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Infrastructure for climate action

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Foreword

Grete Faremo, Executive Director
UNOPS

Infrastructure offers a unique chance to help countries get back on track to meet the Sustainable Development Goals (SDGs), mitigate and adapt to climate change and equally accelerate recovery from the ongoing COVID-19 pandemic.

Sustainable infrastructure is fundamental to addressing climate change- and urgently so. We have once again received a warning on the severity of the climate crisis facing our planet. The latest report from the Intergovernmental Panel on Climate Change (IPCC) is a "code red for humanity", to quote the UN's Secretary-General António Guterres. It calls on all of us to urgently step up our efforts to tackle this crisis.

Against this background, the findings of the Infrastructure for Climate Action Report 2021 - published jointly by UNOPS, the University of Oxford and the United Nations Environment Programme- are particularly important: Infrastructure plays a key role in supporting the achievement of the SDGs and the Paris Agreement.

Infrastructure is responsible for 79 per cent of total greenhouse gas emissions and 88 per cent of all adaptation costs, finds the report, after looking in detail at the influence of infrastructure on climate action across a range of sectors.

The sheer scale of this influence calls for a radical change in how decisions on infrastructure are made. Now more than ever we need decisions that are evidence-based, and that create mutual benefits on climate action and sustainable development.

Despite this importance, infrastructure investments often fail to promote climate action. Too often, decision-makers solve one infrastructure issue at a time, without thinking about how it impacts on and is impacted by others. This needs to end: decisions on infrastructure need to fully account for its role in sustainable development and climate action, they need to aim for long-term impact for people and the planet, and consider that infrastructure systems are interrelated.

Promoting climate-friendly infrastructure requires coordinated action from practitioners across all stages of the infrastructure lifecycle, from planning and implementing, to delivery, management and decommissioning. This report highlights some of the key steps that practitioners can take to ensure infrastructure projects incorporate climate adaptation and mitigation measures, while still aiming for long term sustainability. It presents practical examples of infrastructure projects that have contributed to the achievement of national climate and development targets. It also illustrates UNOPS work to support our partners in developing infrastructure that works for our climate.

Our world's infrastructure needs are immense and unprecedented. We face an uncertain future and far reaching consequences of a climate emergency. This report is a contribution towards ensuring that the infrastructure decisions of today can meet the development and climate needs of tomorrow.

Inger Andersen, Executive Director
UNEP

Infrastructure is key to addressing the triple planetary crisis of climate, biodiversity loss and pollution. Even as the world seeks to bridge the massive infrastructure gap, we know that infrastructure is responsible for over 75 per cent of total greenhouse gas emissions worldwide. Today, more than ever, there is a clear urgency for action to combat climate change; the alarm bells are deafening.

As this report demonstrates, infrastructure holds tremendous potential to drive climate compatible development through evidence-based investments that can mitigate greenhouse gas emissions while also helping us adapt to the impacts of climate change. Low and middle-income countries alone could benefit from a 4 USD return on every 1 USD spent on infrastructure that prioritizes future-focused resilience.

The choice is clear: we cannot continue building "business-as-usual" infrastructure, which contributes to the destruction of ecosystems and undermines nature's ability to regulate the climate. It is critical that we invest in sustainable infrastructure that adapts to future uncertain climate conditions; contributes to the decarbonization of the economy; protects biodiversity and minimizes pollution.

Tackling the transboundary, interconnected impacts of climate change requires integrated approaches. This report provides valuable insights through detailed life cycle analyses of built infrastructure, and by illustrating the interlinkages of different sectors, governance structures and aspects of sustainability. The focus on evidence-based planning aligns with UNEP's International Good Practice Principles for Sustainable Infrastructure, including Principle 10: Evidence-based decision making.

To overcome the triple planetary crisis, we urgently need to conceptualize innovative, circular and sustainable infrastructure systems. This report illustrates the powerful opportunities across six critical infrastructure sectors. It offers a roadmap for building climate compatible, resilient infrastructure that addresses challenges linked with existing infrastructure, as well as rapidly emerging sectors like digital communications.

