Strengthening Adaptation-Mitigation Linkages for a Low-Carbon, Climate-Resilient Future

POLICY PERSPECTIVES

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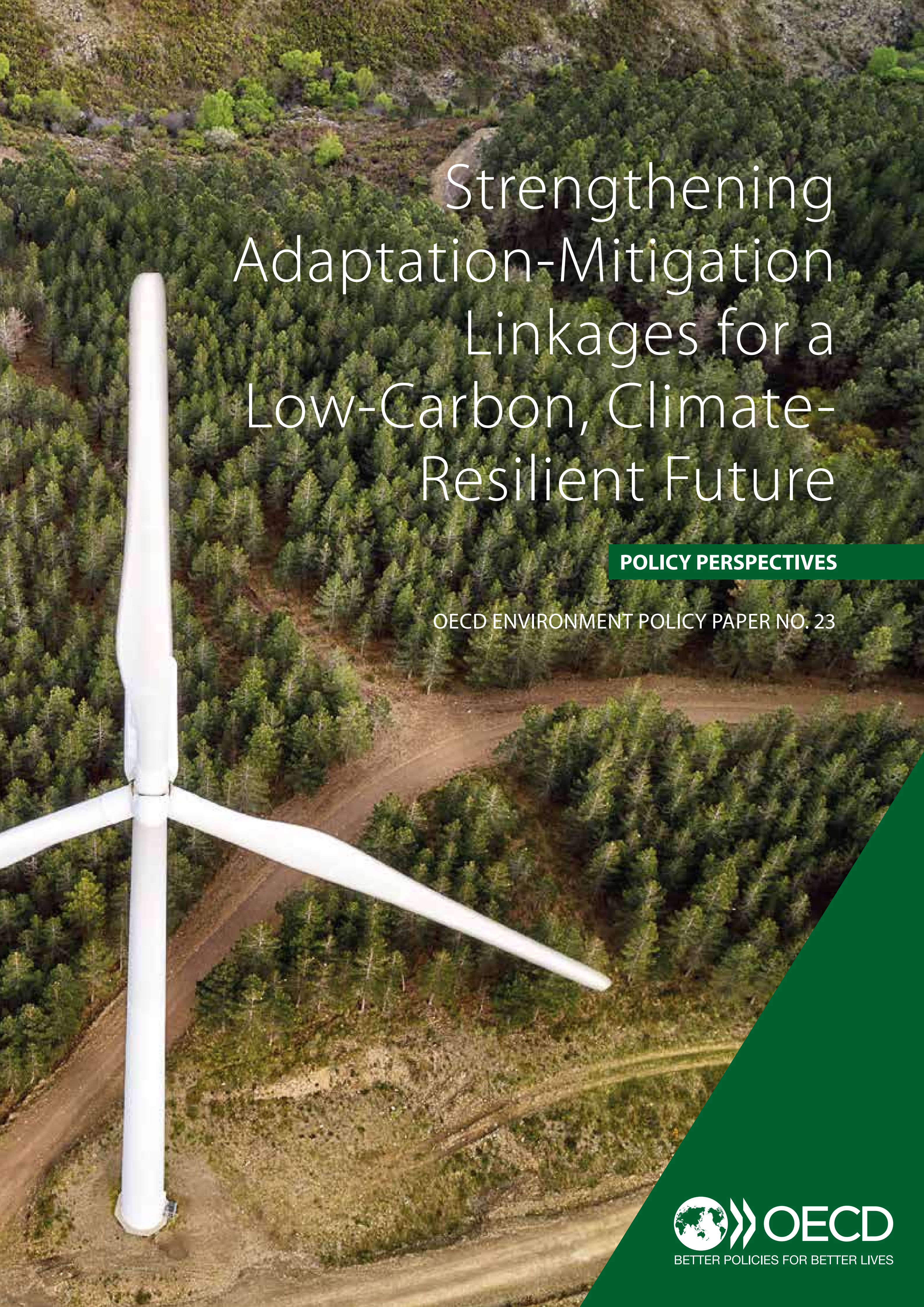

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BETTER POLICIES FOR BETTER LIVES

ACRONYMS

CBD	Convention on Biological Diversity
CCE	Circular Carbon Economy
CO_2	Carbon dioxide
COP	Conference of the Parties
CSWG	Climate Stewardship Working Group
GDP	Gross domestic product
GHG	Greenhouse gas
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IPCC	Intergovernmental Panel on Climate Change
KSA	Kingdom of Saudi Arabia
MDB	Multilateral Development Bank
NAP	National Adaptation Plan
NbS	Nature-based solutions
NDCs	Nationally Determined Contributions
PPP	Purchasing power parity
SDG	Sustainable Development Goals
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change

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Table of contents

FIGURES

TABLES

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BETTER POLICIES FOR BETTER LIVES

Executive summary

As countries continue to accelerate efforts to mitigate the effects of global warming, adaptation actions remain indispensable to protect communities from the detrimental impacts of climate variability and change. Weather-related extreme events, such as storms or wildfires, are becoming increasingly intense and are shifting in their geographical patterns. Adaptation actions will also be crucial to address the consequences of the emergence and wider spread of vector-borne diseases as well as to deal with potentially irreversible environmental changes when so-called climate tipping points are reached. The COVID-19 crisis serves as a stark reminder of how impacts of a major disruptive event can ripple through social and economic systems, especially if countries fail to appropriately reduce or prepare for such risks.

While climate change adaptation and mitigation actions have been undertaken to a large extent separately in the past, there is increasing recognition that there are synergies that could be exploited to achieve climate resilience more effectively. Forest or mangrove restorations can increase carbon storage capacity, while simultaneously reducing exposure and vulnerability to weather-related risks, such as coastal storm surges or landslides. Identifying these opportunities can lead to better understanding, avoiding trade-offs and developing policy measures and financing mechanisms that are mutually reinforcing.

This paper provides an overview of policy areas in which adaptation-mitigation linkages can be fostered, and discusses potential trade-offs to be considered among adaptation and mitigation measures, but also across other environmental policy objectives. It highlights emerging good practices and remaining challenges across OECD and G20 countries and suggests steps to move the agenda forward.

UNDERSTANDING TRADE-OFFS

Many opportunities exist to implement climate actions that bring both adaptation and mitigation benefits across different sectors, notably in forestry, agriculture and land management, water management and urban planning. In forestry management, afforestation and reforestation measures can contribute to increasing carbon sequestration from the atmosphere, while simultaneously acting to reduce the adverse impacts of extreme precipitation such as slope instabilities leading to land or mudslides and torrents. Soil management in agriculture can enhance the level of carbon stored in the soil, while at the same time enhance the resilience to the impacts of drought. Water management measures, such as the restoration of wetlands hold significant carbon storage capacity, and provide a nature-based solution to reducing exposure to flood risks or storm surges.

At the same time, there are trade-offs involved not just between the mitigation and adaptation objectives, but also with other environmental goals. Trade-offs emerge from the complexity and diversity of these linkages across geographical scales. They need to be well understood and managed so as not to risk undermining the ultimate policy objectives. For example, while hydropower dams contribute to mitigating climate change by providing a clean energy source, it can exacerbate the consequences of climate variability for communities downstream of the dams. Desalination plants are an important adaptation measure to cope with water shortages, but they might increase energy demand from potentially greenhouse gas intensive sources of energy production. Decision-support tools, such as the EU's Taxonomy of Sustainable Finance, can help policy-makers and project managers to identify and better manage trade-offs.

Forest restoration measures can increase carbon storage capacity, while reducing exposure and vulnerability to weather-related risks such as mud- or landslides.

STRENGTHENING ADAPTATION-MITIGATION LINKAGES IN PRACTICE

Countries are increasingly recognising the importance of adaptation-mitigation linkages by highlighting them in their national policy documents. Indeed, most G20 countries recognise them in either their National Adaptation Plans (NAP) or their Nationally Determined Contributions (NDC). Linkages are most prominently recognised in the agriculture, forestry and other land use sectors and are least often mentioned as part of waste sector discussions.

More concrete plans for actions and objectives are needed to strengthen implementation of adaptation-mitigation linkages. The recognition of linkages in national policy documents needs to be complemented with implementation actions. Co-ordination between mitigation and adaptation stakeholders, further development of decision-support tools as well as a more systematic exchange of good practices and reporting mechanisms could all be useful accompanying measures to scaling up action.

