and look for actions that can effectively reduce these impacts, like engagement and the use of biodiversity related investment criteria.
Portfolio coverage	In case of an assessment of the biodiversity impact of an investment portfolio, ideally 100% of all project finance is covered. In practice, an assessment of biodiversity impact may also take place to decide on an investment in a selection of one or more specific projects.
Attribution	The attribution is the ratio between the outstanding amount and the and the total equity and debt of the financed project. In the case of debt, the outstanding amount is defined as the value of the debt the borrower owes to the lender (i.e., disbursed debt minus any repayments). In the case of equity, the outstanding amount is the outstanding value of equity the financial institution holds in the project. It is calculated by multiplying the relative share of the financial institution in the respective project by the total equity of the respective project according to its balance sheet. Guarantees have no attribution until they are called and turned into a loan. Financial institutions should either use the calendar or financial year-end outstanding amount, provided the approach is communicated and used consistently.
Absolute potential impact vs. impact intensity	The methodology results in an absolute impact on biodiversity for each project financed. The result can be used to decide on the investment, investment criteria, engagement with the project owners and monitoring requirements. The results can also be aggregated as total impact for the project finance portfolio. The absolute impact can be translated into an impact intensity to report the impact on biodiversity per euro invested in projects. This enables a comparison of different projects within project finance and, on a portfolio level, a comparison of different asset classes, showing where impact hotspots in an investment portfolio are most likely located.

Data	Within the due diligence and monitoring of a project finance transaction, the availability of project-specific data is generally good. As a result, higher quality data on pressures can be obtained than would be available through generic input/output models, without adding an unrealistic amount of additional work to the process. Therefore, it is proposed that input data for project finance should not be based on revenue in the sector which can be linked to generic input-output models, but on project-specific source data, which should be linked to secondary data based on physical quantities. However, since an impact assessment at the start of a project investment needs to be based on expected/estimated impact data, a combination may be necessary of project-specific direct data (like area size and interventions foreseen) and secondary, estimated or averaged data from databases, scientific studies and/or case studies of comparable interventions. The type of data used shall be reported and shall be taken into account in the interpretation of the footprint results.
Baseline	The negative impact of project implementation is calculated using the situation without the activities needed to implement the project (like the use of land and resources) as a baseline. The avoided negative or positive impact on biodiversity of a project is calculated using a business-as-usual situation as a reference (the project does not take place).
Avoided impact	If the investment in a project results in avoided negative impact, this avoided impact can be included in the overall footprint on a portfolio level. For the calculation of avoided impact for green energy projects: see 'Investments in green energy'. Avoided impact should be reported separately from negative impacts and biodiversity positive impacts.
Other considerations	Certification standards can play an important role in projects which intend to deliver a positive outcome for biodiversity, either through a positive impact or an avoided negative impact. For the integration of certification standards in a footprint, see section 4.4 and requirement R10.
Limitations	At the time of the investment in a project, the actual impact on biodiversity has yet to take place. This means that an expected/estimated impact is calculated. When monitoring of the impact following the investment shows that the actual impact is significantly different from the expected/estimated impact, these differences shall be analysed and processed, either to adjust the footprint score and/or to revise engagement activities or monitoring requirements.

7.5 Mortgages

The asset class definition for mortgages is aligned with the definition in the PCAF Standard and includes on-balance sheet loans for specific consumer purposes—namely the purchase and refinance of residential property, including individual homes and multifamily housing with a small number of units. This definition implies that the property is used only for residential purposes and not for commercial activities.

The biodiversity footprinting requirements regarding mortgages are outlined in the table below.

TOPIC	REQUIREMENTS
Scopes covered	*For existing properties* The biodiversity footprint for mortgages should cover Scope 1 and Scope 2, including land occupation and energy use resulting from having a house occupied. *For new properties* The biodiversity footprint for mortgages for newly built properties should cover Scope 1 and Scope 2, including land occupation and energy use resulting from having a house occupied, and Scope 3, resource use and emissions in the construction phase. PBAF recommends financial institutions to find opportunities to influence the homeowner into making pro-biodiversity impact choices. When robust approaches and data to measure the embodied biodiversity impacts of buildings are available, PBAF may decide to expand its coverage to include these impacts.
Portfolio coverage	Ideally, 100% of the mortgage portfolio should be covered. If this is not feasible, at least the majority of the portfolio should be covered, and an indication should be provided for a pathway to full coverage.
Attribution	The share of impact assigned to the financial institution providing a mortgage is calculated by dividing the outstanding amount of the mortgage and the property value at the time of loan origination[40].
Absolute potential impact vs. impact intensity	The methodology results in absolute footprint per household, which can be aggregated as total impact for the mortgages portfolio. A distinction can be made between mortgages for existing properties and mortgages for properties to be built. This information can be translated into an impact intensity, the impact on biodiversity per euro invested in mortgages, which enables a comparison of impact intensity between different asset classes, showing where impact hotspots in an investment portfolio are most likely located.
Data	Actual data on the energy consumption of the properties should be used, if available. An alternative approach is to use the average use of electricity and natural gas of the energy labels of the housing for which the mortgages are provided. Actual data on the land use of the properties should be used, if available. If such data are not available, the average land use of housing in the country or region considered can be used. This average land use should at least include the housing itself. If data are not available in such detail, the land use can also include the garden, communal spaces and roads. The latter would be based on the average number of houses per hectare in suburban areas. Actual data on construction of the properties should be used in case of properties to be built.

40 Using this loan-to-value approach is in line with the PCAF standard. More information about the reasoning can be found in paragraph 5.5 of PCAF (2022).The Global GHG Accounting and Reporting Standard Part A: Financed Emissions. Second Edition.

Baseline	The baseline in case of mortgages for existing properties is the situation in which the land occupation and energy use resulting from having a house occupied would not have taken place. The baseline in case of properties to be built is the situation in which the construction, land occupation and energy use resulting from having a house occupied would not have taken place.
Avoided emissions	A mortgage on a house that is climate-positive, i.e. generating more energy than it consumes, can be seen as avoided greenhouse gas emissions. Such avoided emissions, reducing one of the drivers of biodiversity loss, can be included in the calculation of the biodiversity footprint of the mortgage.
Other considerations	Land transformation that may have occurred before construction of the housing does not have to be taken into account, since information on this transformation, including the biodiversity value of the land before transformation, will often not be available.
Limitations	No specific limitations, other than limitations resulting from the quality of the data used.

