GREENING THE RECOVERY
TO MAKE IT LAST

The role of natural capital accounting

Policy Report

Paul Lucas and Michael Vardon

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Greening the recovery to make it last: the role of Natural Capital Accounting

Corresponding authors
paul.lucas@pbl.nl
Michael.Vardon@anu.edu.au

Authors
Paul Lucas (PBL) and Michael Vardon (Australian National University)

PBL Netherlands Environmental Assessment Agency is the national institute for strategic policy analysis in the field of environment, nature and spatial planning. We contribute to improving the quality of political and administrative decision-making by conducting outlook studies, analyses and evaluations in which an integrated approach is considered paramount. Policy relevance is the prime concern in all our studies. We conduct solicited and unsolicited research that is both independent and scientifically sound.

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Executive Summary

The COVID-19 pandemic has greatly disrupted economies, societies, and livelihoods, around the globe. Even before the pandemic, the world was already facing an escalation of both climate and nature emergencies and was largely off-track to achieve internationally agreed social, economic and environmental goals (e.g. the objectives of the Paris Agreement, the Aichi Biodiversity targets and the United Nations' Sustainable Development Goals). Progress was hampered even further by the pandemic.

Many nations have responded to the impact of the pandemic by implementing economic stimulus packages to mitigate the health and socio-economic impacts of the pandemic. With the pandemic moving into a new phase, nations are shifting their attention to recovery stimulus, to restore employment and boost economic growth. In this context, there is increasing recognition that these recovery efforts should not only address short-term economic problems, but should also be green, inclusive, and resilient to tackle long-standing problems and provide for future well-being. Green, in strengthening natural capital and furthering the biodiversity and climate agendas; inclusive, in tackling the inequalities that the pandemic has exposed; and resilient, in preparing for future crisis and shocks. To achieve this, economies need to be managed in ways that better understand society's dependence on nature, its vulnerability to degradation, and the impact of policy decisions on various groups.

This report shows government decision-makers how a natural capital approach — and more specifically natural capital accounting (NCA) — can support a greener, more inclusive and more resilient recovery; further referred to as a 'green recovery'. It was prepared as input to the *5th Policy Forum on Natural Capital Accounting for Better Decision Making* of 15–16 September 2021.

NCA is a universal approach to measure and value natural capital and the natural resources and ecosystem services they provide to the economy and human well-being, in general. Together with modelling and analysis, this information may contribute to more targeted policy response and investments. With around 90 countries already having NCA in place, and with agreed UN standards building confidence on how to go about developing and implementing NCA (System of Environmental-Economic Accounting (SEEA)), it is now time for NCA to be rolled out in support of a green recovery.

Key message 1: Current recovery efforts tend to ignore the value of the natural capital on which the economy and human well-being critically depend
Recovery efforts provide unprecedented opportunities to ensure that human reliance on natural capital and ecosystem services is recognised, and to facilitate the transformations needed to achieve internationally agreed objectives, such as the Sustainable Development Goals. However, to date, most announced stimulus packages reinforce negative environmental trends. Only a small group of wealthy countries (most prominently the EU Member States) have announced stimulus packages with significant shares of 'green' investments and policies. However, these 'green' investments and policies focus mostly on low-carbon development and pay little attention to nature and biodiversity.

Key message 2: Investing in natural capital provides both short-term and long-term social, economic and environmental benefits
Protecting, sustainably managing and restoring nature (e.g. through nature-based solutions) not only provides employment in the short term and can boost economic growth, but can also deliver social benefits (e.g. improving health and food security), improve the environment (e.g. enhancing biodiversity and carbon sequestration), reduce physical risks (e.g. reducing flooding and limiting storm-related damage) and help prevent future pandemics.

Key message 3: NCA and modelling can support all phases of decision-making
In the short term, NCA and modelling can help identify investment opportunities and policies that would generate short-term economic benefits, in terms of jobs and economic growth, as well as long-term improvements in natural capital and the services it provides to the

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economy and society. This requires using what is already there, in the way of data, accounts and models. It may also help to identify the sectors hardest hit by the pandemic and those most responsible for environmental degradation. Furthermore, it can help identify synergies and trade-offs of investments and policies with human and environmental challenges, over time, between societal groups and across places. In the long term, NCA can help monitor progress and contribute to policy review. This would require regular updating of data.

Key message 4: NCA can help create an enabling environment for actors to cooperate
A green recovery requires that action is taken within all parts of society, including by government authorities (from local to global), the business community, financers, civil society and academia. NCA could help to create an enabling environment to mobilise and empower these stakeholders to cooperate. It can provide information and insights that could be used to reform incentives, mobilise finance, stimulate innovation and learning, integrate and mainstream green investments and policies, ensure equity and inclusiveness and contribute to policy adaptation in uncertain and dynamic contexts.

Key message 5: Existing data and expertise can already support a green recovery
Many countries have demonstrated that NCA can support policies related to sustainable development that are closely aligned with the key aspects of a green recovery (e.g. climate change adaptation and mitigation, biodiversity conservation, land and forest management). Furthermore, rolling out new natural capital accounts or extending existing ones can be done relatively rapidly and inexpensively. Basic accounts, focusing on specific types of natural capital, can be built in months rather than years, when making the right links to existing national data and global data sets and tools, as well as the growing amount of expertise. These accounts can be extended, refined and improved, over time, to strengthen future policy analysis and allow for monitoring progress.

Key message 6: NCA is most effective when mainstreamed across all ministries
Recovery is as much an environmental challenge as it is a social and economic one. This calls for involvement by and cooperation between all the ministries. Mainstreaming NCA across ministries requires recognising that NCA is not only a useful tool for policy analysis, but also a much-needed tool for social, economic and environmental management. There are large amounts of experience to be shared, as the first four global *Fora on NCA for Better Decision-Making* have shown, and which have been synthesised in 10 living principles of NCA that is 'fit for policy purpose'. An important role for the international community is to improve data and analysis, to build country capacity and to further develop a knowledge base.

Key message 7: The biodiversity, climate and green recovery agendas can reinforce each other, both supporting and supported by NCA
There can be strong synergies between better decisions for green recovery and for tackling climate change and the loss of biodiversity and ecosystem services. The 2021 UNFCCC and CBD agendas can encourage mainstreaming NCA in government processes as part of their transparency and accountability mechanisms, while a green recovery can boost achievement of their respective targets. NCA can play a key role in measuring progress as well as in the development and implementation of policies that can address both biodiversity and climate issues, simultaneously. In this respect, nature-based solutions are a key area of overlap.

Key message 8: Planning for a green recovery also entails developing and mainstreaming NCA
The pandemic and the need for green recovery make a strong case for investing in NCA skills and systems, related modelling and analytical tools, and improving communication and access to what NCA can offer to help improve decision-making. All these elements can be part of a green recovery strategy. They not only provide powerful sources of information that can be used in policy design and for monitoring the impact on the environment and economy — and not just those associated with a green recovery — they also increase societal resilience, as they improve future preparedness for a green recovery from shocks and crisis.

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1 Introduction

Background and rationale

The COVID-19 pandemic is having a huge impact on human health around the world. At the same time, the measures that have been put in place to contain the pandemic are having enormous social and economic consequences, such as increased unemployment, extreme poverty and hunger, increases in inequality, as well as reductions in economic production and trade (UN, 2021c). In response, many countries have put stimulus packages in place in an effort to mitigate the health and socio-economic impacts of the pandemic and to strengthen national economies. Still, the impacts have been particularly large for countries that rely on tourism and commodity exports and those with financial constraints for these stimulus packages (IMF, 2021).

With the pandemic moving into a new phase, many nations have shifted their attention from rescue measures to recovery stimulus. In its most basic form, recovery stimulus is intended to restore a country's ability to contribute to human and societal well-being. However, depending on the measures taken and on how they are implemented, they can also have a lasting negative impact on the environment (UNEP, 2020; Vivid Economics and F4B, 2021a).

Not taking environmental considerations into account when designing recovery stimulus packages could lead to further entrenchment of an unsustainable economic pathway with high risk of accelerated climate change and depletion of natural capital and ecosystems services. In the longer term, this could also undermine human development, including hampering the achievement of the Sustainable Development Goals (SDGs) (UNEP, 2021b). This means that future generations not only become saddled with more debt in order to finance the recovery, but also with increased societal costs and a reduced ability to repay the debt as a result of natural capital depletion.

The world's ability to achieve internationally agreed goals (e.g. those of the Paris Agreement, the CBD biodiversity targets and the SDGs) and to put the world on a sustainable development pathway will thus be partly determined by the nature of the recovery stimulus. Therefore, a wide range of organisations and many governments, worldwide, have emphasised the need to use recovery stimulus packages to also address long-standing human and environmental challenges, often under the name of 'green recovery' (e.g. Guterres, 2020; OECD, 2020a; UN, 2021b; UNDP, 2020; World Bank, 2020a).[1]

There is great scope to enrich the content and benefits of existing and new stimulus packages to have a green, resilient and inclusive recovery, e.g. a recovery that tackles long-standing structural problems that compromise natural capital and those who depend most upon it and that helps achieve internationally agreed goals. Improving natural capital provides cost-effective solutions to tackle both the climate and nature crisis, to build societal resilience and to decrease poverty and inequality.

Aim and audience

This report was prepared in the context of the WAVES project for the *5th Policy Forum on Natural Capital Accounting for Better Decision Making* that took place in September 2021 (see Box 1.1). The Forum focused on the question of how natural capital accounting (NCA) can support government investments and policies that are aimed to build a green, resilient and inclusive recovery. It was written to show decision makers in government (both national and sub-national) the added value of a natural capital approach in designing, implementing and monitoring recovery packages.

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[1] Related terms used are 'building back better', 'building forward better' and 'sustainable recovery'

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The report aims to demonstrate how NCA and related tools can help to link socio-economic recovery with improving natural capital and achieve long-term sustainability goals. It pays specific attention to investments and policies to improve natural capital, such as through nature-based solutions, to accelerate biodiversity and climate agendas (e.g. to halt and reverse biodiversity loss and climate change mitigating and adaptation), to improve human well-being and to put the world on a more sustainable development pathway. As the focus of the report is on natural capital, it uses the term *green recovery*, which is interpreted in the broader sustainable development context, including resilience and equity.

The report provides both a theoretical framework and practical understanding, using theme-based and country case studies where available. The work is based on desk research, interviews with scientists and policymakers working on green recovery and/or natural capital accounting and an expert workshop during which a draft version of this report was discussed. See Appendix A for the interview questions and Appendix B for the list of interviewees and workshop participants.

Outline
The report is structured as follows. Chapter 2 is about green recovery. It covers the 'greenness' of announced recovery packages, what is meant with a green recovery, the role of natural capital in a green recovery, and what is needed to achieve green recovery. Chapter 3 is about NCA and related tools. It presents the key features of natural capital accounts, how to produce accounts, and the relation to modelling. Chapter 4 makes the case for using natural capital accounting for green recovery. It shows how NCA and related tools can support a green recovery throughout the policy cycle, with specific attention for investments in natural capital. Finally, Chapter 5 sketches a way forward to further the production and use of NCA in the context of green recovery.

2 Green recovery

Recovery stimulus is about quickly increasing aggregate demand and employment through direct capital investments, as well as expansionary fiscal and monetary policies and targeted sectoral policies, with large economy-wide spill-over effects. This chapter discusses the greenness of announced recovery packages, what is meant with a green recovery, the role of natural capital, and what is needed to implement a green recovery.

2.1 Greenness of announced recovery packages

A range of so-called trackers have assessed the announced stimulus packages with respect to their 'greenness', i.e. positive or negative impacts on environmental issues such as biodiversity loss, climate change and air pollution (see Box 2.1 for an overview of trackers). Although these trackers use different methods and data sources, they all conclude that many of the proposed stimulus packages reinforce negative environmental trends.

**Only a small share of recovery spending is estimated to be green**
In 2020, an estimated USD 15 trillion of public stimulus packages were announced, globally, around 87% of which in immediate rescue efforts to manage the short-term effects of the pandemic (O'Callaghan and Murdock, 2021; Vivid Economics and F4B, 2021a). During the first 6 months of 2021, this value increased to around USD 17 trillion, mostly driven by the USD 1.9 trillion American Rescue Plan Act (Vivid Economics and F4B, 2021b). Around 30% of the USD 17 trillion is estimated to be environmentally relevant as the related investments and policies are directed towards environmentally intensive sectors that have an impact on climate, biodiversity and air quality (i.e. agriculture, energy, industry, transport and waste). Although estimates differ between studies, the investments and policies that have a negative environmental impact outweigh those that enhance sustainability and can thus be considered 'green'. Only in five G20 economies, the stimulus initiatives are estimated to have a net positive environmental impact (Vivid Economics and F4B, 2021b).

Stimulus investments and policies that can be considered green include bailouts with green strings attached, loans and grants for green investments, nature-based solutions and environmental protection, green R&D subsidies, subsides or tax reductions for green products, higher environmental standards and regulations to prevent environmentally harmful activities. Non-green stimulus investments and policies include subsidies or waived fees for environmentally harmful activities, deregulation of environmental standards, environment-related bailouts without green strings, subsidies or tax reductions for environmentally harmful products and environmentally harmful infrastructure investments.

High-income countries, in particular, have proposed green investments and policies
Most of the 'green' investments and policies have been proposed by a small group of wealthy countries (Figure 2.1). The 'Next Generation EU' recovery package is the most environmentally friendly stimulus package proposed, so far (see Box 2.2). Other wealthy countries are lagging behind, as they support traditional practices in the various sectors and pay little attention to greening them. The same holds for emerging economies that strongly depend on environmentally intensive sectors, without strong regulatory oversight (e.g. China, India, Brazil and Indonesia) (Vivid Economics and F4B, 2021b). Debt constraints have restricted spending in many emerging markets and developing economies, while many are heavily dependent on natural capital (O'Callaghan and Murdock, 2021; Piaggio and Siikamäki, 2021). Still, there is some green spending in emerging economies that are not included in the trackers, such as Pakistan (see Box 2.4), Rwanda (see Box 4.4) and the African Union (African Union, 2021). Furthermore, the trackers identify improvements in announced packages, over time. For example, China has launched the world's largest carbon market for the power sector and has set ambitious climate targets. The American Rescue Plan Act does not specifically target climate change and biodiversity issues, but does include investments in public transport, upgrades to water and sewer systems, and projects to improve energy efficiency (Vivid Economics and F4B, 2021b).