SCALING-UP NATURE-BASED SOLUTIONS TO FOSTER ADAPTATION-MITIGATION LINKAGES

Healthy ecosystems are an important natural carbon sink. Increasing the capacity of carbon sinks through the protection, sustainable management, and restoration of terrestrial ecosystems could contribute to about one third of the mitigation efforts needed to keep global warming well below 2°C. While forests have been a prominently recognised natural carbon sink, there are many others such as peatlands, grasslands, wetlands, or mangroves.

Healthy ecosystems can also effectively reduce exposure and vulnerability to the impacts of climate change, while they themselves adapt to changing climatic conditions. For example, preserving and restoring natural storm surge protection, such as coral reefs and coastal wetlands, is estimated to protect 35% of people exposed to coastal flooding globally.

Nature-based solutions (NbS) can therefore effectively foster adaptation-mitigation synergies. For example, restoring wetlands can enhance water storage capacity, reduce flood risk for neighbouring communities, and provide a carbon sink.

Most OECD and G20 countries have recognised the multiple benefits of NbS in building climate resilience in their domestic policies. However, action on the ground remains small in scale and ad hoc. There is scope to continue learning valuable lessons on how to effectively and systematically scale up the use of NbS, often in combination with grey (engineered) solutions.

THE COVID-19 RECOVERY OFFERS A UNIQUE OPPORTUNITY TO FOSTER ADAPTATION-MITIGATION LINKAGES

There is increasing evidence of how a changing climate drives the outbreaks and diffusion vector-borne diseases. Many countries recognise the need to invest in green recovery measures as a way to build resilience not only against future possible disease outbreaks, but also underlying risk drivers, such as climate change. The ambitious efforts undertaken in that regard create a unique opportunity to accelerate climate actions that recognise adaptation-mitigation linkages. Understanding and raising awareness of adaptation-mitigation synergies and trade-offs is crucial to inform policy discussions. Given that adaptation and mitigation decisions made today will have long-lived consequences, understanding how to maximise efficiency and avoid lock-in is of critical importance.

While countries strive to scale up their mitigation efforts, adaptation remains indispensable to protect communities from the detrimental impacts of climate variability and change.

1 Introduction

The impacts of climate change are increasingly being felt, as global average temperatures continue to increase and weather-related disasters become more intense and significantly shift their geographic patterns.

Despite efforts to mitigate the effects of global warming, the impacts from climate change are increasingly being felt. The global average temperature has increased by 1.1°C since pre-industrial times (WMO, 2020[1]), while ocean acidity increased by 26% since then (Le Quéré et al., 2009[2]). Weather-related disasters, such as storms and floods or droughts and related wildfires are becoming increasingly intense and are significantly shifting in their geographical patterns (IPCC, 2012[3]). Climate change is expected to contribute to the emergence and spread of vector-borne diseases, even in previously unaffected regions (OECD, 2015[3]) based on (IPCC, 2014[4]). As temperatures continue to increase, the likelihood of encountering catastrophic or irreversible changes, so-called tipping points, increases as well. The loss of critical ecosystems, such as the Amazon rainforest, or the melting of the West Antarctic ice sheet, could entail potentially dramatic environmental, social and economic consequences (Lenton et al., 2019[5]).

Both climate change adaptation and mitigation policies have the potential to significantly reduce the impacts of climate change. While countries strive to scale up their mitigation efforts, adaptation remains indispensable to protect communities from the detrimental impacts of climate variability and change. In the long run, mitigation responses will shape future adaptation needs and influence climate resilience pathways (Denton et al., 2014[6]).

Recognising the urgency of the ongoing climate crisis, G20 economies have promoted climate change adaptation as a policy priority and aim to mainstream adaptation in national development planning processes. While past efforts have focused on promoting good practices in climate change adaptation, disaster risk reduction and quality, and resilient infrastructure (G20 Argentina, 2018[7]); (G20 Japan, 2019[8]), the Kingdom of Saudi Arabia (KSA) has focused its 2020 Presidency on better aligning climate adaptation and mitigation efforts. The Presidency has sought to identify the linkages between adaptation and mitigation measures and to explore the potential of nature-based solutions (NbS) as a way to foster synergies.

By drawing on existing OECD work, this policy paper provides an overview and a discussion of the linkages, synergies and trade-offs between adaptation and mitigation measures, as well as the role of NbS to achieve both climate adaptation and mitigation goals.

The 2019/2020 bushfires in Australia burnt an unprecedented 24-40 million hectares of land, while killing millions of animals and destroying thousands of buildings.

2 The continued need for adaptation actions

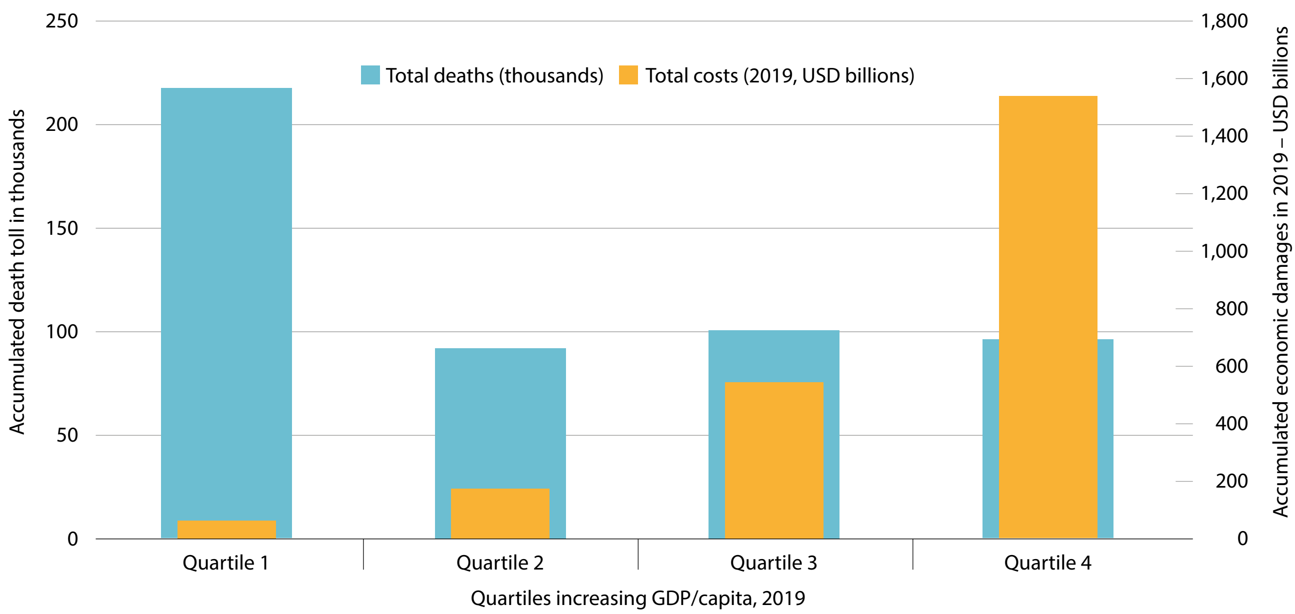
The economic and social costs associated with climate change and climate variability have continuously increased over the past decades. While higher income countries account for most of the total economic (including insured) damages of climate related disasters – as one indicator of climate trends – fatality rates remain significantly higher in lower income countries, where the impacts also account for a greater proportion of GDP (Figure 1).

Extreme weather events keep breaking records. The 2019/2020 bushfires in Australia burnt an unprecedented 24-40 million hectares of land, while killing millions of animals and destroying thousands of buildings (Royal Commission into National Natural Disaster Arrangements, 2020[11]). The 2017 hurricane season in the United States saw three of the strongest and costliest hurricanes recorded in the northern Atlantic, leaving damages of more than USD 245 billion in their wake (Zimmerli et al., 2018[10]). The OECD estimates that climate-induced unabated sea-level rise alone could cause up to USD 5.5 trillion in residual economic damages over the 21st century (OECD, 2019[12]). Apart from the significant environmental and economic impacts, human health and well-being are significantly affected as well. Extreme events have significant and lasting mental health impacts such as post-traumatic stress disorders. Heat-related morbidity, the rise in vector-borne diseases as well as the exposure to air pollution caused by extreme wildfires are some of the many health-related impacts that are set to rise with warmer temperatures (IPCC, 2014[4]) (IPCC, 2018[14]).