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Professor Jim Hall, Professor of Climate and Environmental Risk
University of Oxford

Infrastructure systems are central to reaching a future in which all people have reliable access to the services that they need, whilst halting greenhouse gas emissions that are driving global warming. A transformation of infrastructure is under way to provide clean energy services, green transportation and energy-efficient buildings. This transformation has to also be resilient to the inevitable impacts of climate change, which means that damaging extreme climatic events are becoming more frequent with the potential to disrupt the infrastructure services upon which we all depend.

Yet we also recognize that the infrastructure systems that have been built in the past have become part of the problem. Operating today's infrastructure for the most part depends upon burning fossil fuels. Millions of tons of greenhouse gasses have been emitted during the production of the cement and steel in our built infrastructure. Infrastructure construction has devastated natural habitats and opened them up to even greater exploitation. Too often it has involved the appropriation of land and has excluded the poorest from the essential services that they need, whilst adding to unsustainable levels of public debt.

The central question is not whether we need infrastructure, but how it can be provided in ways that are sustainable, resilient and compatible with a net zero future. There is no simple answer to the question of how to provide climate-compatible infrastructure. It requires a myriad of choices, from the moment an infrastructure project is first conceived, to the end of its life when it is decommissioned or repurposed. Making the right choices is not easy – it depends upon in-depth knowledge of the systems that are to be provided, and the context in which they will operate.

For the last decade, my research group at the University of Oxford has been working with UNOPS and other partners to provide evidence, tools and insights that can help navigate towards climate compatible infrastructure development. This report further contributes to that goal. In this crucial year for climate action, it is absolutely right that our most recent collaboration should focus upon this important topic. There is much still to learn, so I look forward to further collaboration on the pathway to climate compatible infrastructure.

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Executive summary

Globally, we continue to witness the increasingly destructive impacts of climate change. The increased frequency and intensity of events such as wildfires, floods and droughts are costing lives, disrupting economies and setting back development progress that has taken years to establish. Compounded by the COVID-19 pandemic, the world is facing unprecedented challenges that affect all societies.

In the buildup to COP 26, countries are re-affirming their commitments to climate action, including through submission of their revised Nationally-Determined Contributions (NDCs) under the Paris Climate Agreement. Such action not only advances mitigation and adaptation objectives set out in the agreement but can also protect and enhance progress towards many related targets of the Sustainable Development Goals (SDGs).

This report highlights the key role that infrastructure plays in delivering climate action and sustainable development. Developed through collaboration between UNOPS, the United Nations Environment Programme (UNEP) and the University of Oxford, it finds that infrastructure is responsible for 79 per cent of all greenhouse gas emissions, and accounts for 88 per cent of all adaptation costs.

Despite recognition of the need for action, policy makers face challenges in understanding where resources should be allocated, and which practical actions should be prioritized, to maximize progress. Through a systematic assessment of global research, this report offers new insights to help address this challenge. Infrastructure's central importance to climate action and sustainable development can be understood across three main dimensions.

The largest sources of **greenhouse gas emissions** are associated with the energy, transport and buildings sectors (the last of which include homes, offices and schools). In an increasingly connected world, and with the COVID-19 pandemic transforming the way we work, learn and socialize, emissions from the digital communication sector are expected to rise. However, to the extent that digital systems decrease our reliance on the transport and building sectors (e.g. through reduced commuting and remote working), they have the potential to offset emissions and reduce total greenhouse gas emissions overall.

54 per cent of all future **adaptation costs** will need to be spent on the water sector, more than all other sectors combined. These costs originate from hazard protection provided by this sector that can reduce risks from floods, sea level rise, storm surge events, and other climate impacts. Whilst traditional built protective infrastructure (e.g. sea walls) will play an important role in risk reduction, nature-based solutions (such as reforestation, mangroves and wetlands) represent an effective and resource-efficient alternative that can offer a multitude of co-benefits including carbon

sequestration and the enhancement of habitats. Policies that protect those exposed to hazards, in particular those most vulnerable within society, will also play a critical role in managing overall climate risk.