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Figure 2.1
Global announced recovery spending and green spending, 2020
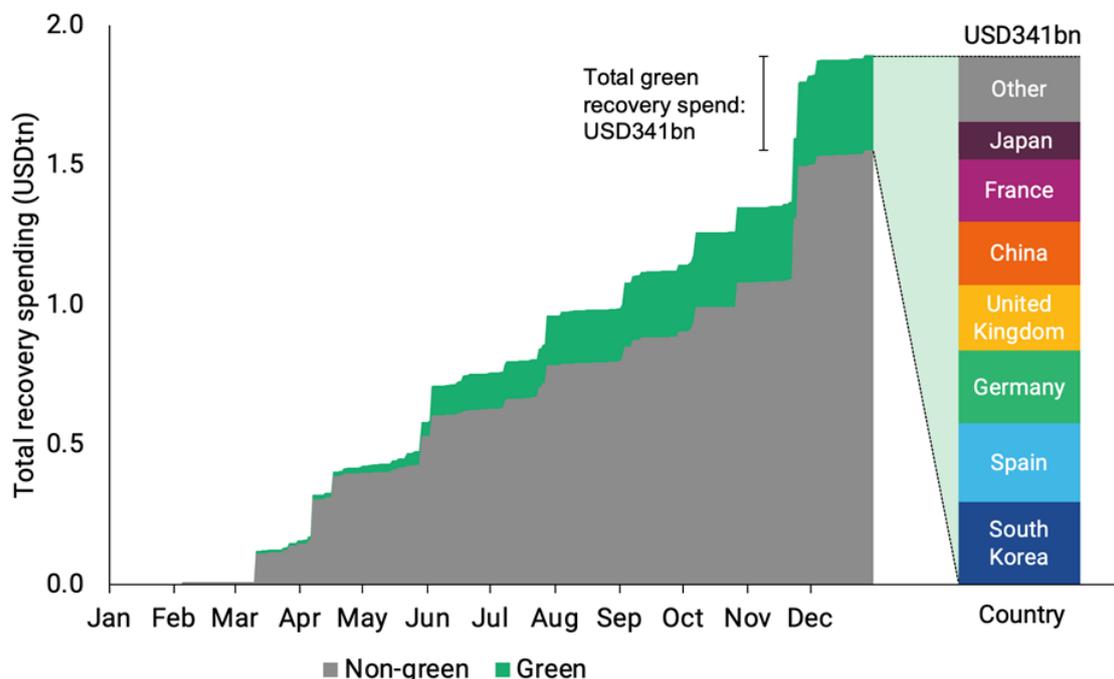
Source: O'Callaghan and Murdock (2021)

Proposed recovery stimulus packages mostly focus on low-carbon development with little or no attention for nature and biodiversity
Of the total in announced recovery spending in 2020, only around 3% was related to natural capital measures. These investments were directed towards public parks and green spaces, tree planting and biodiversity protection, ecological conservation initiatives, and waterway protection and enhancement (O'Callaghan and Murdock, 2021). By far the largest share of 'green' stimulus measures address climate change mitigation and focus on reducing carbon emissions through energy efficiency, house isolation and expanding renewable energy. Furthermore, the investments associated with pollution or direct habitat destruction outstrip total investments related to improving biodiversity or preserving ecosystems.

Box 2.1: Trackers of 'green' recovery from COVID-19

- Greenness of Stimulus Index — assesses the greenness of COVID-19 stimulus packages in G20 countries and other major economies, focusing on 5 key sectors (agriculture, energy, industry, transport and waste)
- Energy Policy Tracker — provides an overview of COVID-19 policy responses and public finance flows in major economies and Multilateral Development Banks (MDBs), from a climate and energy perspective
- Green Recovery Tracker — assesses the contribution of EU Member States' national recovery plans to the green transition
- Oxford Global Recovery Observatory — tracks and assesses COVID-19-related fiscal spending announced by 50 leading economies for potential environmental and socio-economic impacts
- The Green Economy Tracker — tracks adoption of 21 green economy policies, including green recovery from COVID-19, across 20 countries, covering various regions, contexts and levels of economic development
- OECD Green Recovery Database — identifies and tracks the environmental dimensions of announced recovery measures of OECD member countries to provide an overview of both positive and negative environmental implications

Box 2.2 Green Recovery in the EU

The EU has linked its economic recovery strategy to the major ecological challenges (i.e. climate, biodiversity and resource use), as they are central to the European Green Deal presented in December 2019. To this end, a recovery fund ('Next Generation EU') of EUR 750 billion has been set up for the 2021–2024 period. Its main instrument is the Recovery and Resilience Facility (RRF), covering 90% of the entire budget. The aim of the RRF is to reduce the economic and social impact of the pandemic and to make European economies and societies more sustainable, resilient and better prepared for the challenges and opportunities of the green and digital transitions.

Member States can claim money from this facility on the basis of a recovery and resilience plan. The measures included in recovery and resilience plans of the individual Member States should contribute to the green transition, including biodiversity, or to addressing the resulting challenges, and should account for at least 37% of the national plan's total. Economic and budgetary reform measures are conditional to the availability of budget for the Member States and should contribute to more economic convergence between the national economies within the European Union. They do not have a specific environmental objective. In addition, the *do-no-harm* principle applies to all investments and reforms, meaning that spending proposals should not significantly impede the goals of the European Green Deal.

The green recovery tracker assesses the contribution of EU Member States' national recovery plans to the green transition. National projects that are considered environmentally friendly include: energy renovations of buildings, afforestation and nature restoration, public transport, cycling infrastructure, green hydrogen, electromobility, renewable energy and sustainable industry. Projects that are considered environmentally unfriendly include: general VAT reduction, new motorways, support for the fossil car sector, tax reduction for industry without environmental conditions, and airport expansions.

2.2 What is a green recovery?

Green recovery is about linking stimulus spending to addressing (pre-COVID-19) human and environmental challenges, to increasing the resilience of society and to decreasing inequality. It is about maintaining and/or increasing political momentum for policies aimed at achieving internationally agreed goals, such as the objectives of the Paris Agreement, the CBD biodiversity targets and the Sustainable Development Goals (SDGs).

The world is not on track to achieve internationally agreed goals
While the Paris Agreement aims to limit the global mean temperature increase to well below 2 °C, even with full implementation of each country's national mitigation ambitions (Nationally Determined Contributions (NDCs)), the world is headed towards a global warming of at least 3 °C (UNEP, 2020). Furthermore, while the CBD post-2020 Global Biodiversity Framework is aimed at halting and even reversing of global biodiversity loss, negative trends in nature and ecosystem services are likely to continue and may even accelerate (IPBES, 2019). These trends will not only leave internationally agreed environmental goals unachieved, but also undermine achievement of the Sustainable Development Goals (SDGs), as well as increase societies' vulnerability to pandemics and environmental change (UNEP, 2021b).

Further postponement of additional action makes the goals harder and more expensive to achieve (Dasgupta, 2021; Lucas et al*.,* 2020; UN, 2020b; UNEP, 2021b). For example, delaying climate action increases the overall impact and cost to people and nature, creates a lock-in carbon-emitting infrastructure, leads to stranded assets and reduces flexibility in future response options. For biodiversity, certain ecosystem services are irreplaceable once lost (e.g. wild pollination), while others are extremely expensive to replace with man-made infrastructure (e.g. coastal mangroves that provide flood protection). Especially pertinent, in the context of recovery from COVID-19, is the fact that some of the underlying drivers of biodiversity loss and climate change are similar to those of pandemics, e.g. land-use change, agricultural expansion, urbanisation, and wildlife trade and consumption (IPBES, 2020).

Box 2.3: Green growth, green economy, circular economy and sustainable development

A green recovery can be interpreted as a targeted and accelerated transition towards what is known as green growth, green economy, circular economy or sustainable development. Individual definitions vary between sources. Some examples of definitions are:

- **Green growth** means fostering economic growth and development while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies (OECD 2011).

- **Green economy** is an economy that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities (UNEP 2011).

- A **Circular economy** aims to redefine growth, focusing on positive society-wide benefits. It entails gradually decoupling economic activity from the consumption of finite resources and designing waste out of the system (Ellen McArthur Foundation).

- **Sustainable development** is development that meets the needs of the present without compromising the ability of future generations to meet their own needs (WCED 1987).

Although there are some clear differences between these concepts, they are all about sustaining or increasing human well-being, while maintaining natural resources and protecting the environment for future generations. Furthermore, the various concepts can be seen as part of the 2030 Agenda for Sustainable Development. The Sustainable Development Goals (SDGs) set out a long-term global vision for sustainable development to achieve a prosperous, socially inclusive and environmentally sustainable future for humanity and the planet.

Achieving internationally agreed goals requires a clear break with current trends
Achieving internationally agreed goals, and thereby also reducing the risk of future pandemics, requires fundamental changes in technological, economic, social and political factors underlying the drivers of unsustainable development, commonly referred to as transformation or socio-economic transitions (Lucas et al*.,* 2020; UN, 2020b; UNEP, 2021b). (Lucas et al*.,* 2020; UN, 2020b; UNEP, 2021b). This not only requires addressing the systems or activities that directly impact natural capital (e.g. energy production and use, agriculture, resource extraction and processing), but also their indirect drivers (e.g. consumption patterns, population growth, inequality, international trade, technological innovation and financial systems) which are embedded in societal values, behaviour and governance. This includes valuing and embedding natural capital in decision-making by governments and private actors. The coming decade is crucial, in this respect.

Recovery stimulus packages provide a unique opportunity to further internationally agreed goals and to put the world on a sustainable development pathway
All experts interviewed expressed the clear need for a green recovery and underlined recovery stimulus as a unique opportunity for sustainable development, green growth and rethinking the current economic model to address human and environmental challenges that already existed before the pandemic (also see Box 2.3). Greening stimulus packages can help to transform the economy to ensure that our reliance on natural capital and ecosystem services is recognised and that globally agreed goals are achieved. Oliver Greenfield, the Convener of the Green Economy Coalition, an international organisation working on green growth, put it very strongly: *'Green recovery is the last chance to put the world on a sustainable development pathway'.* Furthermore, several other interviewees underlined that now there is momentum for policymakers to address green objectives. The interviewees specifically mentioned to go beyond the current strong focus on climate change in recovery packages and also address nature.

A green recovery aligns short-term recovery with achieving a green, resilient and inclusive future

In putting human and environmental challenges at the forefront, a green recovery can combine short-term socio-economic recovery with medium- to long-term transitions to make human development green, resilient and inclusive. It thereby aligns recovery with sustainable development. Three types of strategies for a green recovery can be identified, each of which describing different ways of linking the achievement of sustainability goals and related sustainability transitions with stimulus spending (Table 2.1; Maas and Lucas, 2021):

- Green recovery as a **co-benefit:** This strategy focuses on socio-economic recovery using investments and policies that have synergies with environmental goals and possibly other sustainability goals. There is no direct coupling with long-term transitions. Examples include investment in nature-based solutions that provide multiple benefits, while delivering significant economic returns and employment benefits (Section 2.3).

- Green recovery as a **necessary condition**: In this strategy, socio-economic recovery should not get in the way of the transitions to achieve long-term policy goals (do no harm). Recovery is the main focus with conditionalities or safeguards to avoid investments and policies that increase environmental pressure or create stranded assets. This strategy, thus, excludes investments in environmentally harmful infrastructure.

- Green recovery as **opportunity:** In this strategy, socio-economic recovery goes hand in hand with long-term transitions. Green investments and policies are combined with structural reform, such as removing environmentally harmful subsidies or phasing out unsustainable practices. By changing or creating new financial and non-financial incentives, more sustainable choices in production and consumption are stimulated.

Building resilience is central to a green recovery. The COVID-19 crisis has revealed the vulnerability of today's society. Building resilience refers to taking preventive actions to address physical, social, environmental, and economic vulnerabilities and shocks, and to anticipation to future environmental change, including to climate change. This also includes anticipating future pandemics, which requires addressing the underlying drivers of biodiversity loss.

Equity and inclusiveness are also important for a green recovery. Although the pandemic has affected almost everyone, its effects are disproportionally felt by vulnerable groups. At the same time, recovery efforts will affect different groups in different ways: some groups may benefit while others may face negative impacts. Addressing equity requires attention for vulnerable groups, including distribution of costs and benefits across groups (intra-generational) and across current and future generations (intergenerational).

Table 2.1
Three strategies of green recovery

	Co-benefit	Necessary condition	Opportunity
Strategy	Measures for economic recovery also contribute to environmental goals and/or sustainable development	Ignoring existing environmental and/or sustainable development challenges in recovery measures will lead to problems in the future	Recovery measures offer opportunities for making additional progress on environmental goals and/or sustainable development
Recovery vs transition focus	Focus on socio-economic recovery	Focus on socio-economic recovery, while ensuring that this does not impede with long-term transitions	Socio-economic recovery goes hand in hand with long-term transitions
Natural capital focus	Recovery can also improve natural capital and its services	Recovery should not result in degradation of natural capital and its services	Recovery should improve natural capital and its services

Source: Adapted from Maas and Lucas (2021)

2.3 Natural capital and green recovery

Natural capital is the world's stock of natural assets on which human well-being critically depends
Natural capital includes air, water, soil, mineral resources and all living things and the complex interactions amongst and between these elements (Bateman and Mace, 2020). Natural capital consists of non-renewable natural capital (e.g. fossil fuels, minerals and metals) and renewable natural capital or ecosystems (e.g. forests, mangroves).

Ecosystem services are the flows from renewable natural capital that are essential for human well-being (Costanza and Daly, 1992; MA, 2005). The ecosystem services cascade model has been suggested as a way to describe the ecosystem services' 'production chain', explicitly showing the linkages between ecosystems, ecosystem functions, ecosystem services and human development (Potschin and Haines-Young, 2011). The supply of ecosystem services relies on ecosystems that are healthy and therefore able to perform their functions and processes.

Figure 2.2
Cluster of Sustainable Development Goals
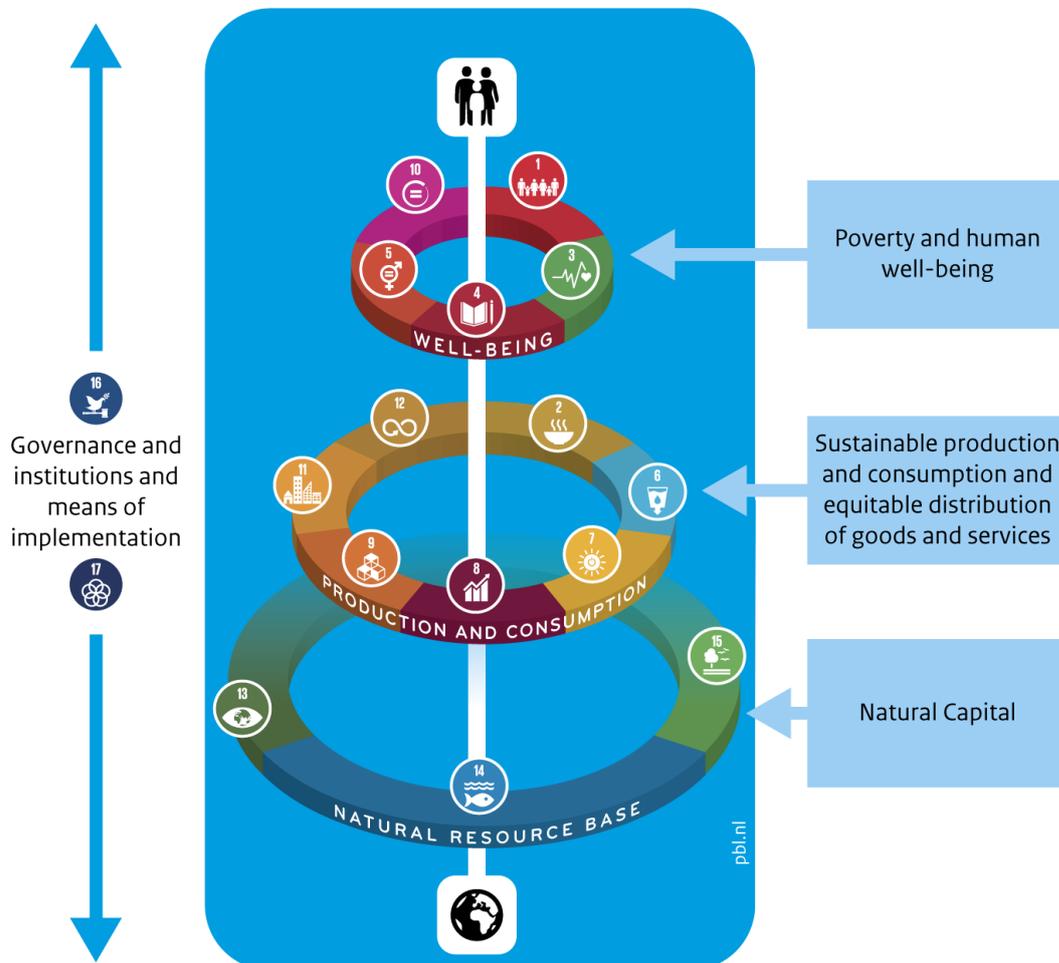
Source: adapted from PBL 2017