The COVID-19 crisis serves as a stark reminder of how impacts of a major disruptive event can ripple through social and economic systems, especially if countries

FIGURE 1. **The distribution of social and economic costs of climate-related disasters**

Death toll and per-capita GDP losses globally by country GDP quartiles (from lowest to highest), 2000-2019



Note: The graph includes climate-related disasters (floods, storms, and related land or mudslides, as well as extreme heat and drought events and wildfires). GDP loss is calculated with reference to 2005 levels, using constant prices and constant PPP.

Source: EM-DAT: The OFDA/CRED International Disaster Database, Université catholique de Louvain, Brussels, Belgium, www.emdat.be (accessed August 2020); OECD (2020), "Gross domestic product (GDP) MetaData : GDP per capita, USD, constant prices, reference year 2005", OECD National Accounts Statistics (database), (accessed August 2020).

fail to appropriately reduce or prepare for such risks. It has also highlighted that adaptation measures are subject to evolving risk patterns, and therefore need regular updating to ensure effectiveness and consistency of measures taken across government agencies and stakeholders over time (OECD, 2020[15]).

PRIORITIES FOR ACTION ON CLIMATE CHANGE ADAPTATION

The mounting evidence of the impacts of climate change has contributed to a growing number of initiatives to accelerate action on climate change adaptation. International negotiations on countries' climate change commitments increasingly recognise the need for adaptation. The Paris Agreement[1] on Climate Change explicitly focused on the topic by calling for stronger adaptation commitments from countries – a discussion that is expected to continue as part of the Conference of the Parties (COP) 26[2] hosted by the United Kingdom. The 2030 Sustainable Development Agenda[3] and the Sendai Framework for Disaster Risk Reduction 2015-2030[4] also emphasised the need for countries to strengthen their societal resilience to climate change impacts.

International co-operation has been instrumental in supporting adaptation planning and implementation at national and subnational levels, by providing methodologies and guidelines (e.g. for the development of national adaptation plans), co-ordinating actions, as well as providing multilateral and regional funding mechanisms for adaptation (Adaptation Committee, 2020[16]). Many UN agencies, Multilateral Development Banks (MDB) and institutions such as the European Union (EU) or the Organisation for Economic Co-operation and Development (OECD) have established dedicated adaptation programmes to provide platforms for policy dialogue and support to countries.

Given the economic and social implications of building resilience, climate change adaptation has also gained increasing attention in discussions of the G7 and G20 economies. The G7 nations established what is now called the InsuResilience Global Partnership[5], which aims to leverage insurance solutions to strengthen the resilience of poor and vulnerable people against the impacts of climate change. Similarly, the G20 economies have established a work programme on climate change adaptation as part of their Climate Sustainability (Stewardship) Working Group (CSWG)[6], which saw the adoption of the Action Agenda on Adaptation and Resilient Infrastructure during its latest Presidency of Japan (G20 Japan, 2019[8])[7].

In 2020, the G20 Saudi Presidency has focused the adaptation discussions of the CSWG on identifying opportunities that lie in the alignment of actions on climate change mitigation and adaptation. Recognising that the two policy areas have been to a large extent separately addressed at both national as well as international levels, the G20 Saudi Presidency seeks to identify adaptation-mitigation linkages as well as to explore the potential of NbS to operationalise synergies (G20 Saudi Arabia, 2019[17]).

Saudi Arabia has proposed to inspire the G20 economies' reflections on synergies by adapting the circular economy concept to the so-called Circular Carbon Economy (CCE) approach. The CCE approach models the natural carbon cycle's interactions with social and environmental systems so as to better understand the vulnerability to climate change as well as to manage the building of climate resilience. The CCE approach then interprets mitigation efforts that contribute to adaptation as "resilience enhancing" and adaption efforts that can contribute to mitigation as "vulnerability reducing" measures (G20 Saudi Presidency, 2020[18]). Identifying linkages and synergies between both adaptation and mitigation will ultimately allow addressing climate change more effectively (G20 Saudi Arabia Presidency, n.d.[18]).

In what follows, this policy paper explores the linkages, synergies and trade-offs between adaptation and mitigation measures, as well as the role of NbS to achieve both adaptation and mitigation goals. It does so by drawing on existing OECD work.

1. https://cop23.unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement
2. https://www.ukcop26.org/
3. https://www.un.org/sustainabledevelopment/sustainable-development-goals/
4. https://www.undrr.org/publication/sendai-framework-disaster-risk-reduction-2015-2030
5. https://www.insuresilience.org/
6. The OECD contributed the following report to the G20 Argentina Presidency: OECD (2018), Climate-resilient Infrastructure: OECD Environment Policy Perspectives Paper No. 14. http://www.oecd.org/environment/cc/policy-perspectives-climate-resilient-infrastructure.pdf
7. The OECD contributed to the following report to the G20 Japan Presidency: OECD (2020), Common Ground Between the Paris Agreement and the Sendai Framework: Climate Change Adaptation and Disaster Risk Reduction, OECD Publishing, Paris, https://doi.org/10.1787/3edc8d09-en.

3 Adaptation-mitigation linkages

Climate change adaptation and mitigation are often described as "two sides of the same coin", as they are intrinsically connected. Whereas climate change adaptation refers to the actions taken to manage impacts of climate change by reducing vulnerability and exposure to its harmful effects and exploiting any potential benefits, climate change mitigation aims at reducing or preventing emissions of greenhouse gases (GHG) (IPCC, 2018[19]). While mitigation actions continue to be implemented and scaled up, considerable climate change has already been locked-in. Adaptation therefore is, and can be expected to remain an indispensable part of strengthening resilience to climate change (Denton et al., 2014[6]).

Climate change adaptation and mitigation policies have been to a large extent separately addressed in the past, and there are good reasons for distinct policies. Limiting climate change through mitigation action has global public good benefits, while those of adaptation actions are mostly accrued locally (Swart and Raes, 2007[20]). This creates different needs and levels of coordinating action. The type of knowledge needed to inform adaptation and mitigation policies is different. While mitigation policy is grounded in information on the source, type and amount of GHG generated by different economic activities, adaptation measures are determined by the estimated scale of local climate change impacts. As a result, distinct stakeholders have been involved in the implementation of adaptation and mitigation policies (Denton et al., 2014[6]) (Adaptation Committee, 2020[16]).

Yet, there are synergies between adaptation and mitigation efforts that can help to achieve climate resilience[1] more effectively. Forest or mangrove restorations, for example, create an opportunity to increase carbon storage capacity, while also contributing to reduce weather-related risks, such as landslides or coastal storm surges. Identifying these opportunities (section 3.2) can lead to better understanding and avoiding trade-offs (section 3.3) and to developing policy measures that are mutually reinforcing (Figure 2).

1. The term "climate resilience" refers to the ability of a social, ecological, or socio-ecological system (and its components) to anticipate, reduce, accommodate, or recover from the effects of a hazardous event or trend caused by climate change in a timely and efficient manner (IPCC, 2018[19]).

FIGURE 2. **Aligning climate change mitigation and adaptation policies: differences, synergies and trade-offs**

SYNERGIES

Carbon sequestration that simultaneously reduces exposure to climate change impacts (e.g. reforestation that reduces landslide hazard, mangrove restoration that reduces coastal hazards).

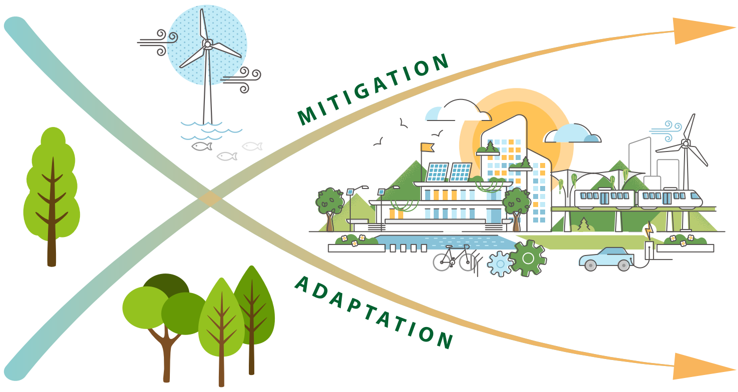
GHG emissions reduction that simultaneously reduces exposure to climate change impacts (e.g. increasing urban green spaces to reduce urban heat island effect).