7.6 Commercial real Estate (CRE)

The asset class definition for commercial real estate is aligned with the definition in the PCAF Standard and includes on-balance sheet loans for specific corporate purposes, namely the purchase and refinance of commercial real estate (CRE), and on-balance sheet investments in CRE when the financial institution has no operational control over the property. This definition implies that the property is used for commercial purposes, such as retail, hotels, office space, industrial, or large multifamily rentals. In all cases, the owner of the building uses the property to conduct income-generating activities.

Moreover:

- In case of no operational control, CRE investments by asset owners are also included in this method. These investments consist of deals where the asset owner partially owns the building in a joint venture, joint operation, or in joint ownership, but doesn't have the full authority to introduce and implement operating policies at the property.
- CRE investments listed in the stock market are classified as listed equity. In this case, financial institutions shall use the method for listed equity.
- Loans secured by CRE for other purposes than CRE and loans to CRE companies that are unsecured are classified as business loans if the loans are for general corporate purposes (i.e., with unknown use of proceeds as defined by the GHG Protocol). In these cases, financial institutions shall use the method for business loans.
- Loans for construction and renovation of CRE are optional. As the building is often constructed by a third party (i.e., a construction company) contracted by the project developer, the emissions of the construction are normally reported under Scope 3 of the project developer during the building's construction phase. As such, it can be impractical for the lender to measure the financed impact of a construction or renovation loan unless the project developer reports construction impact. The following section on emission scopes covered provides further explanation.

The biodiversity footprinting requirements regarding Commercial Real Estate (CRE) are outlined in the table below.

TOPIC	REQUIREMENTS
Scopes covered	For the biodiversity footprint for commercial real estate, Scope 1 and Scope 2 are included, including land occupation and energy use resulting from having a house occupied. Whether impacts related to the construction of the housing (Scope 3) need to be included is subject to discussion. Including these impacts might lead to double counting with investments in construction. For this 2024 version of the standard the approach of PCAF is followed, and Scope 3 is excluded. PBAF recommends financial institutions to find opportunities to influence the homeowner into making pro-biodiversity impact choices. When robust approaches and data to measure the embodied impacts of buildings are available, PBAF may decide to expand its coverage to include these impacts.
Portfolio coverage	Ideally, 100% of the CRE portfolio should be covered. If this is not feasible, at least the majority of the portfolio should be covered, and an indication should be provided for a pathway to full coverage.
Attribution	In line with PCAF, the share of impact assigned to the financial institution providing the loan is calculated by dividing the outstanding amount by the property value at the time of loan or equity origination. When the property value at loan or equity origination is not feasible to obtain, financial institutions shall use the latest property value available and fix this value for the following years. The property value should include the value of the land, the building, and any building improvements. When investing in CRE, asset owners can fully or partially finance properties either individually or in collaboration with others. If a single asset owner fully funds CRE without operational control, all impact is attributed to their financing. In joint financing scenarios, impact is allocated based on each asset owner's investment share.
Absolute potential impact vs. impact intensity	The methodology results in absolute footprint per loan or investment, which can be aggregated as total impact for the CRE portfolio. This information can be translated into an impact intensity to report the impact on biodiversity per euro invested, enabling a comparison of impact intensity between different asset classes, showing where impact hotspots in an investment portfolio are likely located.
Data	Actual data on the energy consumption and land use of the properties should be used, if available. If such data are not available, the average land use of housing in the country or region considered can be used. This average land use should at least include the housing itself. If data are not available in such detail, the land use can also include the garden, communal spaces and roads. For energy use, public sources can be used. PCAF also launched a **publicly available database of emission factors for European buildings**.
Baseline	The baseline in case of CRE is the situation in which the land occupation and energy use resulting from the real estate would not have taken place.
Avoided emissions	A commercial real estate that is climate-positive, i.e. generating more energy than it consumes, can be treated as as avoided greenhouse gas emissions. Such avoided emissions, reducing one of the drivers of biodiversity loss, can be included in the calculation of the biodiversity footprint of the CRE.
Other considerations	Land transformation that may have occurred before construction of the housing does not have to be taken into account, since information on this transformation, including the biodiversity value of the land before transformation, will often not be available.
Limitations	No specific limitations, other than limitations resulting from the quality of the data used.

7.7 Investment in renewable energy

Investments in renewable energy may overlap with other asset classes, like project finance. The biodiversity footprinting requirements regarding investments in renewable energy are outlined in the table below.

TOPIC	REQUIREMENTS
Scopes covered	The biodiversity footprint should cover Scope 1, 2 and 3, including the use and end-of-life phase.
Portfolio coverage	Ideally, 100% of the renewable energy portfolio should be covered. If this is not feasible, at least the majority of the portfolio should be covered, and an indication should be provided for a pathway to full coverage.
Attribution	Impacts are attributed to investors as 'owners' of the renewable energy projects. In other words, attribution in this case is the ratio of invested value per project over the total investments in the project.
Absolute potential impact vs. impact intensity	The methodology results in an absolute impact on biodiversity for each project financed. The result can be used to decide on the investment, investment criteria, engagement with the project owners and monitoring requirements. The results can also be aggregated as total impact for the renewable energy portfolio. The absolute impact can be translated into an impact intensity to report the impact on biodiversity per euro invested in renewable energy projects. This enables a comparison of different renewable energy projects. On a portfolio level, a comparison can be made of different asset classes, showing where impact hotspots in an investment portfolio are most likely located.
Data	Since an impact assessment at the start of a project investment needs to be based on expected/estimated impact data, a combination may be necessary of actual, primary data provided by projects (like electricity production data) and secondary, estimated or averaged data from databases, scientific studies and/or case studies of comparable interventions. Ideally project specific electricity production data will be used. The type of data used shall be reported explicitly and shall be taken into account in the interpretation of the footprint results.
Baseline	The avoided negative impact of investments in renewable energy is calculated using a business-as-usual situation (the production and use of 'grey' energy from the grid) as a baseline. The negative impact of the production of renewable energy (like material use for the production of wind mills and solar panels) is calculated using the situation without these activities as a baseline. Positive and negative impacts which cannot yet be quantified, like the creation of new habitats by off-shore wind mills and impacts of wind mills on birds and bats shall be included in the qualitative analysis.
Avoided emissions	A footprint of investments in renewable energy can take into account the avoided electricity production from grey electricity sources, as renewable energy replaces grey electricity from the grid. This can be done using the average grid mix from the country where the renewable energy is produced. Since the share of renewables in the electricity mixes worldwide is growing, the avoided emissions will decrease over time. The avoided impact can be included in the overall footprint on a portfolio level. This avoided impact should be reported separately from negative impacts and biodiversity positive impacts.