Figure 2.3
Relationships between environment, society and economy
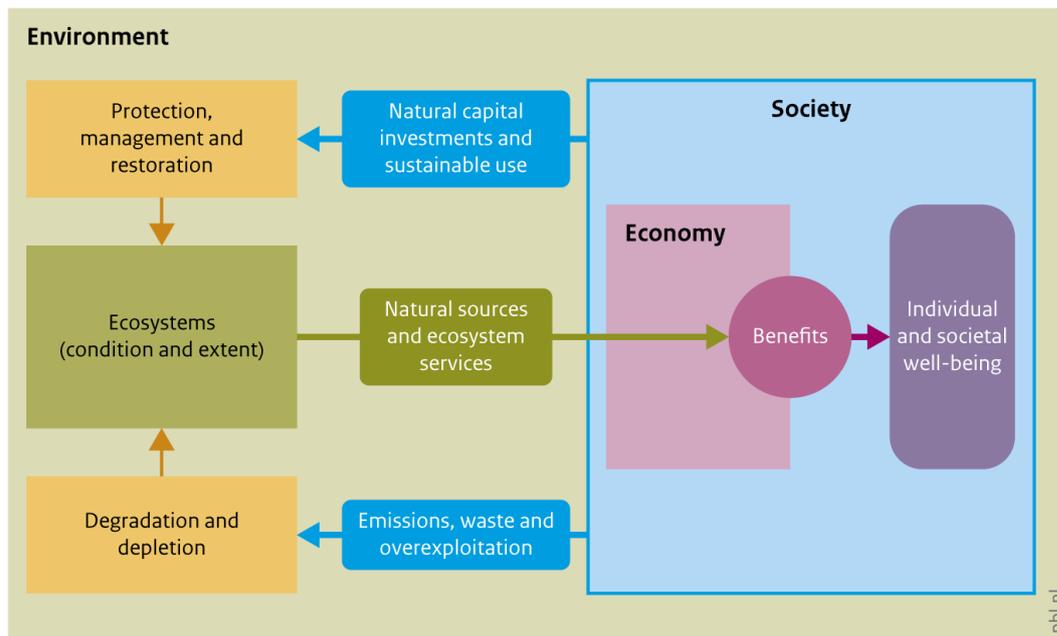
Source: PBL

The dependence of human well-being on natural capital is illustrated in Figure 2.2 in the context of the SDGs. Natural capital is the foundation for achieving SDGs related to sustainable production and consumption, and ultimately to poverty eradication and societal well-being. Natural capital approaches frame the value of nature within the context of economic prosperity and human well-being. This framing empowers decision makers to integrate the value of nature in their decision-making by fostering a better understanding of human impacts and dependencies on nature, as well as highlighting the potential for investments in nature to improve human well-being and help achieve the Sustainable Development Goals (Capitals Coalition, 2021). Government institutions have recognised the dependence on natural capital but have not yet effectively incorporated it into decision-making processes (Vardon et al., 2021).

Investments in natural capital, such as through nature-based solutions, increase the ecosystem services they provide, contributing to individual and societal well-being

Nature-based solutions (NBS) are a specific type of natural capital investment, defined as 'actions to protect, sustainably manage and restore natural and modified ecosystems in ways that address societal challenges effectively and adaptively, to provide both human well-being and biodiversity benefits' (Cohen-Shacham et al., 2016). It is an umbrella concept that includes restoration, management and rehabilitation measures, as well as conservation of ecosystems that enhance nature's contribution to people (IPBES, 2019; Van der Esch et al., 2021). Overall, NBS improve natural capital and the ecosystem services they provide, thereby contributing to improved individual and societal well-being (Figure 2.3).[2] As such, they are both 'people-based' and 'nature-based' and have the potential for transformative change (Palomo et al., 2021).

NBS contribute to both mitigating climate change (e.g. carbon sequestration through afforestation and reforestation and soil carbon sequestration) and halting and reversing biodiversity loss (e.g. protecting, managing, and restoring forests and wetlands). For example, Seddon et al. (2019) estimate that NBS could provide around 30% of cost-effective

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[2] Also see the PBL website on nature-based solutions and scenarios

climate mitigation that is needed by 2030 to stabilise warming to below 2 °C. Furthermore, NBS contribute to reducing physical risks (e.g. restoring mangroves or building artificial wetlands to reduce flooding and mitigate storm damage), achieving food and water security (e.g. adopting 'regenerative' approaches to agriculture, managing watersheds to provide clean water) and improving public health and well-being (e.g. urban greening to reduce air pollution and improve mental health). NBS are also an important strategy to prevent future pandemics, as they address some of the underlying drivers (IPBES, 2020; UNEP, 2021b). Sustainable land management, coordinated and optimised on landscape scale, can enable the multiple objectives to be realised, simultaneously.

Taken together, NBS can help achieve multiple SDGs, including those on climate (SDG 13), biodiversity (SDGs 14 and 15), food (SDG 2) and water (SDG 6), while indirectly contributing to achieving a range of other SDGs, including those on poverty (SDG 1), human health (SDG 3) and cities and communities (SDG 11) (WWF and ILO, 2020). Table 2.1 presents NBS that fit these criteria and are available in most countries.

It should be noted that NBS are not a panacea. Additional measures and policies are required to achieve biodiversity and climate goals, as well as the broad range of SDGs. These include both broad measures (e.g. increasing energy efficiency, decarbonising energy supply, improving agricultural yields) as well as more systemic changes (e.g. transforming financial systems, phasing out unsustainable practices, reforming or removing environmentally harmful subsidies) (Dasgupta, 2021; Lucas et al., 2020; UNEP, 2021). Furthermore, there are concerns that specific NBS require additional land (e.g. protected areas, reforestation), thereby competing with, for example, food security and indigenous rights (IPBES, 2019).

Table 2.2
Environment and well-being benefits of selected nature-based solutions

Nature-based solution	Climate change (SDG 13, UNFCCC)	Biodiversity loss (SDG 15, CBD, UNCCD)	Food security (SDG 2)	Water security (SDG 6)	Health and well-being (SDG 3)
Reforestation	Carbon storage	Reverse biodiversity loss		Improve water regulation	Reduce pandemic risk
Land restoration	Improve carbon storage	Restore ecosystems and reduce degradation	Improve soil fertility		
Agroforestry and silvopasture	Improve carbon storage	Improve biodiversity in agricultural areas	Improve yields; improve drought resilience	Improve water availability	
Agroecological approaches to food production		Improve biodiversity in agricultural areas			
Urban greening		Improve biodiversity in urban areas		Improve urban drainage; flood risk protection	Local cooling, improve air quality, noise buffering, improve mental well-being
Ecosystem restoration (e.g. riparian, wetland, peatland, mangrove)	Improve carbon storage	Reverse biodiversity loss	Reduce soil erosion; improve drought resilience	Improve water, availability and quality; flood risk protection	Reduce pandemic risk
Vertical aquatic farming	Carbon storage		Provide food	Reduce nitrogen and pollution load	

Source: Based on UNEP (2021a); UNEP (2021b); Van der Esch et al. (2021); Vivid Economics (2020); WWF and ILO (2020)

Box 2.4: Examples of natural capital investments in announced stimulus packages

New Zealand's economic stimulus package 'Wellbeing Budget 2020: Rebuilding Together' includes a NZD 1.1 billion programme that aims to create 11,000 'nature jobs' through major investments in restoring wetlands and riverbanks, removing invasive species, and improving tourism and recreation services on public lands.

The Pakistani government allocated USD 90 million in its green stimulus package for afforestation to sequester carbon, protect the natural environment, and provide employment for people who lost their job due to the pandemic. The tree-planting programme is expected to generate tens of thousands of jobs and looks to prioritise work for women and other vulnerable groups. It is expected to generate tens of thousands of jobs if implemented successfully.

The UK's Green Recovery Challenge Fund includes around GBP 40 million for tree planting to protect landscapes, connect people with nature and help create and retain thousands of green jobs. The projects have potential for creating jobs swiftly, improving air quality and health outcomes, and creating resilient new ecosystems.

Investing in natural capital is part of a green recovery, providing both short-term and long-term benefits for the economy, society and environment

Many experts argue that NBS (including nature-based infrastructure and nature-based adaptation) position the environment as an opportunity. Furthermore, they underline that nature-based solutions can help improve local livelihoods and provide socio-economic and environmental resilience to future pandemics and natural disasters, as well as form a buffer against natural volatility. Improving natural capital can further the biodiversity agenda (reverse biodiversity loss and reduce degradation) and the climate agenda (provide or improve carbon storage and climate adaptation), and strengthen policy integration across the two agendas. In addition, NBS can reduce environmental risks, such as reduced losses from floods, storms, heatwaves and wildfires, and provide social and environmental benefits, including improved air quality and nature, as well as reduce climate change and pandemic risk.

Box 2.4 discusses how natural capital investments are included in the announced stimulus packages of New Zealand, Pakistan and the United Kingdom. Box 2.5 discusses the benefits of investments in NBS for employment, economic growth and climate.

For stimulus spending to be effective, it must be targeted (funding is directed to where there is spare capacity in the economy), timely (proposed spending is targeted at ready opportunities that do not require lengthy planning or development processes) and temporary (interventions should be one-off investments that avoid increasing long-term budget deficits and interest rates) (Elmendorf and Furman, 2008). Many NBS fit these criteria.

Natural capital investments (e.g. through NBS) provide both recovery benefits and environmental and well-being benefits (e.g. Kopsieker et al., 2021; Raes et al., 2021; Vivid Economics, 2020; WWF and ILO, 2020). In many countries, natural capital investments or NBS are readily available. They rely heavily on labour for their implementation. Furthermore, they can boost both short-term and long-term economic growth for sectors that depend on natural capital, such as agriculture and tourism. Once built, labour can flow back to other sectors. In addition, as the maintenance costs of NBS are likely to be lower than for produced capital, this allows investments in other forms of capital, including human capital, which can further drive long-term productivity growth (Agarwala et al., 2020).

NBS have gained prominence as an alternative to traditional, grey infrastructures, given the close interlinkages with climate change and biodiversity loss, and the potential of increasing natural capital to deliver environmental, social and economic benefits (e.g. BITC and GMCA, 2020; Table 2.1). As such, they provide the potential for more cost-effective planning to share costs across sectors and various public spending objectives. The IUCN Global Standard provides distinctive parameters for defining NBS and a common framework to increase the scale and impact of NBS, prevent unanticipated negative outcomes or misuse, and help funding agencies, policymakers and other stakeholders assess the effectiveness of interventions (IUCN, 2020; Murti and Sheikholeslami, 2021).

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Box 2.5 Global performance of nature-based solutions for jobs, economic growth and climate

Vivid Economics assessed the social, economic and environmental benefits of investing in nature-based solutions (Vivid Economics, 2020). The study uses an input-output modelling framework based on multi-region input-output tables and satellite accounts for greenhouse gas emissions. The analysis focuses on stimulus spending that entails new capital expenditure funded directly by the government. It compares a business-as-usual investment scenario (BAU scenario) with a scenario that invests in a portfolio of nature-based solutions (NBS scenario).

The analysis concludes that investing in NBS outperforms BAU investments with respect to short-term economic returns, as well as the long-term benefits for climate (Figure 2.4). The NBS scenario results in about 7% more jobs, globally, than the BAU scenario and stimulates 8% more short-term domestic economic activity. Furthermore, relative to the BAU scenario, the NBS scenario sequesters 44 billion tonnes of carbon dioxide equivalent (GtCO$_2$ eq) over 20 years, reducing global net annual greenhouse gas emissions by 4%. An indicative analysis, accounting for projected increases in risks without further investment, suggest that NBS interventions would reduce the financial impact of floods by USD 23 billion annually, which is roughly 57% of the worldwide economic losses caused by floods in 2019. Other benefits, including improved food security, reduced biodiversity loss and improved health were not quantified in this study.

Figure 2.4
Benefits of nature-based solutions versus business-as-usual investment
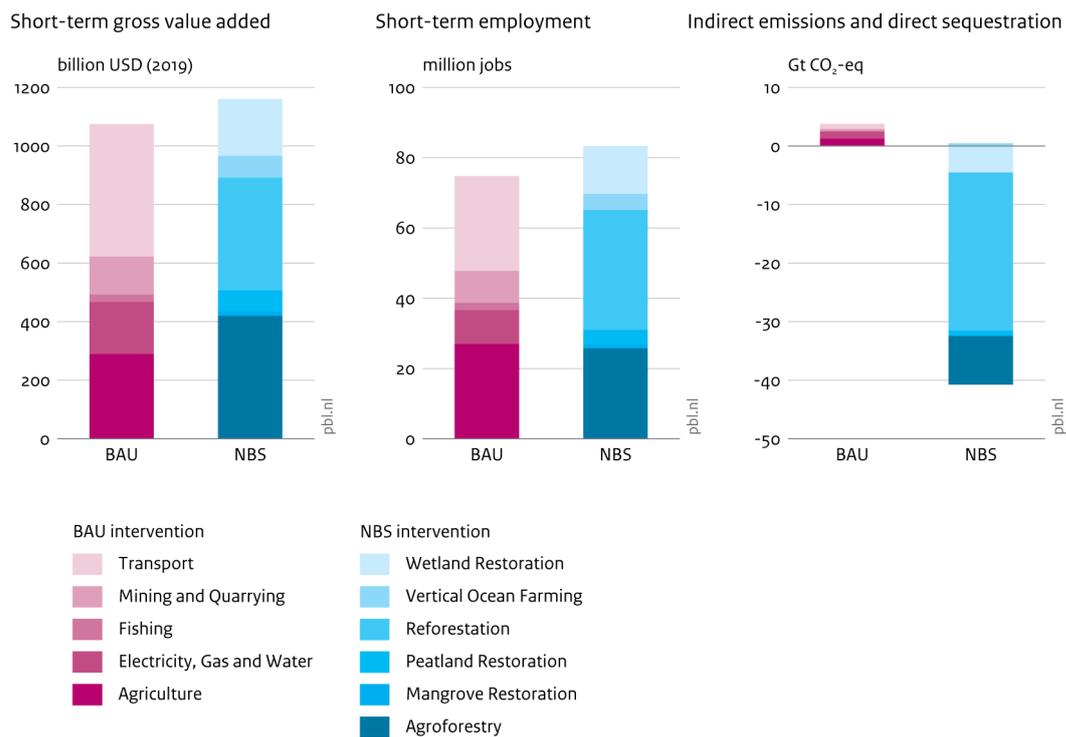
Source: Vivid Economics (2020)

2.4 Achieving a green recovery

Green recovery requires action is taken by all relevant stakeholders, including governments (from local to global), business, finance, civil society and academia. For example, businesses and financers have to move to more sustainable economic activities, civil society plays a key role in the discussion and planning of a green recovery, and much of the material cited and reviewed in this report has come from non-government organisations and academia.