Due to the multiple services provided by buildings, the sector is found to have the single largest influence of infrastructure on the targets of the **SDGs**. The importance of buildings for the SDGs, as well as for greenhouse gas emissions and adaptation costs, highlights the need to transform the way we plan, manage and operate buildings in the future - for example, by integrating nature-based solutions and sustainable building materials, and improving energy efficiency. This can have positive knock-on effects across other sectors required to run buildings, such as energy and water supply. The forecast growth of global infrastructure development, including in buildings, highlights the potential for this transformational change to be driven at scale.

An integrated approach requires an understanding of the synergies and trade-offs between sectoral actions so that negative side effects can be minimized, while opportunities to create positive and wider sustainable development benefits can be enhanced. The concept of climate compatible development sits at the intersection of climate mitigation, climate adaptation and sustainable development, which are equally important in realizing the commitments of the SDGs and the Paris Agreement. Balancing these outcomes will require that the right infrastructure is done well so as to provide maximum benefits within each dimension.

In addition to built physical assets, both the natural environment and an enabling environment of appropriate policy, regulatory and governance frameworks, technical capacity and resources are key components of the overall infrastructure system. Policies and investments that protect and enhance nature will be key to ensuring the provision of essential services that include hazard protection, carbon sequestration and wastewater treatment, whilst also offering an array of co-benefits. Strengthening the enabling environment can be a cost-effective route to ensuring efficient service delivery and that infrastructure is inclusive and works for all people. Action in the built environment should also not be overlooked. Policies that introduce and enforce standards can be effective tools to ensure that built assets work with nature, do not leave unsustainable burdens of debt for future generations, and support the necessary shift towards a circular economy.

The integrated pursuit of climate action with other sustainable development objectives will require the coordination of multiple practitioners across the infrastructure lifecycle to establish, monitor, evaluate and, as necessary, adapt key objectives. Raising awareness of important issues, and defining concrete actions that different stakeholders can undertake to reach these objectives, are critical first steps to making progress.

Creating and embedding climate action and other sustainable development targets across the infrastructure lifecycle will be central to ensuring that the actions of many different actors can come together to ensure that national and international commitments are met. This will require the coordination and support of government and other key actors during the "upstream" phases of the life cycle, as part of strategic planning, project prioritization and preparation processes.

As highlighted by the analysis in this publication, action is required across all sectors. While prioritizing actions that represent 'low hanging fruit' can help to build momentum, it is essential that policy makers take a more holistic, systematic, and integrated approach to infrastructure to create impact at scale. Such integration should be driven by national governments, who have the responsibility to deliver on development objectives. The establishment of infrastructure-specific coordination units, as have been developed in the UK, Canada and Saint Lucia, amongst others, can be effective in harmonizing action across sectors. Communities of practice that develop and share knowledge and experience through case studies are essential for showing how progress can be achieved in different national contexts.

As we rapidly approach the 2030 milestone for the achievement of the Paris Agreement and SDG targets, and in the face of a climate emergency, action is desperately required to reduce climate change and its harmful impacts, as well as ensure that development is sustainable, resilient and inclusive. The research synthesized within this publication highlights the transformative role that infrastructure investments can have, including which sectors have the greatest potential to drive sustainable development, and opportunities to work in a holistic and integrated way to maximize positive impacts. Practical actions and case studies highlight tangible routes to action, while policy priorities show where efforts can be targeted to take this transformation to scale.

Background

Responding to global challenges

In 2017, less than half of the global population had access to essential healthcare services. 2.2 billion people lacked safely managed drinking water, while 4.2 billion lacked safely managed sanitation.[1] By 2018, 24 per cent of the world's population was living in slums, and 789 million people worldwide lacked electricity.[1] Those in vulnerable situations are disproportionately affected by such access gaps. For example, by 2017, only 17 per cent of mothers and children in the poorest fifth of households in low- and lower-middle income countries received at least six of seven basic maternal and child health interventions, compared to 74 per cent for the wealthiest fifth of households.[2]

The COVID-19 pandemic continues to severely aggravate these challenges, causing a 3.5 per cent contraction in the global economy, pushing over 71 million people to extreme poverty and causing disruptions in the provision of essential services such as education and healthcare.[1,3] The pandemic has affected girls and boys, and women and men, differently, with children's education interrupted and families placed under stress by health and economic burdens. Disease outbreaks have increased caring duties for elderly and ill family members, which are often borne by girls and young women, as well as for siblings who are out of school. Girls, particularly from vulnerable communities, are likely to be affected by secondary impacts of the outbreak, such as greater risk of exploitation, child labour and gender-based violence.