Other considerations	For investments in renewable energy funds with multiple projects across different countries, the impact can be calculated based on the technological spread (wind, solar, hydro) and the regional spread of the fund.
Limitations	The assumption that renewable energy replaces grey electricity from the grid (see 'baseline') will not always reflect reality. This is accepted in order to reward investments in renewable energy in a footprint, since climate change is one of the main drivers for biodiversity loss. For this reason, technologies that facilitate low-carbon electricity production will contribute to a reduction of further biodiversity loss.

CASE STUDY: BIODIVERSITY FOOTPRINT FOR INVESTMENTS IN RENEWABLE ENERGY

Climate change is one of the main drivers for biodiversity loss and the use of fossil fuels for energy is a key source of GHG emissions contributing to climate change. Investments in green electricity can contribute to a reduction of this pressure on biodiversity. The following case study illustrates a biodiversity footprint calculation for a solar PV project using the BFFI methodology.

Solar PV energy projects

When calculating the impact from solar energy projects, the first step is to translate the investment in euro, into the annual production of energy in MJ (or kWh). To do so, the expected installed capacity from an investment in solar energy is calculated. This is done by multiplying the value of the investment by the investment costs in euro per kW. These costs differ per country (and project). Unless project specific values for installed capacity, or annual electricity production data are available, data on an "average" solar energy project in a country can be used.

For the calculation of all inputs and emissions of the supply chain, construction, maintenance and operation of solar PV projects, the 'Production of electricity by solar photovoltaic' from the corresponding country in EXIOBASE was used. In order to incorporate the benefits of renewable energy compared to the current electricity mix, the avoided emissions were calculated using the EXIOBASE dataset 'Electricity Mix' for the corresponding country. It is assumed that the energy produced will displace the average grid mix electricity in that country. The 'avoided' impacts were subtracted from the negative impacts of producing solar energy.

The assumption that solar energy replaces a national grid mix is compatible with the PBAF guidelines, but is in fact a conservative way to calculate this. When we look what actually happens in the energy market we will see that if more solar or wind energy enters the grid, the market will switch off those energy generation plants that have the highest marginal costs. Hydropower and nuclear energy plants are characterized by high investment costs and very low operating costs, so these will almost never be switched off. Fossil energy plants have relatively low investment, but high operating costs because they use much fuel. It is therefore much more logical that these will be switched off first, and thus one can safely assume that solar and wind energy replaces fossil fuel based power generation. This also applies in a country like France, that hardly has any fossil fuel based electricity production. France is a relatively high exporter

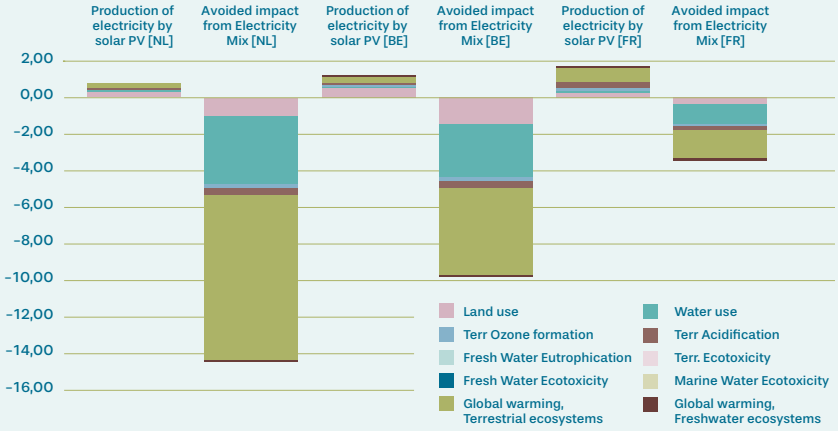


Figure: Biodiversity impact from investing 1MEUR in Solar PV in The Netherlands, Belgium and France. The chart shows the biodiversity loss from PV production and the avoided impact from the grey electricity mix in PDF.ha.yr (expressed in Ha where all biodiversity is lost during one year)

of electricity in Europe (because of the low costs of nuclear energy), so a surplus production will lead to a reduction of fossil fuel in other countries.

The following chart shows the biodiversity impact of solar PV projects in the Netherlands, Belgium, and France. The benefit of renewable energy sources is highest in countries with a carbon intensive energy mix, as the production of renewable energy will replace the average grid mix. In France we find that the grid mix has a relatively low carbon intensity due to the high share of nuclear energy in the French grid mix, which causes significantly less climate change than other fossil energy sources. The results are expressed in hectares where all biodiversity is lost during one year. This unit is derived from the PDF.m2.yr unit from the ReCiPe pressure-impact model. This unit is a multiplication of the potential disappeared fraction of species (PDF), the area where they are lost and the duration of the loss. For simplicity the disappeared fraction is set to 100% and since the reporting period is one year, the duration time is fixed to 1 year. This allows us to report in hectares where all biodiversity is lost during one year. Note that a negative value is in fact a negative loss of biodiversity and therefore positive.

In the case study, the negative impact on biodiversity from an investment of 1 million euro in solar PV varies between 1 and 2 ha, depending on the country. The *avoided* negative impact from solar energy compared to the grid mix (the 'business as usual' situation) varies between -3 and -15 ha. The main drivers of negative impact are climate change, land use and water use. Other drivers such as eutrophication, acidification and ecotoxicity are less important in this case study. N.B.: it must be realized that not all impacts of investments in green energy can be captured by the ReCiPe model. For example, negative impacts of windmills on birds and bats are not included in the ReCiPe methodology. The same is true for potential positive impacts of offshore wind parks (like the creation of artificial reefs). This is the reason why the quantitative analysis is accompanied by a qualitative analysis. This qualitative analysis provides input for a correct interpretation of the results and for biodiversity relevant investment criteria (e.g. no investments in wind parks close to bird migrating routes) or engagement with investees.