The barriers to a green recovery that were mentioned in the interviews included underlying socio-economic structures, institutional silos (e.g. lack of cooperation between ministries but also with other actors), fiscal constraints for low- and medium-income countries, and the absence of a common language. These barriers have consequences for participation.

Mobilising and empowering actors to further a green recovery can be stimulated by direct government spending (e.g. on renewable energy, nature-based solutions), but it also requires other government actions, including reforming incentives, mobilising finance, stimulating innovation and learning, integrating and mainstreaming policies, ensuring equity and inclusiveness and providing for monitoring and reviewing policy adaptation (Capitals Coalition, 2021; Maas and Lucas, 2021; OECD, 2020b, 2021).

Reforming incentives: To further long-term sustainability transitions, green recovery is not only about stimulating green investments, but also about shifting away from unsustainable practices. When the underlying socio-economic structures are not addressed, stimulus spending is wasted or less effective. Therefore, direct investments in specific infrastructure or technologies need to be combined with wider reaching and more fundamental restructuring of critical sectors and activities.[3] This requires reforming incentives, financial mechanisms and regulations. For business, this includes subsidies or other incentives to invest in greener activities, and mechanisms like carbon pricing and the requirement to off-set biodiversity loss to discourage environmentally or socially damaging activities (see Box 2.6).

Mobilising finance: Many of the hardest hit countries are under high debt constraint while heavily dependent on nature. Key instruments to improve both their natural capital and their economy include financial instruments (e.g. nature-performance bonds that link debt payments to nature and climate targets), debt alleviation (e.g. debt-for-nature swaps, in which foreign debt is forgiven in exchange for local investments in nature) and the inclusion of NBS into climate funds (Piaggio and Siikamäki, 2021). Common criteria for 'green' and 'sustainable' investments, such as the EU Green taxonomy and the World Bank Sustainability Checklist, further help accelerate investments.

Stimulating innovation and learning: To foster a green recovery, especially when used as an opportunity to further sustainability transitions, new skills are required, both for newly emerging jobs and for existing jobs that are evolving. Stimulus spending can be an important opportunity to bolster funding for training, innovation, creating new products, processes and methods and increasing productivity. Furthermore, better information and learning can create stronger institutions, thereby improving resilience of society.

Integrating policies: Issues like biodiversity loss, climate change and inequality are highly interrelated and need to be addressed together (UNEP, 2021b). Many measures or policies are associated with both trade-offs and synergies with other sustainability objectives and between groups of people, across spatial scales and over time. Fostering policy coherence and efficient implementation requires frameworks to signal and address potential controversies and adverse consequences (ex-ante policy evaluation). To enable government policy silos to work successfully together requires informal coordination, policy monitoring and learning from experience (Scott and Gong, 2021).

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[3] The Green Economy Tracker lays out 20 green economy policies for structural reform, across 5 themes (governance, finance, sectors, people and nature), including wealth accounting and natural capital accounting. Although no single country has undertaken them all, they are used across the world and proven to be successful.

Ensuring equity and inclusiveness: The pandemic has exacerbated existing inequalities, with vulnerable groups, such as the poor and those living in fragile environments, being hardest hit. To ensure equity and inclusiveness, relieving these impacts is part of a green recovery. Furthermore, discussions between stakeholders are needed to find equitable solutions to the distribution of costs and benefits of green recovery investments and policies. To do so, recovery strategies can build on notions of a just transition (ILO, 2015).

Provide for policy adaptation: Given the magnitude and urgency of the investments as well as the uncertainty of the impacts and efficacy of investments and policies, there is a need for accountability mechanisms and indicator frameworks to provide transparency about investment and policy decisions, monitoring and reporting of implementation, as well as policy review (ex-post policy evaluation) to facilitate adaptation and change of policies by the various actors involved in the green recovery.

Box 2.6 Business accounting initiatives

There is currently no global standard for corporate natural capital accounting, but methodologies are emerging. An overarching framework for the private sector is the *Natural Capital Protocol*. The Protocol is a decision-making framework that enables organisations to identify, measure and value their impacts and dependencies on natural capital. The development of the Protocol was led by the Capitals Coalition (former Natural Capital Coalition), which has also developed other internationally recognised and standardised guidance documents that are being applied by businesses around the world.

A consistent standardised use of a capitals approach is needed throughout the system, from internal business decision-making to external disclosure, audit, finance, incentives and policy. Some of the main initiatives that are already working towards this standardisation in the space of natural capital accounting are:

- The *British Standard Initiative* published in June 2021. The standard on 'Natural Capital Accounting for Organizations' (BSI 8632) provides specifications and guidance on the process of preparing natural capital accounts.

- *Transparent* is an EU LIFE funded project that will develop standardised natural capital accounting and valuation principles for businesses in line with ambitions of the European Green Deal.

- The *Align Project* is a sister project to the EU LIFE project *Transparent*. 'Aligning Accounting Approaches for Nature' will assist the European Commission's efforts to support businesses, financial institutions and other stakeholders in developing standardised natural capital accounting practices by establishing a standardised approach to biodiversity measurement and valuation.

It is important not to consider business accounting initiatives in isolation, but to understand how they could and should interact with government accounting. The Combining Forces initiative of the Capitals Coalition seeks to aggregate business and government cooperation and to understand how this is essential to protect and enhance the world's natural capital. Similarly, the NCAVES project ('Natural Capital Accounting and Valuation of Ecosystem Services') that has been established by UNDP, UNSD, CBD and EU to advance the knowledge agenda on environmental economic accounting, includes a workstream on business accounting to maximise alignment between policy and business (Business Accounting | System of Environmental Economic Accounting).

3 Natural capital accounting and related modelling

To achieve a green recovery, the experts interviewed expressed the relevance of integrated thinking about the environment and the economy. To do so, they specifically pointed to the need for trusted official statistics and a consistent approach to assess measures against their social and environmental implication (both in the short term and the long term).

There are large amounts of data available, but data are usually scattered around various agencies and not easily integrated. Environmental scientists and economists work with different concepts and types of information and have no common 'language', which is compounding the problem and means interactions are fraught with misconceptions and misunderstandings.

Natural capital accounting (NCA) provides a bridge between economists and environmental scientists as well as between economic and environmental information. It provides directly linked environmental and economic data that can be integrated into the models and tools used for policy analysis. Over time, the construction of natural capital accounts leads to a better understanding of the information, as well as to increasing data quality and providing analysist with a regular source of information (Vardon et al., 2018). This chapter describes the key features of NCA, how to produce NCA, the role of modelling and analytical tools.

3.1 Natural capital accounting

NCA provides a systematic framework for measuring and valuing natural capital and the natural resources and ecosystem services they provide. It combines environmental and economic information using common definitions and concepts. This enables a better understanding between the environmental scientists and economists and improves communication of integrated information to decision-makers managing the environment and the economy.

NCA complements the System of National Accounts with data on natural capital and ecosystem services
NCA provides detailed information on stocks, flows, quality and value of environmental resources, allowing systematic analysis of the drivers of change. When times-series are available, they show both depletion and degradation of natural capital, as well as restoration and enhancement. Furthermore, they show the contribution of ecosystem services to both the formal economy and human well-being, more generally.

The System of National Accounts (SNA) records the flows of produced goods and services, income and economic assets in monetary terms (UN et al., 2009). NCA complements this by providing data on natural capital and the resources and ecosystem services that contribute to the economy (and eventually human well-being) and the emissions, waste and potential overexploitation that result from production and consumption. This enables environmental considerations to be 'mainstreamed' in economic decision-making processes.

By integrating environmental and economic data, NCA provides a picture of progress that is broader than the much-criticised metric GDP (Gross Domestic Product). It responds to the call for developing better metrics to account for nature in economic and financial decision-making and to go 'Beyond GDP' (Dasgupta, 2021; Hoekstra, 2019; IPBES, 2019; Stiglitz et al., 2018). Alternative indicators derived from NCA enable different summary metrics to be constructed in a systematic way. NCA makes critical links between the environment and the economy, so that both can be considered in decision-making, in, for example, the protection, management and restoration of natural resources such as forests or lakes that provide a wide range of ecosystem services and contain a wealth of biodiversity.

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Figure 3.1
Types of natural capital accounts

	System of National Accounts (SNA) Framework*	System of Environmental-Economic Accounting (SEEA) Central Framework*	SEEA – Ecosystem Accounts*
Asset accounts	**Economic Asset Accounts** Changes in produced assets and (non-)financial balance sheet items.[1]	**Environmental Asset accounts** Changes in stocks of minerals, energy resources, land, timber, aquatic resources, soil, water, biological resources.[2]	**Ecosystem Accounts** *(including thematic accounts for climate change, biodiversity, oceans and urban areas)* Changes in ecosystem extent (size), condition (quality), and capacity (future expected flows of ecosystem services).
Flow accounts	**Economic Supply and Use Tables** Transactions by residents in the National Economy and income.[1]	**Environmental Supply and Use Tables** Supply and use flows for energy, water, materials, incl. waste and emissions to soil, air and water.[2] **Environmental Protection Activity Account** Transactions to preserve of protect the environment or to influence behaviour.[2]	**Ecosystem Supply and Use Tables** Supply and use of intermediate and final ecosystem services flows (provisioning, regulating and cultural services).[2]

* The three frameworks partially overlap, especially for the environmental and ecosystem goods and services directly used in economic processes such as water, land, materials, energy, timber and agricultural crops.
[1]) In monetary terms ; [2]) In physical or monetary terms (ecosystem extent and condition accounts only in physical terms)

Source: PBL

An important feature of NCA is that it is scalable
Being scalable means that the interaction between activities at different levels of government can be examined and that national policies may be consistently applied at subnational levels. It also enables the impact of economic activity and environmental management at the local level to be nested within an overarching national policy framework. Similarly, the private sector can see its own activities in context and identify areas and activities for investment. This is not just theory. NCA has been used at sub-national levels for different types of ecosystems or land uses, such as national parks, as it has been done in Australia (Varcoe et al., 2017) and Uganda (Box 4.2), or for states or provinces, as has been done in the United States (Warnell et al., 2020) and China (Box 3.1).

The countries compiling natural capital accounts are steadily increasing in number
NCA is formalised through the System of Environmental-Economic Accounting (SEEA). The concept of natural capital is around 50 years old (Schumacher, 1973), and accounting for it has been in development for 30 years. In 2012, the United Nations Statistical Commission (UNSC) adopted the SEEA Central Framework (UN, 2014) and this was followed in 2021 by the adoption of the SEEA Ecosystem Accounting (UN, 2021a). Together, these two parts of the SEEA provide coherent, internationally agreed concepts and methods for producing a suite of accounts linking natural capital and ecosystem services to the SNA (Figure 3.1). In response to the UNSC's decision to scale up the implementation of the SEEA, an implementation strategy is being developed.[4]

In the SEEA, natural capital is recorded as an asset. Natural capital takes several forms, with ecosystems, biodiversity land, water, carbon, and biodiversity all considered as assets in the SEEA. Ecosystem assets are measured in terms of their extent (i.e. area) and condition (physical characteristics such as the ecological composition, structure, and function).

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[4] The draft implementation strategy that was discussed by the UNCEEA at its meeting in June 2021 can be found at https://seea.un.org/sites/seea.un.org/files/seea_ea_implementation_strategy_draft_11june.pdf

Box 3.1 Gross Ecosystem Product and 'eco-compensation' from local to national decision-making in China

The Chinese Government is developing a programme of natural capital accounting using the SEEA (NBS China, 2021). The accounting system has been designed for decision-making at national and sub-national levels and plans to use a new indicator known as Gross Ecosystem Product (GEP) (Figure 3.2). The accounts and the GEP indicator provide decision-makers with evidence of the value of ecosystem services and the consequences of changing the quality and quantity of ecological assets. This, in turn, enables 'eco-compensation' which has two major components: rewards for ecosystem protection behaviour and compensation for disturbing or destroying ecosystems, which is akin to payments for ecosystem services.

Figure 3.2
Ecosystem accounting and decision-making across government levels
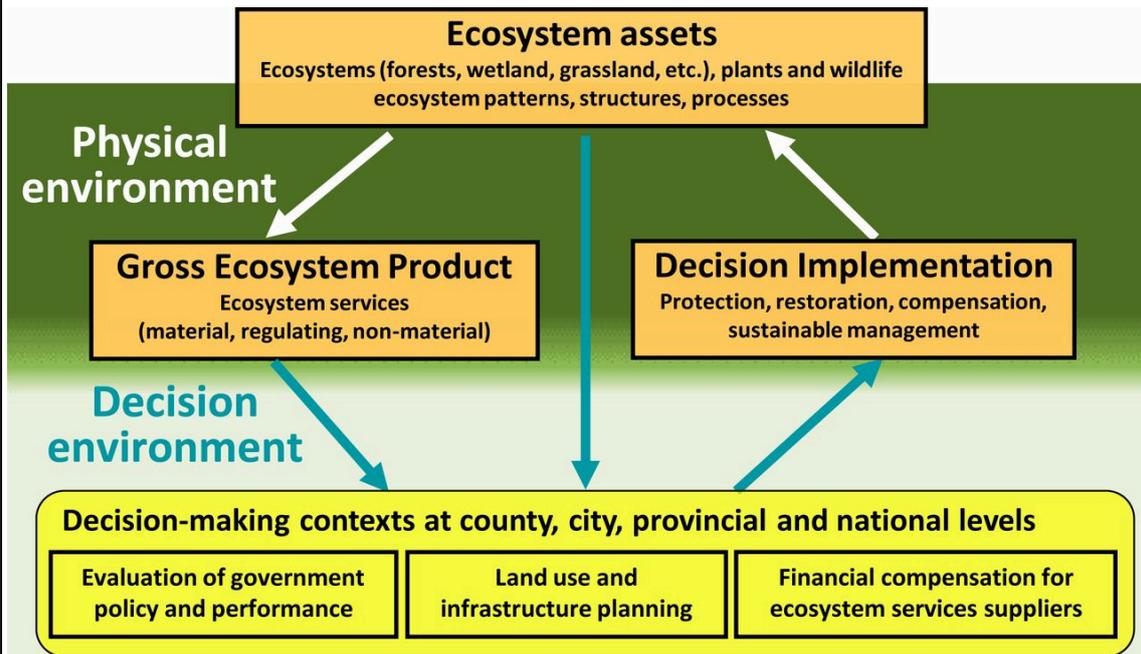
Source: Ouyang et al. (2020)

In 2017, 69 countries reported that they were developing accounts within the SEEA Central Framework (UNCEEA, 2018). In 2020, implementation of the Central Framework was reported by 89 countries and 34 countries reported implementation of Ecosystem Accounting (UNCEEA, 2021). Of the 89 countries, 62 publish at least one type of account on a regular basis and 11 publish their accounts on an ad-hoc basis. Another 16 countries compile but do not yet publish their accounts. With the adoption of SEEA EA in March 2021 as an international statistical standard, more countries are expected to start producing accounts. For example, China has developed a strategy for doing so (Box 3.1).