DIFFERENCES

Different knowledge and information required to inform policy making

Distinct stakeholders

Distinct distributional impacts (global mitigation vs. local adaptation benefits)



TRADE-OFFS

Mitigation actions that increase exposure and vulnerability to climate change (e.g. hydropower investments in hazard prone areas)

Adaptation actions that undermine mitigation efforts (e.g. air conditioning investments)

Urban green space expansions lower the urban heat island effect and save emissions through lowering demand for cooling systems.

OPPORTUNITIES FOR ADAPTATION-MITIGATION LINKAGES

Adaptation-mitigation linkages can be found in a number of policy areas, such as in forestry, agriculture and land management, water management and urban planning.

Forestry measures hold a large potential to pursue the twin goals of climate policy. Forest conservation, afforestation and reforestation measures can all contribute to increasing carbon sequestration from the atmosphere. At the same time these measures can reduce the risk of flooding and associated slope instabilities leading to land or mudslides or torrents. Soil conservation and reforestation policies such as the Sloping Land Conversion Programme (SLCP) and the Reforestation Programme in the People's Republic of China (hereafter 'China'), have managed to increase carbon sequestration while enhancing soil retention services (Hardelin and Lankoski, 2018[26]).

The management of soil quality in agriculture can simultaneously contribute to mitigation and adaptation objectives, while also improving and sustaining yields (IPCC, 2019[27]). Soil quality determines the level of carbon that is sequestered in it, while at the same time enhancing the resilience to drought (see country practice).

> **Country practice highlight: Canada**
> Canada's national climate policy, the Pan-Canadian Framework, identified actions that could contribute to climate mitigation in the agriculture sector without undermining adaptation such as increasing stored carbon in agricultural soils to partially offset emissions from the sector; generating bioenergy and bio-based products to displace emissions in other economic sectors; and advancing innovation in GHG-efficient management practices to reduce agricultural emissions and emission intensity (OECD, 2020[28]).

While general water management requires managing adaptation to climate-induced risks of water scarcity and droughts or risks from storms and floods, it is also a policy area where links to mitigation can be fostered. For example, the development and expansion of hydropower stations or tidal power plants contribute to reducing GHG emissions from traditional power sources. Protective infrastructure against water-related risks can equally be designed to foster mitigation objectives, such as through increasing carbon sequestration by concrete (Xi et al., 2016[29]). Nature-based measures in water management, such as wetland restoration or mangrove rehabilitation are prominent examples of the creation of important carbon sinks, while enhancing natural defences against water-related risks. When solutions against water-related risks are based on nature, they can enhance adaptation against extreme weather events and bring mitigation benefits (Government of Mexico, 2020[24]).

Urban planning has increasingly sought to foster climate mitigation and adaptation objectives in the measures taken. Urban green space expansions, including parks and green roofs, contribute to reducing GHG emissions from energy use by lowering the urban heat island effect. At the same time, such greening measures increase water absorption capacities and thereby reduce the risk of urban flooding (OECD, 2019[31]). This has been a measure put in place in the City of Paris and in Seine-Saint-Denis (France) where nature is restored to allow ecosystems to regulate floods and foster water infiltration (City of Paris, 2017[32]) (IUCN French Committee, 2016[33]).

UNDERSTANDING AND MANAGING TRADE-OFFS BETWEEN ADAPTATION AND MITIGATION

As shown above, there are many policy areas, in which linkages between climate change mitigation and adaptation can be identified and where synergies can be fostered. However, possible trade-offs need to be recognised not just between the mitigation and adaptation objectives, but also with other environmental goals, so as to not undermine the ultimate policy objectives. Table 1 provides an overview of possible trade-offs.

There are a number of policy trade-offs to consider in water-related climate actions. While protective measures against water-related risks can act to reduce GHG emissions as well, such as through hydropower or tidal power plants, their construction itself still involves GHG emissions and can have other harmful impacts on the environment, including on biodiversity. Similarly, hydropower itself is subject to water availability and thus vulnerable to climate change. Desalination plants are another important adaptation measure to cope with water shortages. However, their use increases energy demand and therefore potentially GHG intensive sources of energy production.

Country practice highlight: Saudi Arabia

The solar dome desalination plant pilot project in NEOM in Saudi Arabia, which will run on concentrated solar power to treat seawater, is a good example of how such a potential trade-off can be avoided. The project also aims to address other environmental trade-offs, namely the damage to marine life from brine being discharged into the sea, by reducing and reusing this by-product (NEOM, 2020[34]) (NEOM, 2020[35]).

Where natural carbon sequestration capacities can be limited, this needs to be taken into account of managing linkages. Forestry and other soil quality enhancement measures have a finite carbon sequestration capacity, which decreases as vegetation matures. Furthermore, the carbon stored in vegetation and soils is at risk of being lost through floods, droughts, wildfires or pest outbreaks (IPCC, 2019[27]). Beyond the climate trade-offs, expanding or changing forestry or other soil measures can have important consequences for livelihoods of local communities (Locatelli and Pramova, 2011[36]), a risk that has been partly offset through the payment for ecosystem services (OECD, 2018[37]).

While urban green space measures have attractive twin climate benefits, they also face trade-offs with other environmental objectives. For example, urban green space expansion can decrease urban density and thereby lead to higher transport emissions (Viguie and Hallegatte, 2012[33]).

TABLE 1. **Adaptation-mitigation linkages in G20 members' NAPs and NDCs**

Sector	Climate action	Mitigation benefit	Adaptation benefit	Trade-offs
Forestry	Forest conservation and rehabilitation	Carbon sequestration	Increase resilience to water-related risks (floods, landslides, mudslides, torrents)	Monoculture plantations can be susceptible to fire
Agriculture and land management	Use of crop varieties with higher drought and pest resistance; Sustainable land management practices (efficient nitrogen use and soil management)	GHG emissions savings from reduced energy consumption for irrigation and improved soil quality	Increase resilience to droughts and floods	Biofuel production in some context
Water management	Protect and restore marine ecosystems such as seagrass beds, mangroves, saltmarsh, coastal wetland; storm water management	Carbon sequestration	Enhance resilience to water-related risks (coastal floods and storms; droughts)	Solar water pumps in arid zones
Urban planning	Urban green space expansion (parks, green roofs)	Carbon sequestration, GHG emissions savings from reduced energy consumption for cooling	Increase resilience to extreme heat and urban floods (by decreasing urban heat island effect and increasing water absorption capacity)	Building less dense areas; use of air-conditioning

Source: Adapted from table 3 in (UNFCCC, 2016[21]); presentations at the first G20 CSWG meeting in March 2020 by Dr. Taha Zatari (KSA) (Zatari, 2020[22]), by Tarek Sadek from the ESCWA (Sadek, 2020[23]), by JP Gattuso (Gattuso, 2020[24]) and by David Thomas (Thomas, 2020[25]).

BOX 1. **The "do no significant harm" concept in the EU's Taxonomy on Sustainable Finance**

The EU Taxonomy Regulation, adopted in June 2020, provides a classification system for facilitating sustainable finance investment. The taxonomy connects six environmental objectives through a multi-dimensional "Do No Significant Harm" (DNSH) requirement. The six objectives are: (i) Climate change mitigation, (ii) Climate change adaptation, (iii) Sustainable use and protection of water and marine resources, (iv) Transition to a circular economy, waste prevention and recycling, (v) Pollution prevention and control, (vi) Protection of healthy ecosystems. The DNSH concept is defined for 67 economic activities in agriculture, forestry, manufacturing, electricity, waste, water, transport, buildings, and Information and Communication Technologies. This taxonomy helps identifying and addressing trade-offs between the different environmental policy objectives. So, even if an economic activity contributes substantially to climate change mitigation, it will not qualify as sustainable finance if it generates significant harm to any other environmental objectives, such as climate adaptation.