Source: Case study BFFI, PRé, 2022.

7.8 Motor vehicle loans

The asset class definition for motor vehicle loans is aligned with the definition in the PCAF Standard and includes on-balance sheet loans and lines of credit to businesses and consumers for (corporate or consumer) finance of one or several motor vehicles. The PCAF standard provides the following, non-exhaustive, list of vehicles:

- Passenger car
- Motorcycle
- Light commercial truck (e.g., vans)
- Medium/heavy commercial truck
- Recreational vehicles
- Bus
- Snowmobiles/all-terrain vehicles
- Boats, including outboard motors
- Yellow equipment (i.e., earth-moving vehicles for mining and construction)

A mentioned by PCAF, financial institutions typically finance motor vehicle loans through consumer lending or business lending. Consumer lending for motor vehicles includes financing the purchase of a motor vehicle for a private person, whereas business loans for motor vehicles typically includes financing a fleet of motor vehicles for a business.

The biodiversity footprinting requirements regarding motor vehicle loans are outlined in the table below.

TOPIC	REQUIREMENT
Scopes covered	The biodiversity footprint should cover Scope 1 (impact from direct emissions from fuel combustion in vehicles) and Scope 2 (impact of indirect emissions from electricity generation consumed in EVs, including hybrid and fully EVs) for all vehicles financed. Scope 3 upstream should be covered in case of new vehicles financed. Including Scope 3 upstream is important since many impacts on biodiversity will originate in the production of vehicles. Assessing the impacts throughout the entire value chain is critical to properly account for impacts and look for actions that can effectively reduce these impacts.
Portfolio coverage	All motor vehicle loans should be covered.
Attribution	In line with the PCAF standard, the attribution of impact is calculated as the ratio between the outstanding amount and the value of the motor vehicle at loan origination.
Absolute potential impact vs. impact intensity	The methodology results in an absolute impact on biodiversity for each loan. The results can be aggregated as total impact for the motor vehicle loans. The absolute impact can be translated into an impact intensity to report the impact on biodiversity per euro on loan in motor vehicle loans. On a portfolio level, a comparison can be made of different asset classes, showing where impact hotspots in an investment portfolio are most likely located.
Data	
Baseline	The baseline in case of motor vehicle loans is the situation in which the use (all vehicles) and the production (new vehicles) would not have taken place.
Avoided impact	
Asset class specific considerations	Impacts can be calculated depending on the level of data available. The options are presented in descending order of preference (see the PCAF Standard for financed Emissions for more details on the calculation of financed emissions in case of motor vehicle loans): • Option 1: Actual vehicle-specific emissions and resource use. Actual emissions can be based on, among others, actual fuel consumption. Fuel consumption can also be estimated based on the vehicle model and actual distance travelled. Actual resource use can be based on the vehicle model. • Option 2: Estimated vehicle-specific emissions and resource use. This can be based on the vehicle model and estimated local or regional travel distances. • Option 3: Estimated average vehicle emissions and resource use based on average travel distances and average resource use for vehicle types. • Option 4: Estimated emissions and resource use based on input-output databases such as EXIOBASE. Option 1-3 are in line with the PCAF standard[41], option 4 is added as the least preferred option in case no specific data is available.
Limitations	No specific limitations, other than limitations resulting from the quality of the data used. For example, the use of sector average data (option 4) does not allow any differentiation between the different manufacturing choices and vehicle models.

41 The options 1-3 are described in the PCAF standard. More information about the reasoning can be found in paragraph 5.6 of PCAF (2022).The Global GHG Accounting and Reporting Standard Part A: Financed Emissions. Second Edition.

7.9 Indirect investments

Indirect investments are characterised by having an investment exposure through a 'vehicle', ideally with a look through for the underlying or ring-fenced assets where the financial institution is ultimately invested in. The exposure can consist of a single asset, a local or international universe, and listed as well as private markets. Examples of indirect investments include:

- Equity vehicles, like investment funds (including ETFs and fund of funds) in public and private markets.
- Bond vehicles, like covered bonds and asset-backed securities.
- Derivatives, like FX forwards, IRS, Options, Futures, CDS.
- Collateral, like pledged for derivates (cleared and OTC), securities lending, or reinsurance.

Guidance on indirect investments in the PBAF Footprinting Standard v2022 was based on the guidance provided by the PCAF standard in 2020[42]. However, indirect investments are not covered anymore by the PCAF Standard on Financed Emissions, with the exception of indirect investments (e.g. investments in funds) that incorporate listed equity and bonds.

Indirect investments that incorporate listed equity and bonds

For indirect investments (e.g. investments in funds) that incorporate listed equity and bonds, the methodological approach is the same provided the information on the individual holdings is available. See the approach under *'Listed equity and corporate bonds'*.

General approach other indirect investments

In general, the attributed impacts of the underlying assets for indirect investments should be aggregated and calculated according to the methodology for each specific asset class, such as sovereign bonds, listed equities or mortgage loans. Impacts of the underlying assets in an indirect investment are proportionally attributed to the investor's share in the total vehicle.
Pure cash holdings are considered as having zero impact.

Guidance on derivates most commonly used by financial institutions (see examples in the PBAF Standard 2022) will be considered for future updates of the Biodiversity Footprinting Standard.