3.2 Producing natural capital accounts

The interviewees noted that NCA is generally perceived as very technical and largely academic and beyond the reach of many low- and middle-income countries that lack the resources, expertise and data to build and use such accounts. The perception that NCA is technical is correct but no more so than other data sources and methods traditionally used by governments. For example, nearly all countries produce and use the System of National Accounts and its headline indicator GDP. Proof that NCA is within the reach of many countries is found in the increasing number of countries producing accounts using the SEEA (Section 3.1).

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Establishing and expanding NCA does not have to start from scratch

Availability of basic data and accounts was identified as a key problem by several experts interviewed. This can be broken down into two distinct problems: (1) accounts do not exist or are 'old'; and (2) the data needed to compile accounts do not exist or are difficult to collect.

Although these problems are common, a wide variety of environmental and economic data are available from international agencies, various parts of government (e.g. agencies for environmental protection, meteorology, water, geography, geology, forestry and land management), research institutions and the private sector. Furthermore, most countries have a statistical office that produce a range of economic and social data; for example, the national accounts and population estimates.

All of these data may be identified, drawn together and are a first step towards the construction of accounts. Furthermore, there is increasing availability of global data sets from a range of international agencies, including geospatial data. As an example, the World Bank's Global Program for Sustainability is developing global data sets for compiling comprehensive wealth accounts, as well as data for sustainable finance instruments. Global data from remote sensing and modelling mean that broadscale accounts, for example, for land and ecosystem services are possible.

Box 3.2 Advancing natural capital accounting in South Africa

Statistics South Africa has developed a 10-year strategy for advancing natural capital accounting in South Africa (Statistics South Africa, 2021). The strategy aims to focus the efforts of the national statistics office and other institutions on developing priority natural capital accounts for attaining sustainable development policy objectives of South Africa. It is intended to support coordination of an integrated body of natural capital accounting work in South Africa, and collaboration between national institutions in such a way as to strengthen investment and commitment to the production of natural capital accounts that provide credible and useful evidence for integrated planning, monitoring and decision-making. The strategy was developed via a consultative process that led to 5 goals and 10 strategic objectives (Figure 3.3).

Figure 3.3
South Africa's NCA strategy vision, goals and strategic objectives
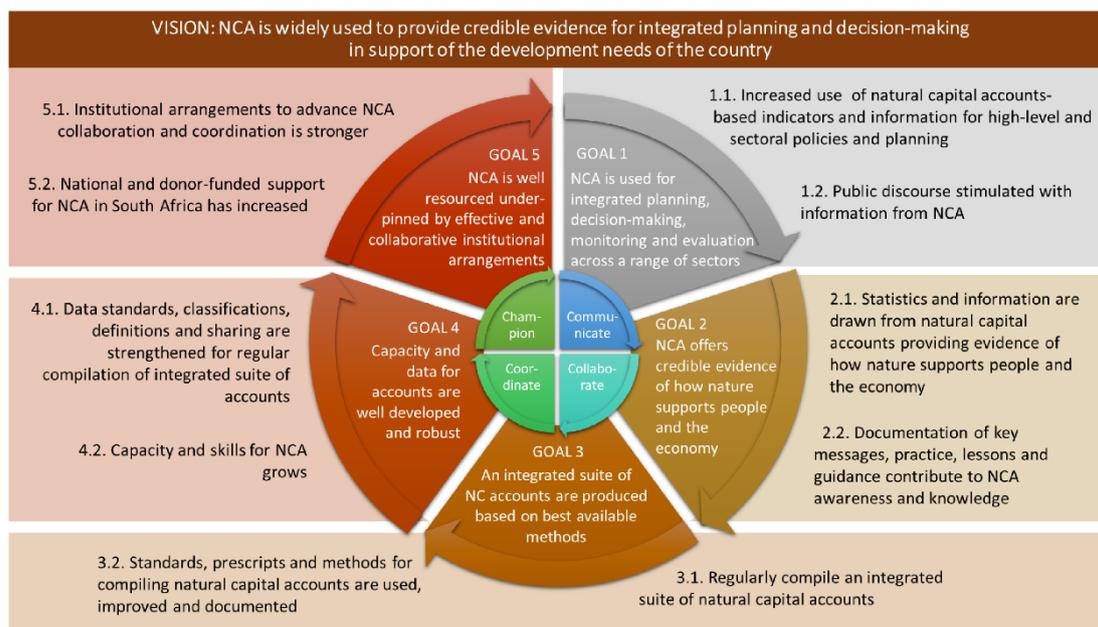
Source: Statistics South Africa (2021)

Building natural capital accounts requires expertise
If there are data available, basic NCA can be built relatively quickly when countries have the required expertise, resources and will to produce these accounts. The expertise necessary to produce accounts can often be found, for example, in the areas of government that produce the national accounts and environmental data. Several online platforms are also available to help with building accounts and modelling flows of ecosystem services. For example, the *ARIES for SEEA* tool allows countries to quickly build accounts using international data and open-access software (Box 3.3).

If a country's capacity for producing NCA is limited, there are still plenty of possibilities. Much material on producing natural capital accounts is available online, with lessons learned and information about how NCA can aid a green recovery (Table 3.1). Online training is available from the UN and universities (e.g. Australian National University), while in-person training courses have been run by the World Bank, United Nations, statistical agencies and universities. Often, NCA experts work with countries who are starting the production process for NCA and there is a wide range of experience and resources available to assist countries in developing and using NCA for policy.

Accounts can be built relatively quickly with existing national data and the aid of global data sets and new tools
In the past, natural capital accounts have been built in 1 to 2 years, as has been demonstrated in, for example, Botswana, Colombia, Costa Rica, Uganda and Zambia (Bass et al., 2017). In most cases, this work has been supported by international agencies and donor countries. However, the growing number of online data sources and tools along with increasing expertise, across the globe, means that basic accounts can now be built much quicker (in months rather than years). This means that existing data can already be used to create basic accounts and support a green recovery. The basic accounts can be refined and improved over time (Vardon et al., 2018).

Table 3.1
Material to help with developing and using NCA for policy

Name	Agency	Web address
SEEA e-Learning	UN	https://seea.un.org/content/seea-e-learning-resources
SEEA Knowledge base	UN	https://seea.un.org/content/knowledge-base
Introduction to environmental accounting	Australian National University	https://fennerschool.anu.edu.au/introduction-environmental-accounting
Green Growth Knowledge Platform	Multiple agencies	https://www.greengrowthknowledge.org/
WAVES Policy Forum proceedings	World Bank, UN, PBL	https://www.wavespartnership.org/en/policy-forum-natural-capital-accounting-better-decision-making
WAVES Knowledge Centre	World Bank	https://www.wavespartnership.org/en/knowledge-center
OECD i-Library - environment	OECD	https://www.oecd-ilibrary.org/environment
Methodological publications	Eurostat	https://ec.europa.eu/eurostat/web/main/publications/manuals-and-guidelines

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Box 3.3 ARIES for SEEA

The [Artificial Intelligence for Environment & Sustainability (ARIES)](#) platform, developed by the Basque Centre for Climate Change (BC3), is an integrated, open-source modelling platform for environmental sustainability, where researchers from across the globe can add their own data and models to web-based repositories. It has been used in the production of NCA in Italy, pilot projects are underway in India and South Africa, and there are plans for using the platform in several other nations.

Based on ARIES, the United Nations Department of Economic and Social Affairs (UNDESA), United Nations Environment Programme (UNEP) and BC3 have developed the 'ARIES for SEEA Explorer'. This application uses innovative open-source and user-friendly technology to enable rapid, standardised, scalable and customisable ecosystem accounts for various areas of interest, which are consistent with the SEEA Ecosystem Accounting framework. The Explorer automatically generates a comprehensive ecosystem accounts report, fully documenting the data, models, coefficients and methods used.

ARIES for SEEA promotes an approach to interoperable data and models that allows all nations to assemble SEEA EA accounts along with a means for data providers, NSOs, and scientists to share data and models to promote their reuse, resulting in accounts that will improve in quality, over time. The use of the application is free for governments, academics, and NGOs, and is available online.

3.3 Modelling and natural capital accounting

Natural capital accounts are a source of information that record what has happened and show the trade-offs that have already been made. Modelling can build on NCA and help to assess the likely future impacts of various policy and management decisions on the economy and the environment. In this, the data from the accounts are combined with assumptions to create models that make future projections.

A broad suit of models already uses NCA
Models using NCA have been used by many countries for decisions on land, forest and water management and a green economy. New models are being developed linking economic models to biophysical models.[5] These models are used in many contexts, showing for example, the likely impact on water quantity and quality from converting forests to agricultural land. Models that use NCA can assess the trade-offs and synergies of various options for investments in a green recovery and have already been applied to sustainable development (e.g. Banerjee et al., 2020a; Banerjee et al., 2020b).

Many models use what is called a social accounting matrix that shows the flow of economic transactions between industries, households and governments. To allow assessment of the interactions between the economy and the environment, this social accounting matrix can be extended with environmental data. An environmentally extended matrix can then be used for various types of models (e.g. economic models, environmental models, integrated assessment models and system dynamic models) (e.g. Collste et al., 2017; La Notte et al., 2020).

For most of these models, natural capital accounts can be incorporated in the social accounting matrices or provide otherwise useful information (e.g. through some of the physical flow or asset accounts on CO_2 emissions, water, energy or materials use). The supply and use tables of natural capital accounts are especially suitable for the suite of models mentioned above, given their direct link with the SNA and the social accounting matrix that is the basis of many modelling approaches.

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[5] Examples include Invest (Integrated Valuation of Ecosystem Services and Tradeoffs) models linked to the GTAP (Global Trade Analysis Project) CGE model, the Integrated Economic-Environmental Model (IEEM) and the Integrated Green Economy Model (IGEM)

An environmentally extended input-output (IO) table or the environmentally extended social accounting matrix used in a computable general equilibrium (CGE) model is based on the supply and use tables from natural capital accounts. The use of IO and CGE models for resource-related issues is not new (Dobos and Floriska, 2007; Lenzen et al., 2014; Leontief, 1970; Vaz, 2017), but the availability of data from natural capital accounts makes it easier to feed models and analyse the interrelationships between the economy and the environment.

**Modelling provides a bridge between NCA, policy and management**

Modelling, fed by the regular provision of structured information from the accounts, makes it possible to bridge past understanding of economic and environmental systems, in order to better meet the needs of decision-makers. In this, governments and the private sector already rely on the information from models based on SNA data to make future projections and make decisions for economic policy and management. Models based on NCA widen the bridge, allowing for integrated economic and environmental modelling for more coherent economic and environmental decision-making. For example, NCA and modelling can be used for assessing future impacts of alternative development pathways, as was done in Indonesia (Box 3.4). More general applications of models using natural capital accounts to make the case for investment in biodiversity conservation and ecosystem services are recognised (World Bank, 2021b; Johnson, 2021).

Box 3.4 Sustainable and inclusive growth in Indonesia

In 2017, the Government of Indonesia declared its goal of integrating climate action into the country's development agenda. The Low Carbon Development Initiative (LCDI) was launched by Indonesia's Ministry of National Development Planning. The initiative aims to explicitly incorporate greenhouse gas emission reduction targets into the policy planning exercise, along with other interventions for preserving and restoring natural resources.

To support this process, four different development pathways were developed using scenario forecasting based on NCA data (Bappenas, 2019). The scenarios examine the impacts of the unconditional and conditional NDCs of Indonesia, as well as further policy action beyond 2024, on GDP growth, forest loss, jobs, air quality and poverty. The GDP projections take into account the impact of reducing environmental pressures and externalities. The analysis finds that a low-carbon growth path can deliver an average annual GDP growth rate of 6% up to 2045 (Figure 3.4) and would unlock an array of economic, social and environmental benefits, including reducing extreme poverty, generating additional better-paid jobs, and avoiding deaths due to reduced air pollution.

Figure 3.4
GDP growth trajectories in four modelled scenarios
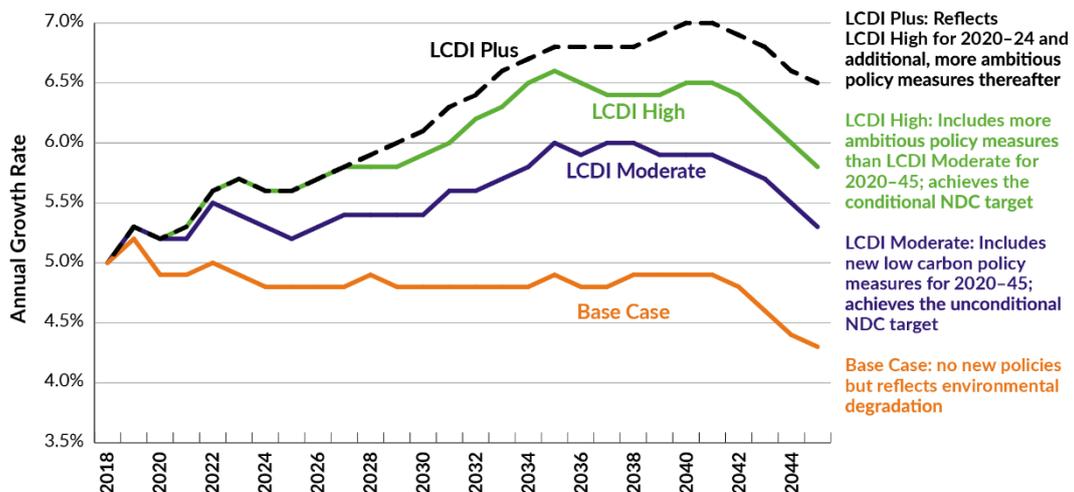
Source: Bappenas (2019)

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4 How NCA supports a green recovery

The purpose of NCA is to provide integrated economic and environmental data to improve decision-making. Information from NCA enables decision-makers to balance the short-term need to ensure the health and well-being of people and for economic recovery with the long-term objectives to address environmental challenges, increase resilience and reduce inequality. It can support multiple perspectives on a green recovery (Section 2.2), assist developing or strengthening recovery packages that build or strengthen natural capital (Section 2.3) and help create an enabling environment for actors to cooperate (Section 2.4).

This chapter shows how NCA and related tools may support a green recovery throughout the policy cycle. It pays specific attention to investments in natural capital and provides real-world country examples of the use of NCA to address policy and management challenges. Furthermore, it discusses how NCA and related modelling can provide the enabling environment to mobilise and empower relevant actors to assist the green recovery.

4.1 NCA and components of a green recovery

Entry points of NCA for a green recovery mentioned in the expert interviews include describing a green economy, linking natural capital to well-being, identifying areas for restoration, designing policies and monitoring progress. To date, only few countries have used natural capital accounting to develop a recovery stimulus. Rwanda is one of the few countries that has made explicit reference to NCA in its recovery package (see Box 4.3).