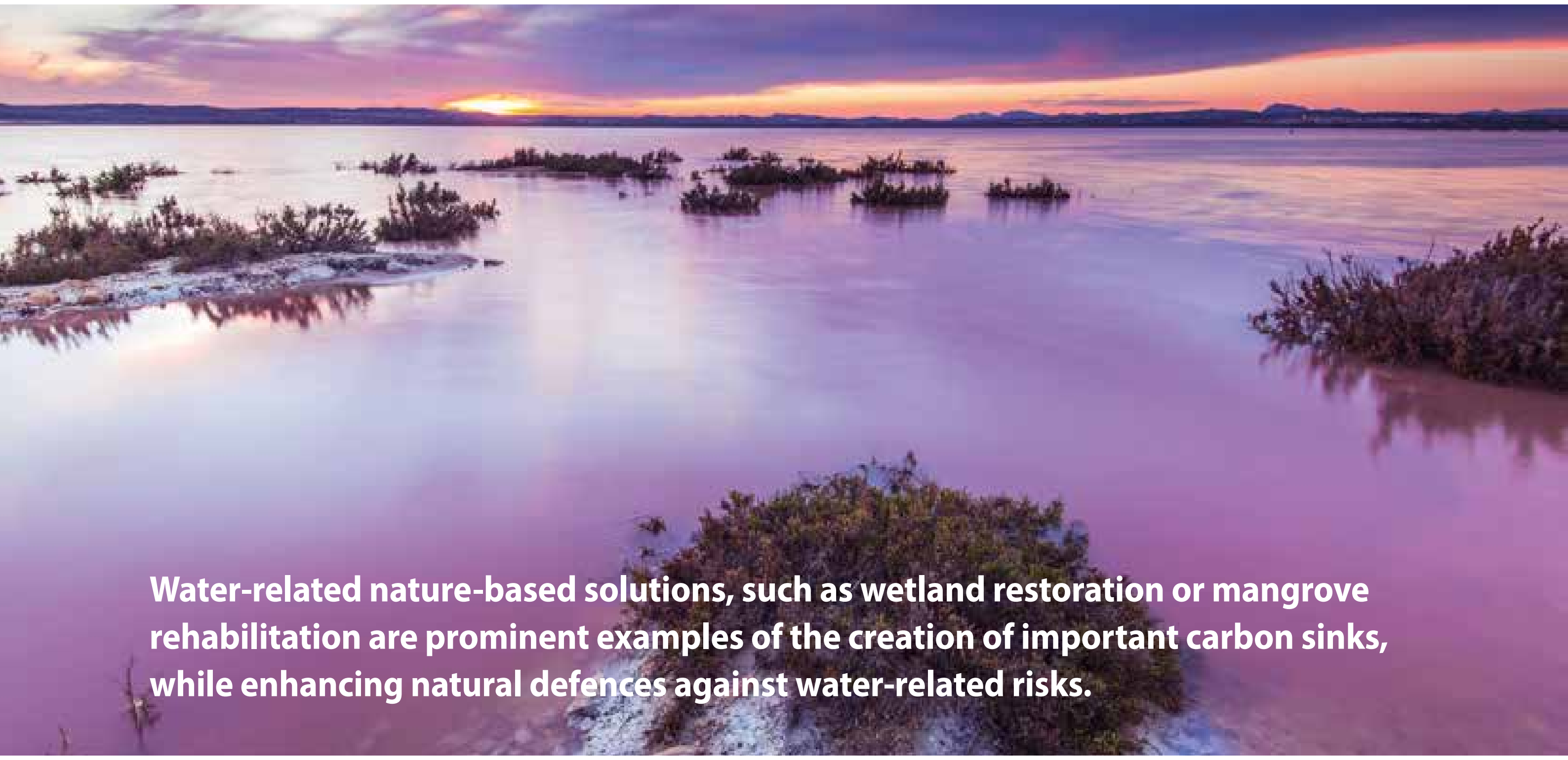
Source: OECD (2020), Developing Sustainable Finance Definitions and Taxonomies, Green Finance and Investment, OECD Publishing, Paris, https://doi.org/10.1787/134a2dbe-en.

Trade-offs are context-specific and are likely to define the long-term success of climate action. Decision-support tools, such as Multi-Criteria Analysis (MCA) can be integrated into planning instruments to help identify and manage possible trade-offs between adaptation and mitigation objectives as well as other environmental, economic or social trade-offs involved (OECD, 2009[34]). The EU sustainable finance taxonomy enshrines the concept of "do no significant harm" as a way to manage potential trade-offs in GHG emissions and building resilience (Box 1). Trade-offs can be minimised if institutional and governance frameworks are enhanced to involve all stakeholders in the process of identifying and managing them (Adaptation Committee, 2020[16]).

STRENGTHENING ADAPTATION-MITIGATION LINKAGES IN PRACTICE

Mitigation and adaptation linkages are being recognised in the climate policies of a growing number of countries. Table 2 shows that the great majority of G20 nations make reference to adaptation-mitigation linkages in their National Adaptation Plans (NAPs) or in their Nationally Determined Contributions (NDCs). Some countries, such as Viet Nam, have recently highlighted co-benefits in their revised NDC[2].

2.. https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Viet%20Nam%20First/VIETNAM%27S%20INDC.pdf



While most countries mention the importance of synergies between adaptation and other environmental goals, often in their introduction or in the context of co-ordination mechanisms, linkages are seldom discussed in depth and specific measures are rarely detailed. Italy is a good practice example. Its National Climate Change Adaptation Strategy[3] provides a detailed section on synergies between adaptation and mitigation. It outlines actions that can be beneficial to both mitigation and adaptation such as sustainable mobility.

Altogether, linkages between adaptation and mitigation are most prominently recognised in the agriculture, forestry and other land uses sector, and least in the waste sector (Table 2). The UK Environmental Land Management schemes, co-designed with farmers, are intended to deliver both mitigation and adaptation benefits by incentivising good soil management practices[4]. Switzerland promotes sustainable forest management and inclusive forest governance as part of adaptation measures and to encourage the mitigation role forests play (G20 Saudi Presidency, 2020$_{[18]}$).

Based on current country practices, a number of actions can be identified that can facilitate better alignment of mitigation and adaptation policies in the future. First of all, it is important to improve co-ordination between mitigation and adaptation stakeholders, who have diverging expertise and policy objectives. Reporting mechanisms by countries on their climate actions can be enhanced to capture adaptation-mitigation linkages (Adaptation Committee, 2020$_{[16]}$). Future research could focus on developing or adapting decision-support tools to facilitate alignment considerations for project managers. Finally, it would be useful to document country practices more systematically and comprehensively so as to inspire actions by others.

3. https://www.minambiente.it/notizie/strategia-nazionale-di-adattamento-ai-cambiamenti-climatici-0

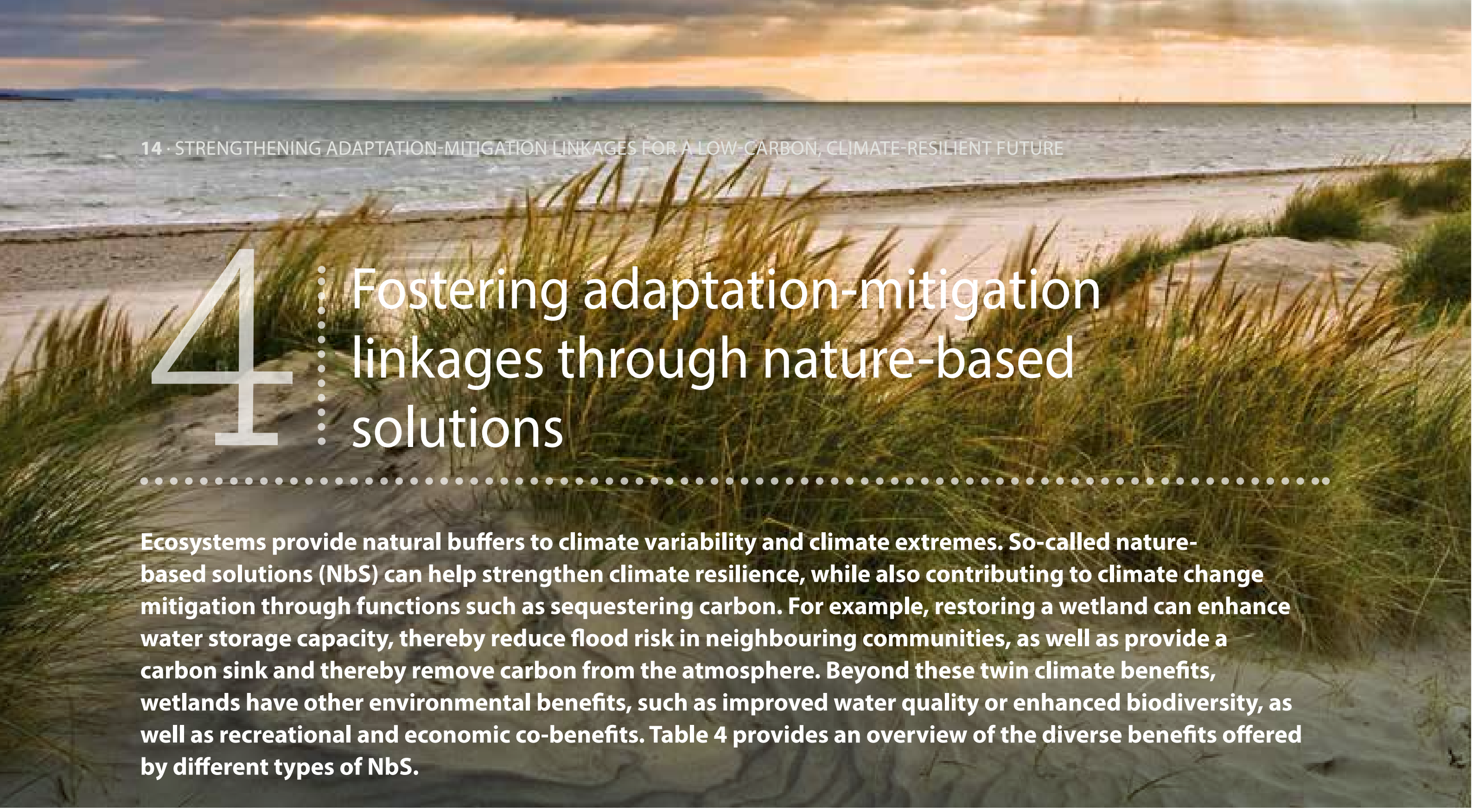
4. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/727252/national-adaptation-programme-2018.pdf