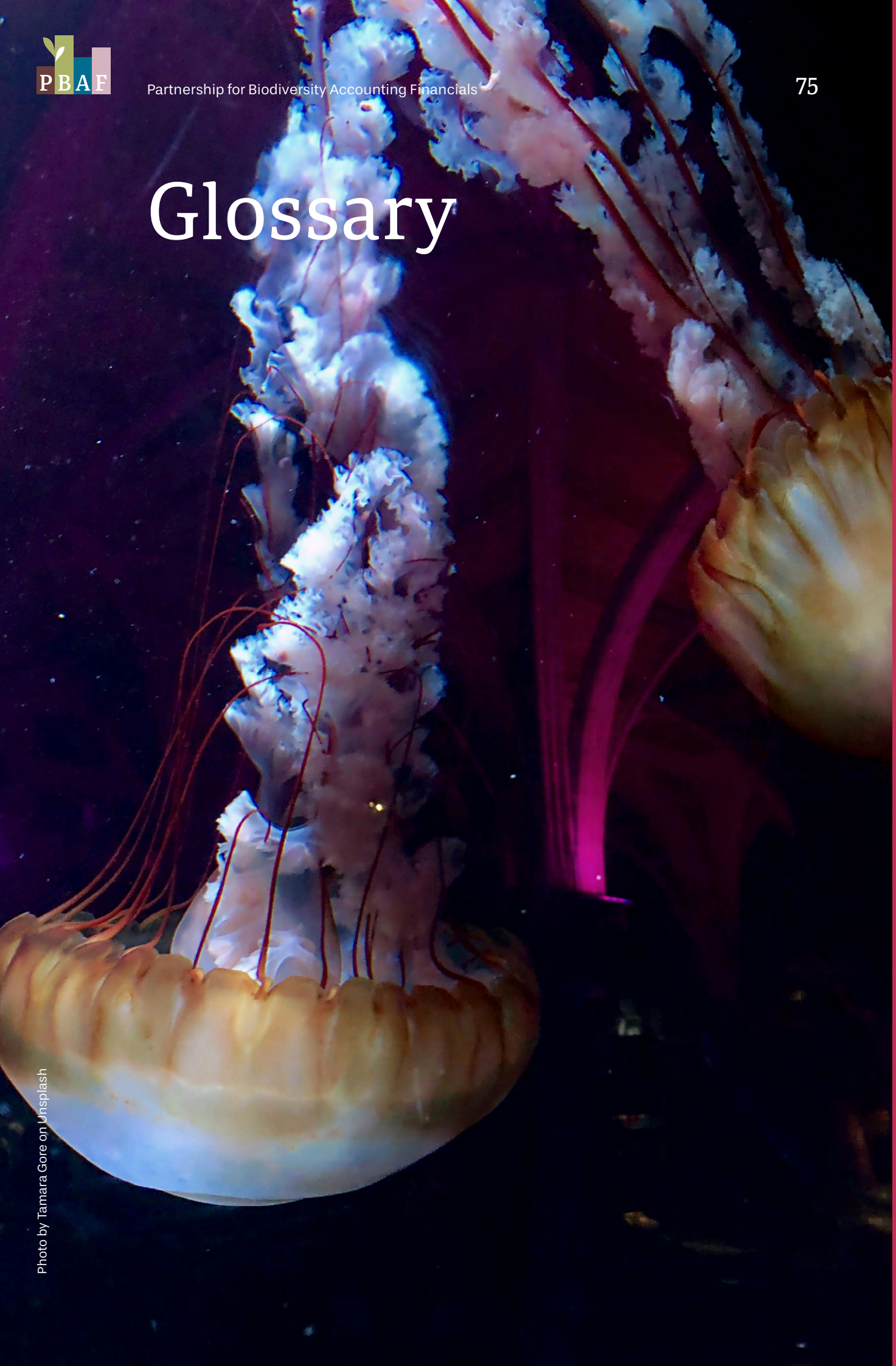
The general approach for indirect investments is included in the table below.

TOPIC	REQUIREMENTS
Scopes covered	Regardless of the nature of the underlying assets of the indirect investments, the biodiversity footprint should cover Scope 1, Scope 2 and Scope 3 upstream and (preferably) downstream.
Portfolio coverage	Ideally, 100% of the indirect investments should be covered. If this is not feasible, at least the majority of the portfolio should be covered and an indication should be provided for a pathway to full coverage.
Attribution	The attributed impacts of the underlying assets for indirect investments should be aggregated and calculated according to the methodology for each specific asset class, such as sovereign bonds, listed equities or mortgage loans. Pure cash holdings are considered as having zero emissions. Impacts of the underlying assets in an indirect investment are proportionally attributed to the investor's share in the total vehicle.

42 PCAF (2020). The Global GHG Accounting and Reporting Standard for the Financial Industry. First edition.

Absolute potential impact vs. impact intensity	The methodology results in an absolute impact on biodiversity for indirect investments. The result can be used to decide on the investments, investment criteria, engagement with the asset manager or issuer and monitoring requirements. The absolute impact can be translated into an impact intensity to report the impact on biodiversity per euro invested in indirect investments. This enables a comparison of different indirect investments. On a portfolio level, a comparison can be made of different asset classes, showing where impact hotspots in an investment portfolio are most likely located.
Data	The first and most reliable source for the impact of an indirect investment should be the asset manager or issuer, based on existing PBAF guidelines and independently verified. Investors should engage with these asset managers and issuers to disclose the attributable impacts of these indirect investments. If not provided, impact data could be made available by other providers, like public data sources or designated data vendors. Investors can engage with data vendors to provide these data. Finally, the investor can assess the indirect investment impacts by capturing the underlying portfolio (look through) and calculating the pro rata impacts with his own PBAF models and data sources. Investors should engage with asset managers and issuers to fully disclose the holdings of their investment funds. This approach is only realistic for underlying assets in public markets.
Baseline	The baseline in case of indirect investments depends on the underlying assets. See also the choice of baseline for the other asset classes discussed.
Avoided impact	If indirect investments result in avoided negative impact (e.g. in case of green bonds), this avoided impact can be included in the overall footprint on a portfolio level. This avoided impact should be reported separately from negative impacts and biodiversity positive impacts.
Other considerations	See 'project finance' for considerations regarding the role of certification standards in projects. See 'investments in renewable energy' for considerations regarding renewable energy bonds.
Limitations	See 'project finance' and 'investments in renewable energy' for limitations regarding footprint calculations for projects and investments in renewable energy. General limitations in case of indirect investments: • Not all providers of indirect investments disclose biodiversity impacts according to the PBAF methodology. • Not all providers of indirect investments disclose the relevant biodiversity impacts for investors. • Not all providers of indirect investments disclose their full underlying portfolio, so investors cannot calculate the impacts themselves. • Indirect investments may have an international universe and part of the universe can be in private markets. It will be challenging (or impossible) for the investor to make the PBAF calculation with a look through approach, because of the required biodiversity impact data for the underlying assets.

Glossary



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An overview of selected terms frequently used in model-based biodiversity footprinting is presented below. Definitions of the asset classes included in this standard can be found in the sections dealing with these asset classes. PBAF will continue to seek alignment with definitions from other initiatives such as TNFD[43], SBTN[44], Align[45] and PCAF[46].