**Many components of a green recovery are already supported by NCA**
Although NCA has not yet been used in response packages, it is already used by a number of countries for issues aligned with a green recovery, such as biodiversity conservation and climate change mitigation and adaptation. Examples of NCA use for policy-making and its relation to the various components of a green recovery are shown in Figure 4.1. These examples are discussed in various parts of this report, while NCA has also played a role in many other environmental themes (related to, e.g., water, forests, minerals and agriculture). Furthermore, NCA has been used to address broader sustainability issues, including those related to integrated land management (Meijer et al., 2020) and the sustainable development goals (Ruijs et al., 2018).

Countries have focused on different components of a green recovery. Using the accounts for green recovery planning requires the use of those most relevant to the spending options for this green recovery. Table 4.1 shows the relationship between various components of green recovery and NCA, by account type. From this table, countries can determine which accounts are most relevant to their situation. The table clearly shows that, just as NCA covers more than one part of the policy cycle, it also spans different components of green recovery. For example, accounts of ecosystem extent, condition and service span all green recovery components mentioned.

Both NCA and modelling are required to meet the needs of policymakers
To further greening recovery stimulus packages and improve the use of NCA, the experts who were interviewed underlined that accounts by themselves are not enough. There is a need for analysis and use of modelling to achieve a better link to the needs and questions of policymakers. This is an extension of the change from an accounting 'push' to a policy 'pull' (Vardon et al., 2016), with analysis and modelling bridging this gap. Experiences from around the world show that mechanisms that effectively bring together the users and producers of NCA helps to ensure natural capital accounts are designed so that they suite the needs of users and are understood by users once they are available. For example, the countries that participated in WAVES established high-level steering committees convened by central planning or finance ministries, with technical working groups established to produce fit-for-purpose accounts (World Bank, 2021a).

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Figure 4.1
Components of green recovery and related NCA examples
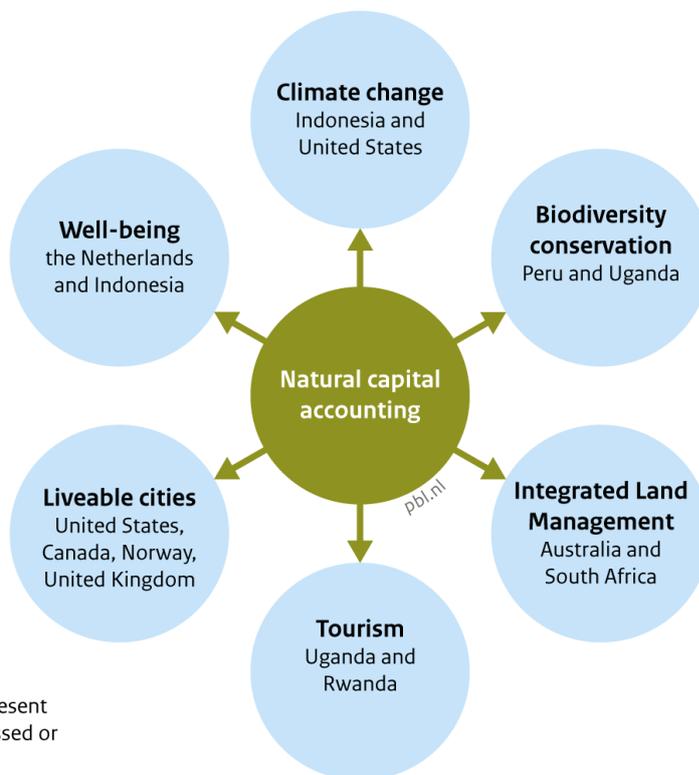
The countries represent case studies discussed or cited in this report

Source: PBL

Table 4.1
Types of NCA relevant to various green recovery components

Component of green recovery / Type of Natural capital account	Climate change	Biodiversity loss	Integrated land management	Health and well-being	Liveable cities
Greenhouse gases	•		•	•	
Carbon	•		•		
Energy	•				•
Air emissions				•	•
Water	•	•	•	•	•
Land	•	•	•		•
Forest	•	•	•	•	
Minerals	•		•	•	•
Ecosystem condition and extent	•	•	•	•	•
Ecosystem services	•	•	•	•	•
Biodiversity		•	•	•	•
EP and RM Expenditure*	•	•	•		•

*Environmental Protection and Resource Management Expenditure

4.2 NCA throughout the policy cycle

The policy cycle — problem identification, policy design, policy implementation, monitoring and review — has been used to illustrate how NCA can be used for policy analysis (Vardon et al., 2016). Table 4.2 shows questions commonly asked by decision makers, as well the information and types of answers NCA can provide, structured along the policy cycle.

In the short term, NCA is most relevant for problem identification, policy design and implementation
Figure 4.2 illustrates how natural capital accounts can be used in various phases of the policy cycle, specifically for a green recovery. NCA is often associated with monitoring and review, but is also relevant for identifying and clarifying problems as well as for policy design and implementation. The interviewees underlined the added value of using NCA throughout the policy cycle. They explicitly mentioned the use of modelling in policy design, including ex-ante assessment of announced measures against their social and environmental implications and near-term economic and employment impacts. Experts also mentioned NCA as relevant for monitoring.

Table 4.2
Use of NCA for policy

Policy use	Decision makers' questions	What information helps (data, accounts and analytical tools)	Types of answers that NCA can provide
Problem identification	• How are we doing? What has changed, and how does that link to changes in the economy and other factors? • Given assumptions about domestic and international development, how will we fare in the future?	• Accounting data and derived indicators, simple projections, input-output analysis, environmental economic models, scenario modelling, spatial analysis, footprint analysis	• Interpretations from the data on past and present state • Scenarios for future development of economy and environment
Policy design	• If we want to change the current state or projected future state, what can we do? • Who benefits from changes in policy? • Who bears the costs of producing these benefits?	• Accounting data and derived indicators, input-output analysis, computable general equilibrium modelling, environmental economic models, scenario modelling, cost-benefit analysis, integrated assessment	• Economic and environmental effects of restrictions on scenarios to achieve policy targets • Ex ante assessment of the policies' effects on the economy and environment
Policy implemen-tation	• How can we target the policy response to get the most improvement for the least cost? • Which activities should be done first? • What price should be put on natural resources?	• Accounting data, derived indicators, environmental economic modelling, spatial analysis, industry analysis, cost–benefit analysis, business case	• Detailed assessment of all the pros and cons of the policy interventions
Policy monitoring	• Are the policies making progress toward goals and targets?	• Accounting data and derived indicators	• Ex post assessment of policy progress and evaluation of the need to adjust policy instruments
Policy review	• How can we make the existing policy more effective to achieve the goals and targets? • Are there any unintended consequences of the policy response? • Do we need different policy responses?	• Accounting data and derived indicators, econometric modelling	• Ex post policy evaluation of effectiveness and efficiency of policy instruments

Source: After Bass et al. (2017)

The use of NCA in problem identification, policy design and implementation is especially pertinent in the context of 'greening' existing and new stimulus packages. It requires using what is already there, in the way of data, accounts and models. In the longer term, the more traditional role of NCA for monitoring and review becomes relevant. This requires regular updating of data.

NCA can help problem identification by clarifying and prioritising issues
A key question is where the environment is most in need of protection, management or restoration. NCA and modelling can help to identify the relative importance of environmental issues, by area or ecosystem type, and hence where natural capital investments or updated policies are needed. They can show the state of natural capital and the current flows of ecosystem services to the economy and estimate future flows. Furthermore, NCA can identify the sectors that drive environmental degradation and can be used to identify industries (e.g. agriculture, mining, manufacturing) where recovery investments would be most beneficial, which may be concentrated in a country's particular regions. The relative importance of each type of asset or industry will differ between countries as well as across regions.

Figure 4.2
Use of natural capital accounting for green recovery across the policy cycle

NCA and modelling for identifying industries, ecosystems and areas that could benefit most from green recovery investment and policy

NCA and modelling for assessing synergies and trade-offs of green recovery investment and policy to deliver the greatest level of short- and long-term economic, social and environmental benefits

NCA and modelling for assessing the efficiency of green recovery investment and policy

Problem identification

Policy design

Accounts

Information system

Primary data

Modelling

Policy review

pbl.nl

Policy monitoring

Policy implemen-tation

NCA for monitoring progress on green recovery goals and targets

NCA and modelling for selecting industries, ecosystems and areas most in need of green recovery investment and policy

Source: Adapted from Vardon et al. 2016

Box 4.1 Using NCA for assessing trade-offs in alternative forest use in Australia

Ecosystem accounts developed for the Central Highlands, near Melbourne, Australia, informed decision-makers about forest use (Keith et al., 2017). Currently, timber harvesting from native forests conflicts with water provisioning, carbon sequestration, biodiversity conservation and recreation. Synthesising ecosystem and economic information in accounts allowed quantitative comparisons, in physical and monetary terms, which enabled trade-offs between various ecosystem services to be defined explicitly and spatially. The accounts demonstrated that a transition away from native forest harvesting would improve the condition of ecosystem assets for the conservation of biodiversity. The provision of the ecosystem services in the way of water supply, carbon sequestration and recreational services would far exceed the losses from ceasing native timber production (Figure 4.3).

Figure 4.3
Value of ecosystem services and industrial value added (2013–2014) and the potential changes if native forest harvesting ceased

Source: Keith et al. (2017)
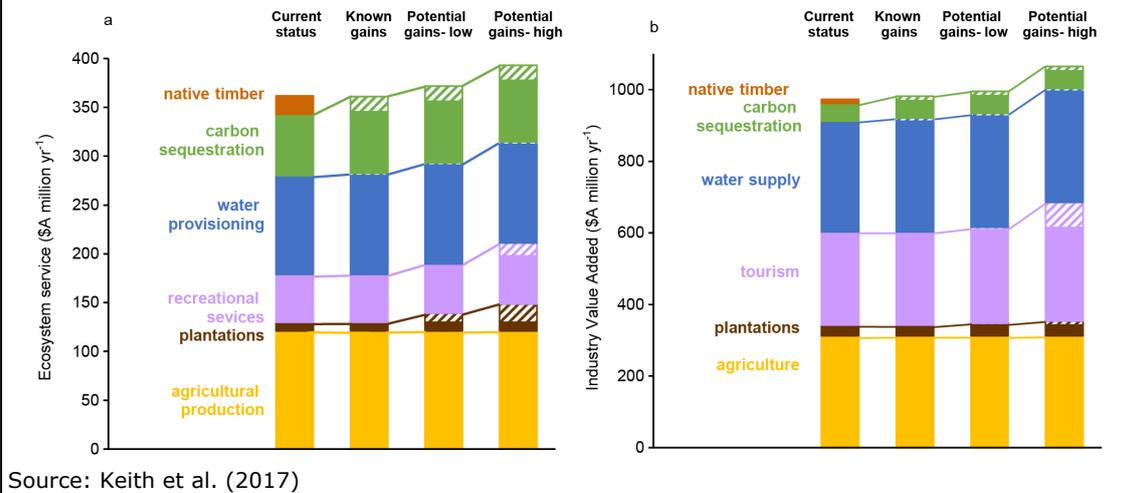
NCA can aid policy design and implementation by assessing the impacts and efficiency of proposed natural capital investments and management policies
A subsequent question is that of which investments and policies could deliver the greatest benefits, now and in the future. This can be in a particular sector (e.g. agriculture, energy, education, manufacturing, transport), in a specific place (e.g. country, province or catchment) and for a specific resource (e.g. land, timber, water). Reframing spending on natural capital as an investment in future benefits would represent a significant and fundamental change in approach (Vardon et al., 2019) and, as such, assist designing green recovery packages. NCA can identify the sectors driving environmental degradation through unsustainable use of resources and pollution as well as those contributing to natural capital, economic growth and employment. Furthermore, NCA and modelling can help to identify where the short-term benefits are likely to come from as well as the long-term benefits of alternative investment and policy decisions. Finally, they can show synergies and trade-offs of investment and policy decisions across human and environmental challenges, in space and over time.

Design and implementation of biodiversity policy and management with NCA
Biodiversity underpins the supply of ecosystem services essential for human well-being and economic development. Linking biodiversity indicators with national economic accounts provides a means of mainstreaming biodiversity into the economic planning and monitoring processes. Case studies from Australia, Uganda and Peru demonstrate the potential of accounting for integrating biodiversity into mainstream economic thinking (King et al., 2021).

An earlier WAVES study discusses how natural capital accounting can aid mainstreaming biodiversity (Ruijs and Vardon, 2018) and integrated landscape management (Meijer et al., 2020). Figure 4.4 shows how NCA can help assess the expenditures and benefits of

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investments and policies for the conservation, restoration and protection of biodiversity, both species and ecosystems. Examples of the use of NCA for this purpose are found in comparing the benefits of alternative forest uses in the Central Highlands of Australia (Box 4.1); inform action on the green growth development strategy of Uganda (Box 4.2); analysis of alternative strategies to increase the value of nature-based tourism in Rwanda (Box 4.3); and analysis of the cost and benefits of addressing land degradation in a catchment in KwaZula-Natal, South Africa (Turpie et al., 2021).

Figure 4.4

Natural capital accounting for assessing biodiversity conservation benefits
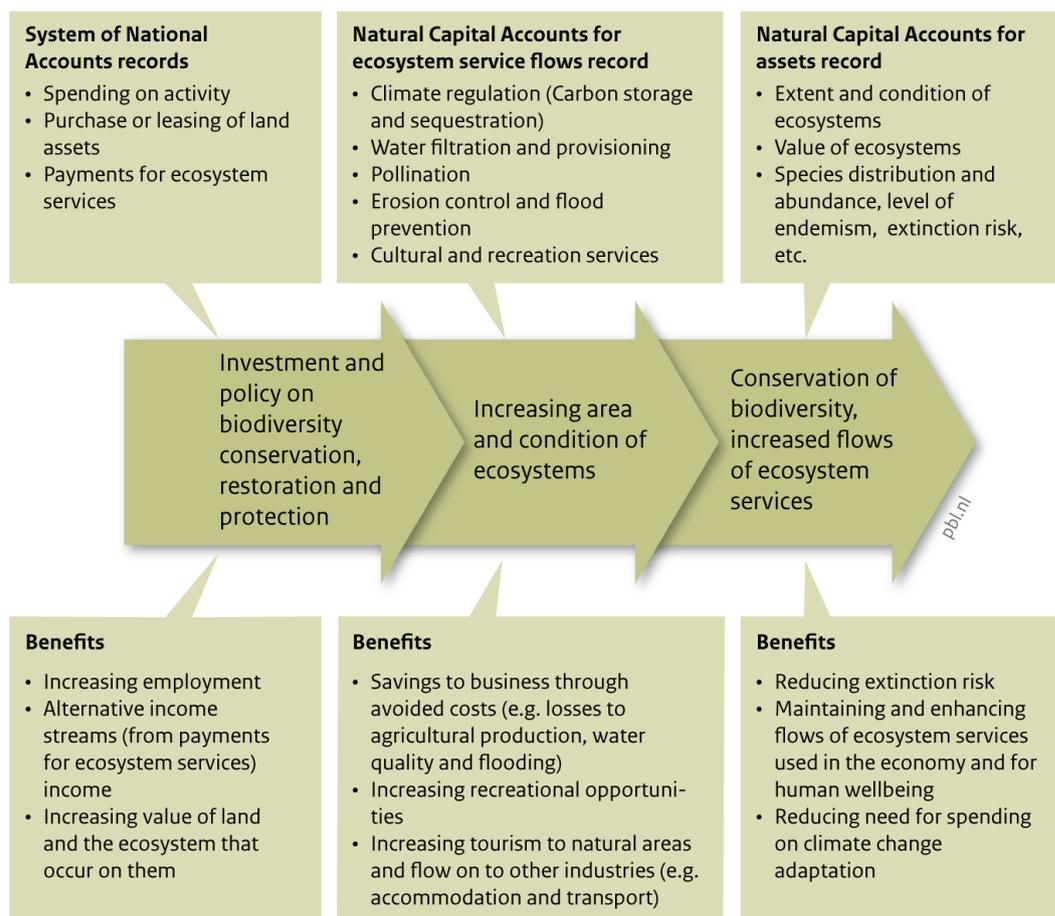
Source: PBL

Box 4.2 Accounting for biodiversity and green growth in Uganda

Uganda, with support from the UK Government's Darwin initiative, compiled accounts for three biodiversity-related themes to inform action on their green growth development strategy. The strategy targets the Tourism and Wildlife Sector as one of four natural capital sectors, aiming to quadruple the value of foreign tourism by 2030. Integrated accounting for biodiversity and tourism revealed total spending by tourists during their visits to 12 protected areas increased from approximately USD 25 million in 2012 to USD 75 million in 2019. This spending is mainly by foreign tourism.