Whilst progress has been made over the past decades to provide the global population with the essential services that they need, much of this development has come at a cost to people and the planet. As of 2016, investment in fossil fuels ($781 billion) was almost 15 per cent higher than investment in climate activities ($681 billion), and fossil fuel subsidies witnessed an increase of 34 per cent from 2015 to 2018.[1] As a result of deforestation, unsustainable agricultural practices, urbanization and other human activities, one fifth of the Earth's land area was reportedly degraded by 2020, threatening biodiversity and ecosystems, driving species into extinction and aggravating climate change. This compounds growing pressure from drivers such as population growth, the depletion of natural resources and the effects of climate change, such as more frequent flash floods, droughts, hurricanes, wildfires, storm surges, heat and cold waves, sea-level rise and coastal erosion, among others.

Climate-related shocks and stressors have undermined the stability of infrastructure systems and their ability to operate and provide essential services for communities, especially the most vulnerable. Countries have witnessed increasing economic, social and environmental losses during the 21st century, a direct result of climate-related disasters, which deepen access gaps and set back efforts to promote sustainable development. From 2000 to 2019, a 74.5 per cent increase in disaster events was recorded over the previous 20-year period.[4] These extreme events have affected over 4 billion people worldwide, claimed approximately 1.23 million lives and resulted in approximately $2.97 trillion in economic losses (an increase of over 82 per cent over the previous period).[4]

Such events have hit the poorest countries hardest, as communities and individuals already struggle with strained resources and acute vulnerability. In 2020, over 1,770 recorded weather-related events led to about 30 million new displacements, the highest number since 2010.[5] Displacement rates were almost five times higher in countries with the lowest incomes when compared to those in high-income countries.

In the decades to come, climate change has the potential to push more than 100 million people back into poverty by 2030, particularly in Sub-Saharan Africa and South Asia.[6] It is also in those fragile contexts that access gaps to public services such as safe drinking water, sanitation and electricity are most acute, where resource competition and perspectives of inequality are likely to drive instability and conflict.[7]

In response to the global challenges faced by countries and societies worldwide, governments have committed to a series of global agendas that aim to support low-carbon and sustainable development that is resilient to the harmful impacts of climate change. These include, among others, the Sendai Framework for Disaster Risk Reduction, the **Paris Agreement on Climate Change**, and the **Sustainable Development Goals (SDGs)**, the latter two of which are the focus of this report.

The Paris Agreement on climate change

The Paris Agreement was adopted by 196 countries at the 21st Conference of the Parties (COP) in 2015. This treaty aimed to limit the rise in global temperature to below 2 degrees Celsius, and preferably 1.5 degrees Celsius, compared to pre-industrial levels, and to achieve a net-zero world by 2050. It also established a common goal of enhancing the adaptive capacity of parties, fostering their resilience and reducing vulnerabilities to climate shocks.[8] The signing of the Paris Agreement represented a landmark moment in the fight against climate change, being the first legally binding international treaty to address the need for countries to undertake ambitious efforts to combat climate change and adapt to its effects, as described by the United Nations Framework Convention on Climate Change Executive Secretary:

"It was a remarkable achievement, a milestone for multilateralism—a declaration that humanity could and would stand united and address the most significant threat to its collective future."[9]

In the lead up to the COP in 2015, countries developed Nationally Determined Contributions (NDCs) which set out their specific targets, objectives and actions to reduce their greenhouse gas (GHG) emissions, build resilience and adapt to the impacts of climate change. Following the signature and ratification of the Paris Agreement, 191 parties have continued to increase the ambition of their NDCs and improve their alignment with national plans and strategies.