		ALIGNED WITH:
Absolute potential impact	Impact attributed to an investment or investor. The term 'absolute potential impact' is also used to indicate the calculation of the impact of an activity, using a baseline.	
Actual impact	An actual impact on biodiversity is an observed change in biodiversity measured directly on the ground.	
Asset class	A group of financial instruments that have similar financial characteristics.	
Attribution factor	The share of impact drivers linked to the borrower or investee that are allocated to the loan or investment.	
Avoided negative impact	The avoidance of negative impact on biodiversity refers to the reduction or impact prevention of negative impacts resulting from an intervention/economic activity by means of, for example, better management practices or the replacement of raw materials with a high impact on biodiversity with raw materials with a lower impact on biodiversity. The avoided negative impacts can refer to existing impacts, but can also relate to future, expected impacts.	Align
Baseline	A minimum or starting point with which to compare other information (e.g., comparisons between past and present or before and after an intervention)	Align
Biodiversity metric	A system or standard of measurement capturing changes in biodiversity.	TNFD Biodiversity Indicators Partnership
Drivers of nature change	All external factors that affect nature, anthropogenic assets, nature's contributions to people and good quality of life. They include institutions and governance systems and other indirect and direct drivers (both natural and anthropogenic). Please note that these 'drivers of nature change' were called 'impact drivers' in the 2022 version of the PBAF Biodiversity Footprinting Standard.	TNFD
GDP	Gross domestic product (GDP) is the standard measure of the value added created through the production of goods and services in a country during a certain period.	
Impact driver	A measurable quantity of a natural resource that is used as a natural input to production (e.g. the volume of sand and gravel used in construction) or a measurable non-product output of a business activity (e.g., a kilogram of NOx emissions released into the atmosphere by a manufacturing facility). Please note that 'impact drivers' were called 'environmental inputs and outputs' in the 2022 version of the PBAF Biodiversity Footprinting Standard.	Capitals Coalition, TNFD

43 Taskforce on Nature-related Financial Disclosures, Glossary, Version 2.0, June 2024
44 SBTN Glossary of Terms, SBTN Steps 1-3 Glossary, 2022
45 UNEP-WCMC, Capitals Coalition, Arcadis, ICF, WCMC Europe (2022) Recommendations for a standard on corporate biodiversity measurement and valuation, Aligning accounting approaches for nature
46 PCAF (2022). The Global GHG Accounting and Reporting Standard Part A: Financed Emissions. Second Edition.

Impact intensity	The absolute impact of a company can be divided by the market capitalization, the enterprise value or the revenue of a company to get the impact per (invested) euro and per euro revenue. Another option is to calculate impact intensity based on physical units, like the production of a ton of soy. Impact intensities allow for better comparison of companies with different sizes and with different production related impacts.	
Impact on biodiversity	The negative or positive effect of business activity on biodiversity.	Align
Indirect impact	A change in the state of biodiversity caused by an impact driver or business activity with an indirect causal link (for instance GHG emissions have indirect impacts on biodiversity). Please note that 'indirect impact' is also sometimes used to refer to impacts in the value chain.	Align
Input-output database	Input-output databases are built from input-output tables of a countries' the system of national accounts. An input-output table depicts the flows of goods and services represented by their monetary value during a specific period (typically one year) between the economy's various sectors. Each entry, or cell, details the value of goods supplied by one "industry" and acquired by another. A global input-output database harmonizes individual countries' input-output tables and international trade flows, making a model of the world economy. Input output databases can include environmental, economic, and social extensions.	
Investee	In this document, the investee is the organisation, company or project a financial institutions is investing in or providing a loan to.	
Investment	The term 'investment' (unless explicitly stated otherwise) is used in the broad sense: 'putting money into activities or organisations' with the expectation of making a profit'. Most forms of investment involve some form of risk taking, such as investment in equities, debt, property, projects, and even fixed interest securities which are subject to inflation risk, amongst other risks.	
LCA	Life Cycle Assessment, is a methodology for assessing environmental impacts associated with all the stages of the life cycle of product, process, service, or company.	
LCI	Life cycle inventory (LCI) is the methodology step that involves creating an inventory of input and output flows for a product system. Such flows include inputs of water, energy, and raw materials, and releases to air, land, and water. The inventory can be based on literature analysis or on process simulation.	
LCIA	Life cycle impact assessment (LCIA) translates emissions and resource extractions into a limited number of environmental impact scores by means of so-called characterization factors. These factors represent the magnitude the impact on the environment of an emission or a resource used.	
MSA	Means Species Abundance, a metric used to measure biodiversity intactness or the remaining level of biodiversity in an impact area. MSA offers a value from 0 (completely destroyed ecosystem with no original species) to 1 (species abundance is unchanged).	

Negative impact	A negative impact means a loss of biodiversity resulting from interventions (like economic activities) compared to a baseline.	
PDF	Potentially disappeared fraction of species, a metric used to assess the potential decline in species richness in an area over a time period. PDF offers a value from 0 (completely intact ecosystem) to 1 (all species are lost).	
Positive impact	To be included in 2025.	
Potential impact	A potential impact on biodiversity is the impact on biodiversity that might take place as a result of changes in the drivers of nature change. Whether this potential impact will result in an actual impact also depends on the characteristics of the impact location. For example, water use is an important driver of biodiversity loss. Therefore, the use of water has a potential impact on biodiversity. The actual impact of water use will depend on site specific characteristics of the ecosystems, like the level of water scarcity in the impact area.	
PPP adjusted GDP	Purchase Power Parity (PPP)-adjusted GDP (i.e., the value of a country's output as a proxy for the 'value of the country') adjusted by the PPP factor to improve the comparison between the actual economy sizes. Purchasing power parities, abbreviated as PPPs, are indicators of price level differences across countries. PPPs tell us how many currency units a given quantity of goods and services costs in different countries.	PCAF Standard Financed Emissions
Reference state	Previous state or desired state (of nature) which a target aims to recover or achieve.	Align
Scope 1	All activities and sites (e.g., buildings, farms, mines, retail stores) over which the enterprise has operational or financial control. This includes majority-owned subsidiaries. Depending on the activities owned or operated by the company, this can include material or resource extraction, manufacturing and processing, packaging, distribution and storage.	SBTN
Scope 2	The purchase and consumption of electricity, including the production of energy, distribution of electricity, and heating or cooling of facilities used in direct operations.	GHG-Protocol
Scope 3	All activities that are linked to the sale of products and services produced by the company. This includes the use and re-use of the product and its end of life, including recovery, recycling, and final disposal. Depending on the activities owned and operated this typically includes distribution and storage, activities associated with the use of a product or service (within households, other companies, or other users such as governments) end-of-life (e.g., landfilling or incineration) and recycling.	SBTN