The accounts link tourist spending and biodiversity-related natural capital. This can support planning the recovery of the sector, which was the hardest hit by COVID-19 in Uganda (Ahebwa and English, 2021). The accounts demonstrate the long-term economic benefits of investment in Uganda's protected areas. They inform on marketing and investment opportunities for less-visited protected areas, increasing visitor numbers, length of stay and spending in regional areas. This can help catalyse the recovery of the sector, as a whole.

Box 4.3 Nature-based tourism, NCA and biodiversity conservation in Rwanda

Nature-based tourism is at the centre of Rwanda's recovery plan. Tourism services form by far the largest foreign source of economic revenue, accounting for USD 498 million in 2019, 10 times the value of 1998. Much of this is based on nature-based tourism in protected areas and related to iconic species, such as the Gorilla. There would be no nature-based tourism without the conservation of biodiversity, which is why this has great economic benefits for Rwanda.

The revenues from tourisms in Rwanda collapsed in 2020, as it did around the world. Natural capital accounts played a prominent role in the development of the plan, providing the evidence needed to ensure the protection of ecosystems and demonstrating the link to economic development (Benitez et al., 2021). With the evidence from NCA, the Rwandan Government has estimated the investment required to maintain and restore the environment to ensure that nature-based tourism can return to pre-COVID-19 levels and continue to grow, while also providing other ecosystem services including carbon sequestration. The resources needed for environmental management and restoration to achieve the long-term environmental and economic benefits are not fully funded, but the accounts and the plan provide a strong basis for seeking additional resources from donors and other investors.

The accounts relevant for these tasks concern ecosystem extent, ecosystem condition, ecosystem services and biodiversity. Together with environmental protection expenditure and resource management accounts, they can be used to assess the effectiveness of already implemented biodiversity-related policies and the likely impact of investments and policies aimed to increase effectiveness.

Design and implementation of climate policy with NCA
An earlier WAVES study examined how NCA can be used to inform the process of designing and implementing policies and actions for climate change mitigation and adaptation (Ruijs and Graveland, 2018; UN, 2020a). Figure 4.5 shows how NCA can contribute to the assessment of the costs and benefits of climate mitigation and adaptation measures. Examples of using NCA and modelling for policy on climate change can for example be found in Indonesia, where the impacts are assessed of various levels of climate policy efforts on GDP growth, forest loss, employment, air quality and poverty (Box 3.4), and in the United States where green spaces are shown to provide benefits for urban areas (Box 4.4).

The accounts most relevant for designing and implementing climate change mitigation polices depend on the green recovery spending options being considered. For informing climate change mitigation policy, greenhouse gas emission accounts are often the starting point. This can be extended to full carbon accounts and accounting for the ecosystem services related to climate regulation — NBSs for carbon sequestration and carbon storage. Evaluating nature-based solutions for climate mitigation and conservation requires comprehensive carbon accounting (Keith et al., 2021). Separating carbon sequestration from carbon storage prevents the perverse outcome of an incentive for removing carbon stored in trees, which is not counted in the UNFCCC accounting, to be replaced by new trees which store carbon at a faster rate (Keith et al., 2021).

For informing climate adaptation policy, accounts related to ecosystems, water, forest and agriculture, are useful. Ecosystems such as mangroves can sequester and store carbon as well as provide protection from storm surges. In this respect, natural capital accounts identify areas where short-term job creation could be used to deliver long-term improvements in the natural capital that delivers these ecosystem services and where payments for ecosystem services could be made in the future to ensure the ongoing maintenance of the ecosystems that deliver these services. Water accounts can highlight industries that are susceptible to changes in water availability, such as agriculture. Again, accounts in combination with modelling can be used for targeting adaptation measures and policy responses, such as moving to agroecological approaches that use less water and prevent erosion.

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Figure 4.5
Natural capital accounting for assessing climate policy benefits

System of National Accounts records	Natural Capital Accounts for flows record	Natural Capital Accounts for assets record
• Spending on activity • Production and consumption of fixed assets	• Supply and use of energy and greenhouse gas and other emissions recorded • Supply and use of the ecosystem service of climate regulation (e.g. by forests)	• Condition of the atmosphere • Extent and condition of forests

Spending on climate change mitigation → Increased supply of renewable energy and reduction in greenhouse gas and other emissions → Slowing and ultimately stopping the degradation of the atmosphere

Benefits	Benefits	Benefits
• Increasing employment and income • Increasing fixed assets (e.g. wind farms and public transport) and improvements to existing assets (e.g. better thermal insulation)	• Savings to business and households through reduced energy use • Improving air quality through reduced pollution (e.g. NOx, SOx, PM2.5) associated burning of fossil fuels for electricity production and transport • Increasing reason to protect forests	• Reducing impacts on biodiversity, society, and economy • Reducing need for spending on climate change adaptation

Source: PBL

Monitoring progress requires regular data updates
Provided that it is updated regularly, NCA provides information on changes, over time, in the economy (e.g. in industry mix, production technology and methods, increases in job numbers), environment (e.g. carbon storage, improvements in ecosystem services) and society (e.g. change in household income and expenditure on various goods and services and their distribution). Furthermore, in combination with other tools, NCA can help to assess the effectiveness and efficiency of government policies and programmes. For example, NCA has been used to review water management and pricing in Botswana (Pule and Galegane, 2017), Colombia (Romero et al., 2017) and Zambia (World Bank, 2020b).

Two examples of regularly updated accounts for monitoring are provided by New Zealand and Sweden, who are producing quarterly greenhouse gas emissions, according to the SEEA, allowing it to track emissions and relate them to certain economic activities (Roth and Steinbach, 2018). The IMF is producing experimental quarterly air emission accounts for more than 20 countries.[6] These accounts allow governments to monitor and adjust climate change policies, on a quarterly basis, in much the same way that the quarterly accounts from the SNA are used for adjusting monetary and fiscal policy. In this respect, it is useful to note that a quarterly decline in GDP was the key indicator of the COVID-19 economic recession and an increase in GDP will be the key indicator of economic recovery. For a green recovery, a downward trend in the quarterly production of greenhouse gases would be an indicator of success in addressing climate change. Box 4.5 shows another example: annual monitoring of human well-being in the Netherlands.

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[6] https://climatedata.imf.org/pages/re-indicators/#re1 (accessed 28 August 2021)

Box 4.4 Assessing the economic benefits of urban greening in the United States, using NCA

Natural capital in cities provides many ecosystem services that improve quality of life for residents and visitors. Natural capital accounting for urban areas is relatively new, but has been done in a few countries, including Canada (Grenier et al., 2020), Norway (Steines, 2018) and the United Kingdom (eftec, 2017). Much work is focused on green spaces in urban areas. For climate change, the benefits of green spaces and vegetation are seen in the provision of ecosystem services that result in urban cooling, carbon sequestration and flood prevention. Additional benefits from green spaces include air filtration, noise reduction, increased recreational opportunities, which may also be reflected in improvements in physical and mental health.

Heris et al. (2021) used ecosystem accounting to assess the economic benefits from trees in US cities, for two ecosystem services: (1) cooling, mitigating climate change and reducing the need for air conditioning, and (2) rainfall interception providing improved water quality and flood mitigation (Figure 4.6). The estimated value of these two services for 768 US cities in 2016 was estimated at USD 539 million for cooling and USD 425 million for rain interception. Model code used in the study was made available in a public repository to support its future reuse; subsequent testing of the models occurred to support urban ecosystem accounting in Europe.

Figure 4.6
Economic benefits from trees in US cities, 2016
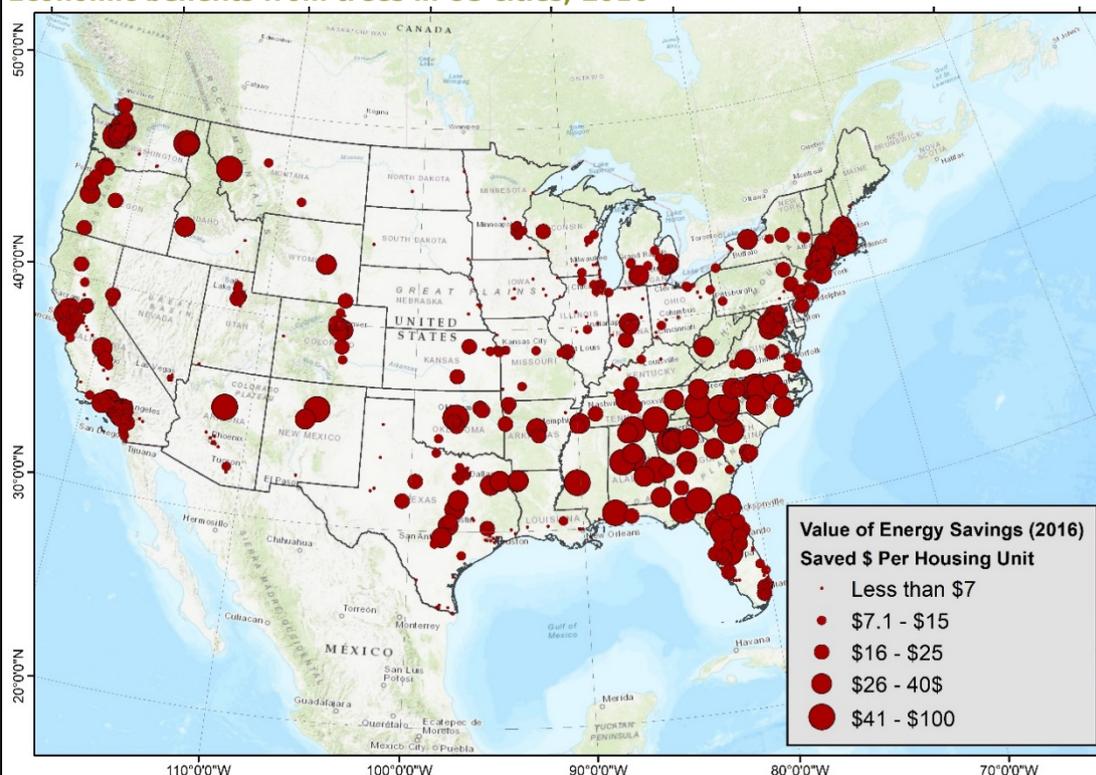
Source: Heris et al. (2021)

The SEEA can play a supporting role in reporting on a range of SDGs and global environmental agreements

A green recovery aims to further globally agreed environmental goals. An estimated 40 SDG indicators could potentially come from the SEEA framework, including for SDG 2 (zero hunger), SDG 6 (clean water and sanitation), SDG 8 (decent work and economic growth), SDG 11 (sustainable cities and communities), SDG 14 (life below water) and SDG 15 (life on

land) (UNSD, 2021). Furthermore, SEEA can play a supporting role in reporting on subjects from the three Rio conventions: on climate change (UNFCCC), land degradation (UNCCD) and biodiversity loss (CBD). For a range of indicators, the SEEA can provide most if not all of the information required (UNEP-WCMC and UNSD, 2019).

Both the Paris Agreement and the CBD post-2020 Global Biodiversity Framework recognise the importance of transparency and an accounting framework. Although the UNFCCC has its own standards for reporting greenhouse gas emissions, these can be mapped to the SEEA (see UN et al., 2014a; Keith, 2018). For the CBD, this is recognised in the post-2020 targets currently under discussion, especially target 13 and related indicators (CBD, 2021b). Furthermore, the long-term approach to biodiversity mainstreaming identifies the need to develop and implement nature and biodiversity reporting and implement ecosystem or natural capital accounting, using the SEEA framework as part of national accounts to inform decision-making and implementation (CBD, 2020).

Box 4.5 Monitoring well-being in the Netherlands

At the request of the Dutch House of Representatives, the Dutch Government asked Statistics Netherlands in 2017 to develop a system of monitoring the well-being of the Dutch population and SDG progress: the *Monitor of Well-being*. The aim of this Monitor is to provide politicians and society with information on well-being in the Netherlands, and on the level of achievement of the Sustainable Development Goals (SDGs). The Monitor describes the development of well-being 'here and now', the potential well-being of future generations ('later') and the effect of actions on well-being in other countries ('elsewhere'). To this end, it uses a structured set of economic, societal and environmental indicators and a description of the developments observed, over time. Several indicators are derived from Dutch Environmental Accounts, based on the SEEA framework.

The 2020 Monitor of Well-being concludes that the Netherlands is doing well with respect to GDP and employment, while part of the increase in welfare is associated with exporting environmental pressures (CBS, 2020). Furthermore, the Netherlands is vulnerable in the area of natural capital. The Monitor shows that the nitrogen surplus is amongst the highest in Europe and the capacity and share of renewable energy amongst the lowest. Furthermore, with the exclusion of one neutral development, all biodiversity indicators are showing a downward trend.

4.3 NCA for creating an enabling environment

A green recovery reinforces the need for bring all societal actors together. This requires institutional cooperation, an enabling environment and effective communication.

Developing natural capital accounts can increase institutional cooperation
Institutions are often siloed, with different agencies responsible for, for example, economics, environment, energy or transport. This hinders integrated and coordinated policy responses. Also, the various agencies often rely on differing sources of information, which can be inconsistent and confusing. As a result, many agencies have developed their own decision-making processes based around the data they have access to, often collected by the agency making the decisions. Developing natural capital accounts can increase institutional cooperation, as it requires institutions to collaborate by sharing data and understanding and reconciling various data sources.

NCA can be used to create an enabling environment to mobilise and empower actors to cooperate
NCA provides an agreed information system on which to assess trade-offs and base decisions. It can contribute to the identification of synergies between individual investments in nature-based solutions for both economic and environmental gains. Furthermore, it can enable financing by the private sector and international donors and show opportunities for both public and private co-investments. Table 4.3 provides an overview of how NCA can support the six government actions relevant for creating an enabling environment for a green recovery, as discussed in Section 2.4.