TABLE 2. **Adaptation-mitigation linkages in climate actions across sectors**

	Does the NAP or NDC mention adaptation-mitigation linkages?	Are adaptation-mitigation linkages covered in the following policy areas discussions of the NAP or NDC?					
		Biodiversity and ecosystems	Urban development	Agriculture, forestry and other land uses	Water	Infrastructure	Waste
Argentina*	● (orange)	● (orange)					
Australia	● (orange)					● (orange)	
Brazil	● (orange)						
Canada	● (orange)		● (orange)	● (orange)			
China*	● (orange)			● (green) (darker cell)			
France	● (orange)	● (orange) (darker cell)		● (green)	● (orange)		
Germany	● (orange)		● (orange)	● (orange)			
India**	● (orange)		● (green)	● (green)	● (green)	● (green)	● (green)
Indonesia*	● (orange)			● (orange) (darker cell)	● (orange)		
Italy	● (orange)			● (green)	● (orange)	● (orange)	
Japan	● (orange)						
Korea	● (orange)						
Mexico	● (orange)	● (orange)	● (orange)	● (orange)	● (orange)	● (orange)	● (orange)
Russian Federation	● (orange)						
Saudi Arabia*	● (orange)	● (orange)	● (orange)		● (orange)		
South Africa	● (orange)						
Turkey	● (orange)			● (orange)	● (orange)		
United Kingdom	● (orange)			● (green)	● (orange) (darker cell)		
United States***	● (orange)				● (orange) (darker cell)		

Notes: ● (orange) mentioned, ● (green) mentioned in detail, darker cells – tied to a nature-based solution; * based on NDCs, for countries without a NAP.
** refers to India's National Climate Change Plan. *** refers to the 2014 US Environmental Protection Agency policy document presenting adaptation implementation strategies.

Source: authors based on G20 members' NAPs and NDCs.



4 Fostering adaptation-mitigation linkages through nature-based solutions

Ecosystems provide natural buffers to climate variability and climate extremes. So-called nature-based solutions (NbS) can help strengthen climate resilience, while also contributing to climate change mitigation through functions such as sequestering carbon. For example, restoring a wetland can enhance water storage capacity, thereby reduce flood risk in neighbouring communities, as well as provide a carbon sink and thereby remove carbon from the atmosphere. Beyond these twin climate benefits, wetlands have other environmental benefits, such as improved water quality or enhanced biodiversity, as well as recreational and economic co-benefits. Table 4 provides an overview of the diverse benefits offered by different types of NbS.

Generally speaking, NbS can be defined as *measures that can protect, sustainably manage, and restore nature, with the goal of preserving and enhancing ecosystem services to help address societal goals*[1] (OECD, 2020[39]). NbS have been found to address societal, environmental and economic challenges such as those arising from the causes and the consequences of climate change, but not limited to them.

THE ROLE OF NATURE-BASED SOLUTIONS FOR ACHIEVING CLIMATE RESILIENCE

Healthy ecosystems can capture and store carbon. Increasing the capacity of carbon sinks through the protection, sustainable management, and restoration of terrestrial ecosystems could contribute to about one third of the mitigation efforts needed to keep global warming well below 2°C (Griscom et al., 2017[49]). There are several types of NbS that can provide carbon sinks, but one of the most recognised carbon mitigation potential lies in forest restoration and management as well as reduced deforestation (IPCC, 2019[27]). Indeed, forests have featured prominently in international climate discussions (Box 2), and many countries invest in significant reforestation programmes to meet their climate change mitigation and adaptation targets. For example, the extensive reforestation efforts in Korea through five National Forest Plans spanning from 1973 to 2017 contributed to restoring more than a million hectares of denuded forest with fast-growing tree species, which reduced disaster risk, notably from drought (OECD, 20107[44]), and increased carbon sequestration (Lee et al., 2018[50]).

1. Nature-based solutions can be considered as an umbrella term which encompass similar concepts such as "ecosystem-based adaptation" and "green infrastructure". For a more detailed review of the term and how it is used by countries and international organizations refer to (OECD, 2020[42]).

TABLE 3. **The multiple co-benefits offered by nature-based solutions (NbS)**

	Associated ecosystem services							
Nature-based Solution	Coastal protection	Reduction in riverine flood impacts	Reduction in urban flood impacts	Filtering pollution	Carbon sequestration	Habitat creation	Heat mitigation	Recreational opportunities
Protecting/ restoring coastal habitats	●			●	●	●		●
Protecting/ restoring upland forests		●	●	●	●	●	●	●
Creating urban green spaces			●	●		●	●	●

Source: (OECD, 2020[39])

BOX 2. **The role of forests in international climate policy**

Due to their role as both a source and a sink for CO_2, forests have long played a key role in international climate change policy:

- The UN Framework Convention on Climate Change (UNFCCC) in 1992 first mentioned forest management for carbon stock enhancement. The Kyoto Protocol reinforced this in 1997, by formally introducing the concept of afforestation and reforestation to achieve climate mitigation goals. The role of forests in achieving mitigation targets has continued to feature prominently in climate change negotiations, including through commitments to REDD+. More recently, the "Ministerial Katowice Forests for Climate Declaration" discussed at the COP 24 encourages all parties to take action to conserve and enhance sinks and reservoirs of GHG.
- In 2011, the International Union for Conservation of Nature (IUCN) and Germany launched the Bonn Challenge as a global effort to restore 150 million hectares of deforested and degraded land by 2020 and 350 million hectares by 2030.
- In 2014, 37 governments, 63 non-governmental organisations, 53 multinational companies and 16 indigenous community groups signed the New York Declaration on Forests, with pledges to halve deforestation by 2020 and end it by 2030.

Source: (Seddon et al., 2018[45]) (NYDF Assessment Partners, 2019[46]).

In addition to forests, the contribution of other ecosystems to countries' climate change mitigation and adaptation objectives is starting to get increasingly recognised. Coastal wetlands, such as tidal marshes and mangroves, store significant amounts of carbon, while buffering inland areas from the effects of storms, supporting resiliency (Mitsch et al., 2012[47]). The bulk of sequestered carbon in wetlands is stored in soil, and draining wetlands for agricultural conversion oxidizes soil matter and releases significant CO_2 into the atmosphere (Moomaw et al., 2018[47]). Peatlands are also significant sinks, and despite their small land coverage of about 2 to 3%of global terrestrial area, they store about 25% of the world's carbon (Leifeld and Menichetti, 2018[50]). Similarly, grasslands store considerable amounts of carbon in the soil and represent a particularly reliable carbon sink with long-term resilience as they are resistant to drought and wildfires (Dass et al., 2018[51]).