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Annex 1 Overview footprinting requirements and recommendations

Photo by Bernd Dittrich on Unsplash

R1: *In case of a quantified biodiversity footprint, the focus shall be on biodiversity as a whole, not on specific species or ecosystems (like endangered ones) only.*

R2: *Since the link between a loan or investment and economic activities determines what impact drivers (resource use and emissions) will be included in the footprint calculation, transparency about this step is required. If full transparency is not possible due to data related legal restrictions, the step and possible limitations needs to be explained.*

R3: *In a biodiversity footprint, the full Scope 1 ('Direct operations'), Scope 2 (energy purchased, part of 'Upstream value chains') and Scope 3 ('Upstream value chains' and 'Downstream value chains') shall be included. Impacts per Scope shall be reported separately.*

R4: *Transparency is required regarding the inclusion of the different Scopes and the potential consequences for the footprinting results of not (fully) including one or more of the Scopes.*

R5: *For the biodiversity footprint to be relevant, the main drivers of nature change shall be covered in the impact assessment / footprint, as well as the most important impact drivers/ pressures linked to these drivers of nature change. Drivers of nature change and related key impact drivers/pressures that cannot be included in the quantitative impact assessment shall be covered by means of a complementary qualitative analysis.*

R6: *A biodiversity footprint shall cover terrestrial, freshwater and marine impacts on biodiversity. Realms that cannot (yet) be fully included in the quantitative impact assessment shall be covered by means of a complementary qualitative analysis.*

R7: *The choice of baseline(s), reference state(s) and cutoff date(s) used in footprint calculations shall be transparent and disclosed.*

R8: *If a certification standard includes measures, captured in certification criteria, aimed at reducing specific environmental pressures compared to standard (sector average) practices, these reductions in pressures may be translated into one or more 'impact correction factors' to correct a footprint based on sector average environmental data, provided that:*

k) The certification standard is a voluntary, criteria based, third-party assessed program, based on life cycle considerations.
l) There is no evidence of net negative impacts associated with the certification.
m) The certification standard includes criteria which explicitly address one or more drivers of biodiversity loss and/or the enhancement of biodiversity. Special attention should be given to uncaptured trade-offs when estimating a correction factor without all drivers being addressed.
n) The impact correction factor takes into account potential differences in the certification criteria in different countries.
o) The impact correction factor is limited to the criteria mentioned under (c) and to those criteria that need to be implemented before certification can be obtained. No voluntary criteria or criteria which can, but do not have to be selected from a long list of criteria and no criteria with a non-compliance.
p) The impact correction factor is preferably based on quantified changes in impact drivers required by and specified in the certification standard.
q) The impact correction factor takes into account the percentage of produce which has been certified according to the certification standard when applying the correction factor to assess the impact of a production company.
r) he impact correction factor takes into account the effect the certification standard already has on the sector average which is adjusted.

s) *The certifications for which correction factors have been applied are disclosed with the result of the footprint. The correction factors shall be available to the financial institution using the footprint, e.g. in a public methodology report.*
t) *A footprint without the use of correction factors shall be disclosed separately to show the effect of using correction factors.*

R9: *In the quantified part of a biodiversity footprint, changes in drivers of nature change need to be translated into an impact on biodiversity and the linkages need to be explicit, quantitative, transparent and science based. This ensures that the impact assessment is responsive to change, results are replicable, and results are relevant to companies and investors.*

A1: *When ex-post monitoring data of actual changes in biodiversity become available (e.g. during the implementation of a project), this data should be compared with the ex-ante data on estimated/potential impact. In case of significant differences between actual impact and estimated/potential impact, these differences should be analysed. The result can be used to adjust the potential impact calculated using ex-ante data, e.g. for reporting purposes, and/or to monitor impact targets and/or to identify options to improve the quality of monitoring of actual impact.*

R10: *To claim, based on a biodiversity footprint, an avoided negative impact on biodiversity, the business-as-usual scenario used in the footprint calculations shall be transparent and supported with sufficient evidence. Avoided negative impacts shall be reported separately.*

R11: *Negative, avoided negative and positive impacts shall be reported separately.*

R12: *Even when a net impact is calculated or communicated for specific purposes, negative and positive impact shall (also) be reported separately. Moreover, when a net impact is communicated by a financial institution, the use and interpretation of this net impact by the financial institution shall be explained.*

R13: *Since the choice to use time integration or alternative approaches to deal with the time dimension of impacts will influence the footprint result, this choice needs to be explained and reported with the footprint result.*

R14: *The following applies to the attribution of impacts on biodiversity, based on the PCAF attribution principles (PCAF, 2022)[47]:*
1. *Financed impact is always calculated by multiplying an attribution factor (specific to that asset class) by the impact of the borrower or investee.*
2. *The attribution factor is defined as the share of total impact of the loans and investments of a financial institution over the total equity and debt of the company, project, etc. to which the financial institution has lent money or in which it has invested capital.*

R15: *A qualitative analysis shall accompany a quantitative footprint in order to complement impact assessment results, to recognise and report on limitations (see also disclosure requirements in R26) and to take these limitations into consideration in the interpretation and use of the footprint results.*

R16: *Regardless of the type of data that is being used to assess the impact on biodiversity, data use (including data sources and their limitations) shall be fully transparent to allow for a traceable and replicable assessment and to allow for correct interpretation of the impact assessment results.*

47 PCAF (2022). The Global GHG Accounting and Reporting Standard Part A: Financed Emissions. Second Edition.

R17: *Financial institutions and data providers shall use the most recent data available to them. Any deviations shall be reported explicitly, including the reasons why. PBAF recognizes there is often a lag between financial reporting and required environmental data, such as borrower or investee environmental data. In these instances, it is acceptable that the data represent different years, as long as the years are expected to be broadly comparable. If this is not the case, the differences must be explained and taken into account in the data used.*

A2: *Financial institutions and data providers should use the highest quality data available for each asset class for calculations and, where relevant, improve the quality of the data over time. This includes the use of primary data instead of secondary data when (part of) such data is available.*

A3: *Since it is the responsibility of the investee to provide the data required to assess the impact on biodiversity, it is recommended to always ask investees for biodiversity impact data and provide support in identifying the data need and the tools available to gather this data.*

R18: *The following information on the methodology and data used to calculate the footprint shall be reported, where relevant per asset class:*

Table R18: PBAF template for description of the method and data, main limitations, and how they affect the footprint result.