Table 4.3
Role of NCA in providing an enabling environment for a green recovery

	Role of NCA	Policy relevance
Reform incentives	• Reveal how current and new policies, taxes and subsidies are influencing the economy and the environment	• Align incentive structures to stimulate more sustainable production and consumption
Mobilise finance	• Provide insights into costs, as well as economic, social and environmental benefits of investments decisions	• Make the case for 'green' investments for business, investors and international donors
Stimulate innovation and learning	• Provide a comparison between sectors of production factors, including human capital, produced capital and natural capital	• Identify sectors that benefit most from technological innovation and skill development
Integrate policies	• Assess the synergies and trade-off of investments and policies across sustainable development objectives, over time, across sectors and between various areas	• Ensure that decisions in different parts of government are aligned and do not create tensions
Ensure equity and inclusiveness	• Assess the use of ecosystem services in different parts of society, as well as the impacts of investments and policies on these services and society. • Income distribution is not standard in NCA and requires the household sector to be disaggregated (or decomposed) to show the levels of income and ecosystem services received by different income groups	• Make sure investments and policies benefit those most in need
Provide for policy adaptation	• Monitor progress and assess the effectiveness and efficiency of investments and policies in terms of costs and benefits for the economy, environment and society	• Provide feedback on progress and policy effectiveness to the actors involved

Effective Communication for bringing NCA and green recovery communities together

NCA can provide the necessary evidence base for decision-making that incorporates the environment's contribution to economic development and long-term resilience. To increase the understanding of NCA amongst policymakers, there is a need to sharpen the narrative on the added value of NCA for both public- and private-sector decision-making and policy. A green recovery can only be possible with a better flow of information within government and between the public and private sectors and civil society. This could create a virtuous cycle. Improved communication on NCA may lead to a better understanding of NCA, which, in turn, enables better decisions by government for achieving a green recovery and improved acceptance of these decisions by the private sector and civil society.

The first step is effective communication on how NCA could contribute to a green recovery. This report is part of this communication, as is the 5th Policy Forum on NCA for Better Decision Making, for which this report serves as input. It is an introduction of the NCA to the green recovery communities. But more is needed if NCA and its role in a green recovery is to be widely understood, particularly with government decision-makers.

The year 2021 is important for nature and global climate action. The pandemic has underscored the close link between human and planetary health and the need to build back greener and stronger. A new biodiversity framework and targets are expected to be agreed at CBD COP15, hosted by China in October 2021, and the UNFCCC COP26, hosted by the United Kingdom in November 2021. Both are expected to have biodiversity and nature-based

solutions high on the agenda. Events around the two conferences would be an opportunity for communicating key messages around the role of NCA in green recovery.

Another forum that could create more awareness is the Africa Community of Practice (CoP) on NCA, set up in 2019, which now has nearly 500 members from 40 countries and 11 partner organisations. The CoP holds regular webinars and learning events and can serve as an effective platform to inform policymakers on the role of NCA in green recovery.

Guidance on communication with government decision-makers is provided by the Bennett Institute for Public Policy (2020). The means of communication — such as reports, one-page briefing notes, blogs, social media, video seminars, in-person briefings — as well as the messages need to be tailored to various audiences.

The NCA community will have to come together, not only to create a common narrative but also to use their channels and audiences to raise more awareness of how NCA can aid green recovery. For example, The Global Program of Sustainability (GPS), led by the World Bank, and the UN's NCAVES project have communication programmes that can help reach policymakers. Similarly, in the private sector, the Green Growth Knowledge Platform and the Capitals Coalition can reach finance and business communities.

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5 Moving forward

A green recovery is not just a task for environmental ministries. Almost all ministries have a role to play. Already many statistics offices are implementing accounts, including the development of data sets that follow the agreed classifications and statistical principles. To further greening recovery stimulus packages and improve the use of NCA, the experts underlined that NCA needs to be better linked to the questions by policymakers, made relevant for all ministries (Ministries of Finance were mentioned most often) and cut across policy fields. The experts stressed the catalysing role that international conventions and agreements and related conferences can play. Furthermore, recognising that most countries do not have natural capital accounts, or their accounts are incomplete, they proposed to include investing in national NCA, related tools and required capacity in national stimulus packages. This chapter provides guidance for further mainstreaming NCA for planning, implementation and monitoring a green recovery, building on these insights.

NCA is most effective when mainstreamed across all ministries
Recovery is as much an environmental challenge as it is a social and economic one. This requires all ministries to play a role and to cooperate. NCA can aid this process. Mainstreaming the use of NCA and related tools across ministries requires recognising that NCA is not only a useful tool for policy analysis, but also a much-needed tool for economic and environmental management. Building bridges between the NCA communities, most prominently statistical offices, and policy communities is a key part of this. The Policy Forum on Natural Capital Accounting for Better Decision Making was established specifically for this purpose and has delivered a range of material (Box 1.1). Furthermore, there are many examples of interagency steering committees and working groups that enhance data use and awareness of intersectoral policy issues and opportunities (World Bank, 2021a).

Based on experience and discussions at earlier NCA Policy Forums, 10 principles for making NCA fit for policy were developed (Ruijs et al., 2019; Box 5.1), which requires them to be comprehensive, purposeful, trustworthy and mainstreamed. The 10 principles provide a process for the use and development of NCA for green recovery, which also supports multi-sectoral collaboration and promotes understanding within governments.

Mainstreaming NCA requires a demonstration of usefulness. Countries that are yet to begin with NCA or have just started to create them, rely on examples from other countries. This is one area where national experts see a key role for the international community — to improve data and analysis, to build country capacity and to develop a knowledge base. Already, high-income countries and international organisations have provided resources, expertise and capacity for low- and middle-income countries, for example via WAVES and NCAVES (Table 3.1).

The biodiversity, climate and green recovery agendas can reinforce each other, supporting and supported by NCA
International conventions and agreements and related conferences can play a catalysing role for a green recovery and mainstreaming the use of NCA in policy-making. Postponed from 2020, due to the COVID-19 pandemic, the year 2021 will see two major events to further the biodiversity and climate agendas, i.e. the Conferences of Parties of the United Nations Convention on Biological Diversity (CBD) to be held in Kunming, and of the United Nations Framework Convention on Climate Change (UNFCCC) that will be held in Glasgow.

A green recovery could further NCA development and implementation by aligning stimulus spending with achieving the objectives and targets of the biodiversity and climate conventions. It can build on existing plans, including Nationally Determined Contributions (NDCs), National Biodiversity Strategy and Action Plans (NBSAPs), national adaptation plans and SDG strategies, as well as other national plans. A green recovery, thereby, increases their short-term importance and can further their development and implementation. NCA can contribute to this process by providing insights into the short- and long-term benefits of increased natural capital investments and policies on nature, climate and human well-being.

Furthermore, through their monitoring and review mechanisms, the conventions and agreements can strengthen the relevance and uptake of NCA, as part of their transparency and accountability mechanism. Mainstreaming both biodiversity and climate across government policies are important topics on the agendas of the two COPs, and the CBD already recognises the SEEA as important for the monitoring framework of the Post-2020 Global Biodiversity Framework (CBD, 2021a).

Planning for a green recovery also entails developing and mainstreaming NCA
A green recovery provides an incentive to invest in NCA and its use in the development of integrated policies. Creating or further developing NCA and related tools, as well as improving capacity to apply them, will provide an information source that supports the designing and monitoring of integrated economy–environment policies; and not just those associated with a green recovery. Furthermore, it increases societal resilience, as it improves future preparedness for a green recovery from shocks and crises. With the adoption of the SEEA-EA, the momentum to produce accounts in the statistical community is enormous. Recovery efforts provide an opportunity to seek resources for account production and modelling, especially for key issues such as climate change and biodiversity conservation, as well as for furthering capacity and the knowledge base to apply them for policy analysis.

Box 5.1 living principles of NCA that is 'fit for policy purpose' (Ruijs et al., 2019)

From the first NCA Policy Forum, we drew 10 tentative principles for NCA that will make it fit for policy purpose. These are termed 'living principles', which are intended to be tested and updated with experience. NCA is fit for improving policy if it is:

Comprehensive
1. *Inclusive* — Acknowledging the various stakeholders concerned with decisions affecting natural capital, responding to their informational needs, respecting different notions of value, and using appropriate means of engagement
2. *Collaborative* — Linking the producers of NCA, the users of NCA for policy analysis and the policymakers who use the NCA results, and building their mutual understanding, trust, and ability to work together
3. *Holistic* — Adopting a comprehensive, multi/interdisciplinary approach to the economic and environmental dimensions of natural capital and to their complex links with policy and practice

Purposeful
4. *Decision-centred* — Providing relevant and timely information for indicator development and policy analysis to improve and implement decisions with implications for natural capital
5. *Demand-led* — Providing information actually demanded or needed by decision makers at specific levels

Trustworthy
6. *Transparent and open* — Enabling and encouraging public access and use of NCA, with clear communication of the results and their interpretation including limitations of the data sources, methods, and/or coverage
7. *Credible* — Compiling, assessing, and streamlining data from all available sources, and deploying objective and consistent science and methodologies

Mainstreamed:
8. *Enduring* — With adequate, predictable resourcing over time; continuous application and availability; and building increasingly data-rich time series
9. *Continuously improving* — Learning-focused, networked across practitioners and users, testing new approaches, and evolving systems to better manage uncertainty, embrace innovation, and take advantage of emerging opportunities
10. *Embedded* — NCA production and use becoming part of the machinery of government and business, building capacity, improving institutional integration for sustainable development, and incorporating NCA use in procedures and decision-support mechanisms

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Appendix A: Interview questions

1. Can you give me some background about yourself and your/your organisation's involvement/experience in green recovery and/or in natural capital accounting?

- Can you point to any specific projects that you/your organisation are currently/have been involved with?

- What is your experience of natural capital accounting? Have you/your organisation used NCA in analysis or decision-making processes?

2. What is your/your organisation's vision of a successful green recovery and what would you say would be the most important characteristics of a green recovery? Focus can be more general or in the context of the interviewee's country or organisation

- What would you say needs to be the core principles and focus?

    o For example: Is addressing green objectives a co-benefit, a necessary condition (do no harm) or an opportunity of recovery stimulus? What role is there for resilience? Green recovery / building back better.

- What issues would you say would need to be the main focus?

    o Would green recovery be more targeted to environmental issues e.g. focusing on solving climate change, biodiversity protecting, ecosystem restoration or would you say that the focus needs to be broader and more all-encompassing, e.g. focusing on transitions of food and/or agricultural systems, circular economy? Would green recovery also have a focus on social goals such as reducing poverty and/or inequality?

- What would you say would be the main barriers and challenges towards achieving this vision?

- Which government actions or criteria, from your unique perspective, would best reconcile short-term socio-economic recovery (e.g. restoring jobs and income) with long-term environmental/sustainability challenges (e.g. biodiversity loss, ecosystem degradation, climate change, increasing inequality)?

    o How could we best capitalise on synergies and address trade-offs with other socio-economic and environmental goals? How can we ensure that equity and inclusiveness is accounted for?

- What existing policy instruments could be used in green recovery?

    o For example: green investments, green taxes and subsidies, regulation/legislation (e.g. make illegal some activities, mandate levels of environmental protection), polluter pays principle (e.g. CO_2 pricing) or beneficiary pays (e.g. payments for ecosystem services), Lead by example with publicly owned enterprises, Education and training, circular economy

- How do you think the international community could support this green recovery?

3. How could natural capital accounting support/best serve a green recovery?

- What would you say would be the kind of information/data needed for the design of a green recovery stimulus/investments packages put forward by countries?

- What do you think are the best entry points for NCA in developing green recovery stimulus and what would be needed to facilitate this?

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- What parts of the policy process could NCA support e.g. problem identification, policy response design, implementation or the monitoring and review aspect? What NCA information would be most useful in this regard?

- What analytic tools could use NCA information for the design, testing and implementation of policies or programmes aimed at achieving green recovery?

- What would you say would be the main barriers to NCA use in supporting a green recovery and how could these barriers be addressed?

  - e.g. barriers to production of NCA/the data itself, use of NCA by analysts and use of NCA analysis by decision makers

4. What are the main issues or questions that you would like to see being addressed at the 5th Policy Forum in relation to using NCA approaches with green recovery

- What in your unique perspective should be the goals of the 5th Policy Forum in relation to this topic?

- What would you like to see on the agenda of the 5th Policy Forum to achieve these goals?

- Who would you recommend to be part of the forum?

5. Do you have any other final ideas or thoughts on a green recovery?

- Please share any relevant informational sources that you would recommend to further our understanding of a green recovery in your context — documents, countries/agencies/experts doing work in this area as well as experts.

Appendix B: Interviewees and workshop participants

Table B.1: List of experts interviewed

Interviewee	Affiliation
Mao Amis	African Centre for Green Economy (AfriCGE)
P. Bhanumati	Ministry of Statistics and Programme Implementation, India
Jaime Carrera	Institute of Research and Outreach on Environment and Society — Rafael Landivar University, Guatemala
Oliver Greenfield	Green Economy Coalition (GEC)
Gemma Van Halderen	Economic and Social Commission for Asia and the Pacific (ESCAP) [1]
Ronald Kaggwa	National Planning Authority (NPA), Uganda
Nuno Lacasta	Portuguese Environment Agency (APA)
Hamza Ali Malik	Economic and Social Commission for Asia and the Pacific (ESCAP)
Muhammad Shuaib Malik	Ministry of Finance, Pakistan
Albert A. Musisi	Ministry of Finance, Planning and Economic Development, Uganda
Andrew Prag	Organisation for Economic Co-operation and Development (OECD)
Claudine Uwera	Ministry of Finance and Economic Planning, Rwanda
Santiago Aparicio Velásquez	National Planning Department (DNP), Colombia

[1] On 1 July 2021, Gemma van Halderen returned to the Australian Bureau of Statistics

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Table B.2: List of expert workshop participants

Expert	Affiliation
Alessandra Alfieri	United Nations Statistics Division (UNSD)
Anthony Dvarskas	Economic and Social Commission for Asia and the Pacific (ESCAP)
Bert Hof	PBL Netherlands Environmental Assessment Agency
Bram Edens	United Nations Statistics Division (UNSD)
Carl Obst	Institute for Development of Environmental-Economic Accounting (IDEEA Group)
Catherine Farell	Trinity College Dublin
Diane Coyle	Bennett Institute for Public Policy, University of Cambridge
Gemma van Halderen	Economic and Social Commission for Asia and the Pacific (ESCAP) [1]
Izabella Teixeira	Senior Fellow of CEBRI — Brazilian Center for International Relations
Jaffar Al Rikabi	World Bank
Jeremy Webb	Tiaki Institute
Juha Siikamäki	International Union for Conservation of Nature (IUCN)
Marko Javorsek	United Nations Statistics Division (UNSD)
Martin Lok	Capitals Coalition
Matthew Agarwala	Bennett Institute for Public Policy, University of Cambridge
Michael Vardon	Australian National University (ANU)
Mimako Kobayashi	World Bank
Najma Mohamed	Green Economy Coalition
Oliver Hillel	Convention on Biological Diversity (CBD)
Omer van Renterghem	Netherlands Ministry of Foreign Affairs
Paul Lucas	PBL Netherlands Environmental Assessment Agency
Raffaello Cervigni	World Bank
Roberto Astolfi	Organisation for Economic Co-operation and Development (OECD)
Sofia Ahlroth	World Bank
Sonu Jain	World Bank
Steve Bass	International Institute for Environment and Development (IIED)
Steven King	United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC)

[1] On 1 July 2021, Gemma van Halderen returned to the Australian Bureau of Statistics