In addition to their ability to store carbon, certain types of NbS – such as planting urban trees and green roofs – can help contain temperature extremes and reduce residential energy demand, thus contributing to both climate change adaptation and mitigation. For example, (Liu, 2005[52]) found that adding a green roof to a building in Canada could reduce daily energy demand for air conditioning by over two thirds in the hottest periods.

A number of studies have aimed at valuing both mitigation and adaptation benefits of NbS. For example, Vermaat et al., (2015[42]) found that NbS interventions to restore riverbeds in Europe have increased flood protection, while also enhancing agricultural production, carbon sequestration and recreation, for a total net economic benefit of EUR 1400 per hectare per year.

In terms of climate change adaptation, there is increasing evidence of the effectiveness of nature in reducing exposure and vulnerability to the impacts of climate change. Preserving and restoring coastal ecosystems – such as mangroves, saltmarshes, and coral and oyster reefs – can protect communities from coastal flooding and limit coastal erosion and saltwater intrusion (Narayan et al., 2016[41]) (Möller et al., 2014[53]). It is estimated that 35% of people exposed to coastal flooding globally currently benefit from nature-based storm surge protection, such as coral reefs and coastal wetlands (Van Coppenolle and Temmerman, 2020[40]). During one of the most destructive hurricanes in the North Atlantic region, Hurricane Sandy in 2012, wetlands helped avoid an estimated USD 625 million in direct flood damages (Narayan et al., 2016[41]). In India, for example, it is estimated that mangroves protect 3.3 million people from flooding and USD 9 billion worth of property from flood damage annually (Menéndez et al., 2020[54]).

Due to the large adaptation potential offered by natural ecosystems, national governments are increasingly investing in nature-based protection against climate hazards. For example, as protecting, restoring or managing wetlands in upper catchments can secure and regulate water supplies, reduce soil erosion, and protect communities from flooding and wildfires (Vermaat et al., 2015[42]) (Seddon et al., 2020[55]), Canada has dedicated funds towards conserving its wetlands in the province of Saskatchewan. It is estimated that, over a 10-year period, the economic returns of this intervention might reach USD 5-6 for every dollar that has been invested (OECD, 2019[47]). Similarly, as enhancing urban green areas (such as green roofs and tree plantations) can moderate the impacts of heat waves, regulate water flow, and reduce urban flooding (see country practice) (Bowler et al., 2010[56]; Liu, Chen and Peng, 2014[57]; Kabisch et al., 2016[58]).

In addition, NbS are particularly well-suited as a tool to adapt to a non-stationary and uncertain future. Indeed, as NbS yield benefits even in the absence of an expected climate hazard, they represent a "low-regret" policy option. When NbS are implemented in combination with grey infrastructure, they can also provide flexibility (for example, by extending the lifetime of existing grey assets) and avoid large sunk costs of capital-intensive infrastructure (OECD, 2020[39]).

Country practice highlight: Sweden
Sweden has invested in green drainage investments in the cities of Augustenborg and Malmö. These interventions have resulted in a 50% reduction in water run-off, as well as in a substantial increase in urban biodiversity (OECD, 2020[39]).

WHAT ROLE HAVE NATURE-BASED SOLUTIONS PLAYED IN CLIMATE POLICY DISCUSSIONS TO DATE?

The potential of NbS to address the causes and consequences of climate change has been recognised by policy makers at the national and international levels.

Recent international agreements on climate change and disaster risk reduction have highlighted the linkages between ecosystem health and societal vulnerability, as well as the role nature can play in managing emerging environmental risks:

- **The Paris Agreement on climate change (2015)** calls on all parties to acknowledge "the importance of ensuring the integrity of all ecosystems, including oceans, and the protection of biodiversity, recognised by some cultures as Mother Earth".
- **The Sendai Framework for Disaster Risk Reduction 2015-2030 (2015)** recognises the need to shift from post-disaster planning and recovery to the proactive reduction of risks, specifying that risk reduction strategies should consider a range of ecosystem-based solutions.
- **The 14th Conference of the Parties (COP)** under the United Nations Convention for Biological Diversity (CBD) (2018) has formally decided to integrate climate change action into national biodiversity strategies and vice versa, highlighting the interdependencies between the two policy domains.

Several reports issued by intergovernmental bodies – such as the Global Assessment Report on Biodiversity and Ecosystem Services by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) (IPBES, 2019[63]) and the IPCC Special

Where nature-based solutions are implemented in combination with grey infrastructure, they can provide flexibility and avoid large sunk costs of capital-intensive infrastructure.

Report on Climate Change and Land (IPCC, 2019[27]) – have advocated for the use of NbS to address climate change. In addition, the International Union for the Conservation of Nature (IUCN) has recently issued a global standard for NbS that aims to "increase demand for NbS while safeguarding people and nature" (IUCN, 2020[62]). Building on this momentum, NbS have been identified as a key priority of the discussions for the G20 Climate Stewardship Working Group under the G20 Saudi Presidency in 2020 and the United Kingdom is putting them at the heart of the COP26 to be held in 2021.

Such international commitments are reflected in key strategic documents at the national level. A recent study highlights that two thirds of the Paris Agreement signatories refer to NbS as a way to achieve their climate change mitigation and/or adaptation goals within their National Determined Contributions (NDCs) (Seddon et al., 2019[65]). However, the same study also finds that few countries recognise the existing synergies between mitigation and adaptation actions and targets, with only 17 countries seeking to jointly address adaptation and mitigation objectives (Seddon et al., 2019[65]). Similarly, the majority of OECD countries make NbS an explicit priority in their NAPs (Table 3.5). For example, Japan's NAP recognises NbS as an effective way to address climate impacts, while Australia acknowledges NbS as important complements to grey infrastructure solutions, explicitly recognising their suitability to address climate-related coastal and riverine flood risks (OECD, 2020[39]).

PRACTICAL LIMITATIONS OF NATURE-BASED SOLUTIONS

Despite the recognised benefits of NbS, their implementation has been constrained by a number of factors. While NbS are increasingly used to address specific issues, such as reforestation for carbon sequestration benefits, the wide range of co-benefits offered by NbS – including the potential synergies between adaptation and mitigation – are still poorly appreciated. In terms of managing the impacts of climate change, grey measures, such as sea walls, have had more immediate and easily-measurable benefits and, in the short term, are particularly effective in reducing the impacts of specific hazards. In contrast, the benefits of an NbS often take a longer time to manifest and are more difficult to quantify (Wingfield et al., 2019[59]). In addition, to date, the knowledge base on the effectiveness of different NbS measures in different contexts is limited (Cohen-Shacham et al., 2019[60]; Nesshöver et al., 2017[61]). Building this evidence base is particularly challenging, as the effectiveness of NbS measures depends on many site- and context-specific variables (e.g. geology, ecology, land management over time). Finally, NbS often involve the use of ecosystems that are themselves vulnerable to climate change (Seddon et al., 2020[55]). For example, rising temperatures can alter forest stability (e.g. through wildfires), thus affecting the capacity to store carbon (Anderegg et al., 2020[62]). Similarly, between 70 to 90% of coral reefs would disappear if global surface temperatures increased by

1.5°C – and more than 99% would be lost if temperatures increased by 2°C (IPCC, 2018[14]) – thus limiting the role they can play in protecting coastlines.

A growing body of literature has highlighted policy challenges related to the systematic deployment of NbS (Browder et al., 2019[66]; OECD, 2020[39]; Kabisch et al., 2016[58]; Kapos et al., 2019[67]):

- **Institutional and governance challenges** relate to the lack of knowledge on (or the misperception of) the costs of implementing NbS among national governments, local authorities and property developers. In addition, the lack of co-ordination among institutional actors and arrangements can make it difficult to take advantage of the multiple benefits of NbS.
- **Methodological and valuation challenges** relate to limited capacity in cost-benefit analysis, and particularly in the valuation of NbS co-benefits, and to the difficulty of demonstrating the performance of NbS as compared to grey infrastructure (e.g. due to long ecological restoration processes that show tangible results); and to monitoring, reporting and verification of forest carbon removals (e.g. the storage of carbon in forest biomass and soil is reversible).
- **Policy and regulatory challenges** relate to the prevailing regulatory requirements, funding mechanisms and lock-in failures that might act as disincentives to the use of NbS and create a bias towards grey infrastructure to address certain impacts of climate change. Similarly, engineering norms and standards might need to be updated. Policies relating to land ownership and use, biodiversity conservation, water management, energy and other sectors can all be key to the feasibility and appeal of implementing NbS.
- **Financial and investment challenges** relate to the limited ability to value and monetise the benefits of NbS, which undermines potential revenue flows. In general, investments in NbS are predominantly driven by the public sector as the valuation habits of private investors are generally not well suited to NbS. Finally, conservative financing strategies (e.g. those usually adopted by international financial institutions) typically favour large-scale, conventional infrastructure, thus undermining the capacity to implement innovative solutions such as NbS.