FOOTPRINT APPROACH AND DATA QUALITY	DESCRIPTION	LIMITATIONS	HOW COULD THIS AFFECT THE FOOTPRINT RESULT?
1. Scopes included			
Scope 1			
Scope 2			
Scope 3 upstream			
Scope 3 downstream			
2. Expected impacts covered in the footprint Qualitative description of the main impacts expected and how these are included in the footprint: quantitatively or qualitatively			
3. Modelling of economic activities Description of the way the economic activities of companies have been identified/assessed, including sector classifications used			
4. Impacts in supply chains Description of how data on supply chains have been included in the footprint, including potential modelling			
5. Environmental data used			
Primary data: Reported impact drivers/pressures, including source(s), year(s) and means of verification			

Secondary data: Physical activity-based (⋆) impact drivers/ pressures, including source(s), year(s) and level of consistency with the primary business activity (⋆⋆)			
Secondary data: Economic activity-based (⋆) impact drivers/pressures, including source(s), year(s) and level of consistency with the primary business activity (⋆⋆)			
Responsiveness of data to company action (⋆⋆⋆)			
6. Baselines, reference states and cutoff dates used in the footprinting calculations			
7. Pressure - impact model used			
Name of the pressure-impact model and its associated output metric(s)			
Drivers of nature change included in the model			
Drivers of nature change not included in the model and how these drivers are addressed			
Extent to which local biodiversity data and ecosystem characteristics were taken into account in the impact calculation			
Was time integration used to account for future impacts? If not, what other approach was used regarding the time dimension of impacts and why?			
8. Main limitations of the footprint and what this means for the footprint result and its use			

(⋆): Financial institutions and data providers should use environmental data as consistent as possible with the primary business activity. For example, for a business loan to a paddy rice farmer, the financial institution / data provider should seek to find and use sector-specific average environmental factors for the paddy rice sector and not environmental factors for the agricultural sector in general.

(⋆⋆): Physical activity-based environmental data are (secondary) environmental data on the actual physical activities a company is involved in; economic activity-based environmental data are environmental data on the sectors in which a company is creating its revenue.

(⋆⋆⋆): To what extent are actions by companies to mitigate negative impacts reflected in the data used in the footprint calculations? How is this effectuated (e.g. by taking into account a reduction in impact drivers required by certifications)?

R19: *Transparency is required regarding the references/benchmarks used to interpret foot-printing results, including potential limitations to these references/benchmarks.*

A4: *The importance of location specific data in the assessment of impact and dependency related (financial) risks stresses the need to ask clients/investees for such data and maybe even set targets for 'asset location transparency' and 'supply chains transparency' on the level of a loan and investment portfolio.*

Annex 2 Comparison PBAF Standard V2022

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The table below provides an overview of the Requirements (R) and recommendations (A) in the PBAF Standard v2022 and the changes in numbering and/or content in the updated Biodiversity Footprinting Standard 2024. The main changes in the footprinting approaches per asset classes are summarised below the table.

PBAF STANDARD V2022		BIODIVERSITY FOOTPRINTING STANDARD V2024	
NR	TOPIC	NR	CHANGES, APART FROM #
R1	Transparency step 1, understanding the investment	R2	
R2	Inclusion of Scopes	R3	
R3	Transparency inclusion Scopes	R4	
R4	Transparency supply chain impacts	X	This requirement overlaps with the new R4 and is removed.
R5	Attribution of impact	R14	
R6	Biodiversity as a whole	R1	
R7	Cover main drivers & qualitative analysis	R5	
R8	Cover terrestrial, freshwater and marine impacts & qualitative analysis	R6	
R9	Transparency inclusion of drivers	X	Is covered by R5
R10	Certification standards	R8	Added: The correction factors shall be available to the financial institution using the footprint, e.g. in a public methodology report. A footprint without the use of correction factors shall be disclosed separately to show the effect of using correction factors
R11	Changes in drivers lead to quanti-fied changes in impact	R9	
R12	Negative, positive and avoided impact reported separately	R11	
R13	Net impact	R12	
R14	Use of ex-post monitoring data	A1	Recommendation instead of requirement
R15	Transparency time integration or other approach	R13	
R16	Complementary qualitative analysis	R15	
R17	Transparency of data used	R16	
R18	Use of most recent data	R17	
R19	Disclosure methodology and data per asset class	R18	
R20	Transparency references used in interpretation	R19	
A1	Use of ex-post monitoring data at the time of an exit	A1	Not explicitly linked to an exit anymore.

A2	Use of highest quality data	A2	
A3	Ask investees for impact data	A3	
A4	Ask investees for asset location data	A4	
		R7	The choice of baseline(s), reference state(s) and cutoff date(s) used in footprint calculations shall be transparent and disclosed.
		R10	To claim, based on a biodiversity footprint, an avoided negative impact on biodiversity, the business-as-usual scenario used in the footprint calculations shall be transparent and supported with sufficient evidence. Avoided negative impacts shall be reported separately.

Main changes in biodiversity footprinting approach Asset classes

Added:
- Unlisted equity & business loans
- Sub-sovereign debt (subject to change based on changes PCAF)
- Supranational debt
- Commercial Real Estate (CRE)

Sovereign debt: attribution changed to PPP adjusted GDP (approach PCAF)

Mortgages: including Scope 3 for new properties

Indirect investments
- Indirect investments that incorporate listed equity and bonds: see 'Listed equity and corporate bonds'
- A general approach for other indirect investments based on underlying assets
- Removal of guidance on the derivates most commonly used by financial institutions
- Pure cash holdings are considered as having zero impact

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