The development of robust and effective enabling environments is essential for catalysing larger-scale NbS adoption (OECD, 2020[39]). National governments can help overcome the challenges through the following actions:

- Properly valuing nature in decision-making, so as to make trade-offs more evident.
- Building the knowledge base on NbS by strengthening links between science and policy. Countries need to collect and synthesise the growing evidence base on the socio-economic and ecological effectiveness of NbS for climate change mitigation and adaptation. This knowledge base should include local and indigenous knowledge, as many indigenous communities are key actors in the preservation of natural environments.
- Encouraging or requiring consideration of NbS by decision-makers. Integrating NbS into planning efforts often involves active policy guidance. For example, governments could provide criteria for infrastructure projects to include NbS evaluations at the planning stage, or adopt building codes or zoning laws that require a portion of space dedicated to green infrastructure. For example, in Norway, a requirement was introduced at the national level asking municipalities to favour the conservation, restoration and establishment of NbS to reduce exposure to hazards such as flooding and, when other measures are chosen, to justify why NbS were not the chosen option. Similarly, an increasing number of cities, such as Toronto and Mexico City, have introduced development criteria to encourage the use of green roofs (OECD, 2020[39]).

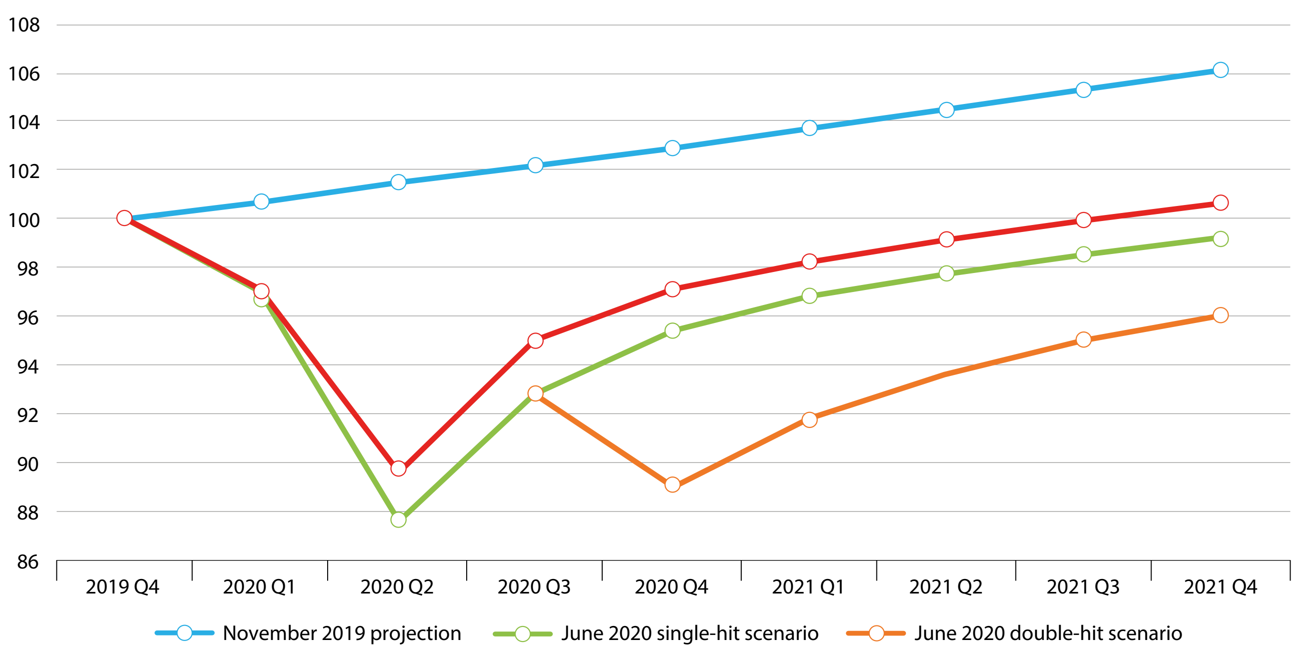
5 The green recovery from the COVID-19 crisis: an opportunity to strengthen adaptation-mitigation linkages

The COVID-19 pandemic caused, and continues to cause, unprecedented impacts on human health, and as a consequence of countries' responses, on their economic development. Countries' prompt financial support has helped limit economic contractions. Nonetheless, as Figure 4 demonstrates, there remains significant uncertainty in terms of the outlook on the global economic recovery. (OECD, 2020[68]).

After the immediate policy support provided, many countries have moved on to discuss and launch programmes that will strengthen the longer-term recovery of their economies. They are designing recovery programmes that aim at *building back better*, to strengthen resilience against future disease outbreaks. Many of them recognise a greener and more climate-friendly economic development can encourage job creation and sustainable economic development, while at the same time boosting the resilience of the natural and socio-economic systems to absorb and better recover from future such risks (Coalition of Finance Ministers for Climate Action, 2020[69]).

The COVID-19 recovery phase creates a unique opportunity for countries to align mitigation and adaptation policies and scale up projects that implement them in practice. A paper informing a recent OECD Environmental Ministerial Meeting shows that some 30 OECD and Key Partner countries include green, climate-friendly measures in their recovery programmes or strategies, including investments to mitigate climate change through transport or clean energy measures, as well as funding for ecosystem restoration and conservation. For example, Germany has allocated EUR 700 million to support forest conservation and management measures in support of both mitigation and adaptation objectives. As part of its EUR 600 million recovery programme, New Zealand plans to invest in restoring wetlands and riverbanks in support of climate objectives (OECD, 2020[66]).

FIGURE 3. **Outlook on potential economic recovery paths from COVID-19**



Source: OECD Economic Outlook database in OECD (2020), *OECD Economic Outlook, Interim Report September 2020*, OECD Publishing, Paris, https://doi.org/10.1787/34ffc900-en.

6 Conclusions

Understanding adaptation-mitigation linkages, synergies, and trade-offs is crucial to inform policy decisions, as in the long run, mitigation responses will shape future adaptation needs and influence climate resilient pathways. Countries are increasingly recognising the importance of these linkages by bringing this discussion into their national adaptation plans. However, more research is needed to understand how to design policy which reflects synergies and trade-offs and how they take place in different geographic context. Given that adaptation and mitigation decisions made today will come from increasingly constrained public resources and have long-lived consequences, understanding how to maximise efficiency and avoid lock-in is of high importance.

In order to help send a strong political commitment to both agenda and avoid actions that inhibit progress on the other agenda, it is thus important that countries work to:

- **Identify and seize synergies, notably through the use of nature-based solutions (NbS)**
- **Avoid and address trade-offs.**

Most G20 countries have highlighted their commitment to fostering the use of NbS to address climate change adaptation and mitigation challenges. The ability of measures such as reforestation and coastal wetland restoration to address both climate challenges has been brought forward in international policies and reflected in countries' domestic priorities. However, while countries are increasingly prioritising NbS measures in strategic policy, action on the ground remains small in scale and ad hoc. Countries can continue to learn valuable lessons from peers on how to effectively and systematically scale up the use of NbS.

Recovery efforts for COVID-19 provide an important opportunity to build a path towards a low-carbon, climate resilient development. Measures that contribute to both adaptation and mitigation objectives are an attractive option to include in sustainable recovery policy packages, as they can play an important role in creating and sustaining jobs while offering important co-benefits for human and environmental health, now and in the longer term.

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Strengthening Adaptation-Mitigation Linkages for a Low-Carbon, Climate-Resilient Future

Strengthening linkages between climate change adaptation and mitigation policies can improve the efficiency and effectiveness of actions in support of a low-carbon, climate-resilient economic development. This policy paper provides an overview and a discussion of linkages, shedding light on the synergies that can be achieved as well as the trade-offs that could arise between the two policy agendas, but also across other environmental or social policy objectives. It aims at inspiring reflections of fostering linkages, especially as part of countries' ongoing discussions on designing green recovery measures in response to the COVID-19 pandemic.

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