The Sustainable Development Goals

The 2030 Agenda for Sustainable Development was unanimously adopted in 2015 by all 193 United Nations Member States. Together, the 17 development goals, its 169 targets and 247 indicators provide a blueprint to stimulate action in areas of critical importance for humanity and

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the planet. In practice, achieving the SDGs requires a dramatic shift in the way that countries pursue economic, social development and inclusive growth, as highlighted by the United Nations Secretary-General:

"The 17 Sustainable Development Goals (SDGs) demand nothing short of a transformation of the financial, economic and political systems that govern our societies today to guarantee the human rights of all."[1]

Through their commitment to the 2030 Agenda, countries have recognized that the greatest global challenges such as poverty and deprivation can only be addressed through sustained efforts to reduce inequalities, foster sustainable economic growth and protect the planet. At the national level, many countries have established national development plans that reflect their commitment to the SDGs. National plans outline priority areas and key actions to promote sustainable development within their territories.

The Paris Agreement and the SDGs set a framework and direction for countries, the private sector and civil society to promote sustainable development and climate action. However, six years after these commitments were established, progress remains uneven, and intensified efforts by all stakeholders are more critical than ever. The Decade of Action to deliver these climate and development agendas, alongside the recovery needs of the COVID-19 pandemic, provides an opportunity to support development that is sustainable, resilient and inclusive.

While the Paris Agreement and the SDGs each lay out a different set of commitments, achieving development across both agendas requires an integrated approach that accounts for the societal, economic and environmental impacts of human activity. The 193 Member States of the United Nations recognized this need for integrated approaches to sustainable infrastructure development in a resolution at the 4th Environment Assembly in 2019[10], and since then UNOPS, the University of Oxford, and UNEP and have been working together under the Sustainable Infrastructure Partnership to raise awareness about the role of infrastructure in delivering the SDGs, develop normative guidance on the application of integrated approaches, and provide technical support and capacity building to countries.

This report represents a milestone in the partnership between UNOPS, the University of Oxford and UNEP in contributing to the discussion on the role of infrastructure in achieving global agendas. To avoid making the mistakes of the past and exploit opportunities for co-benefits, it is essential that we take an integrated approach to our future - one that fosters **climate compatible development** as the norm.

Towards climate compatible development

The interconnected nature of the Paris Agreement and the SDGs can create both synergies and trade-offs for promoting sustainable development and climate action. For example, utilizing Nature-based Solutions (NbS) to promote climate adaptation can not only reduce climate risks but also support the development of healthy and productive ecosystems. Activities to promote climate action can also hinder sustainable development, for instance, by forcing the displacement of vulnerable groups and deepening socioeconomic inequalities.[11]

It is therefore important that governments and practitioners avoid contradictory approaches that create negative side effects to sustainable development or climate action. Rather, they should prioritize solutions that exploit their synergies and manage trade-offs where they are unavoidable. Investments that create mutual benefits on climate action and sustainable development will advance climate compatible development, defined as:

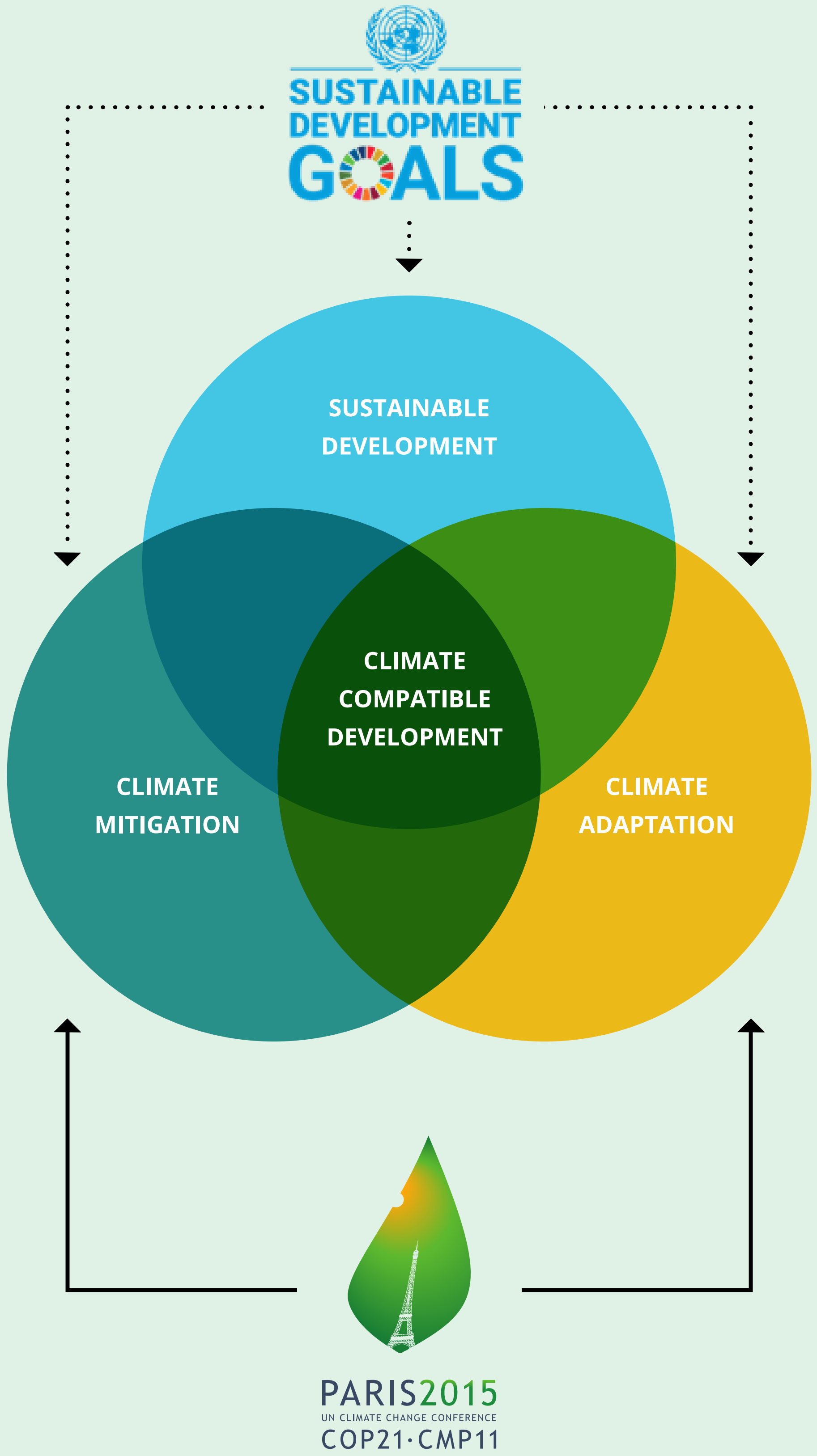
"Development that minimizes the harm caused by climate impacts, while maximizing the many human development opportunities presented by a low emission, more resilient, future."[12]

Climate compatible development is rooted in the recognition that our planet has finite resources and that human activity must respect environmental boundaries to avoid producing consequences that will endanger human life. In practical terms, actions to achieve interdependent SDG targets (i.e., reducing poverty, gender equality, education, clean energy, improving sanitation or increasing healthcare capacity) must not aggravate climate change or create vulnerabilities to it.

Climate compatible development lies at the intersection of climate mitigation, climate adaptation and sustainable development, making it a central framework to assessing the achievement of both of these agendas (Figure 1).

At the heart of all societies are infrastructure systems that deliver essential services, including energy, water, communications, healthcare and education. Through their prevalence, interconnectivity and long lifetimes, infrastructure systems have the ability to profoundly impact our collective future - our collective decisions and plans will determine whether those impacts are positive or negative. The following sections of this report explore why **infrastructure is at the heart of climate compatible development** and how actions to ensure that the right infrastructure is done well can enable unprecedented progress towards the Paris Agreement and the SDGs.

Figure 1: Climate compatible development and the global agendas.



Infrastructure and climate compatible development

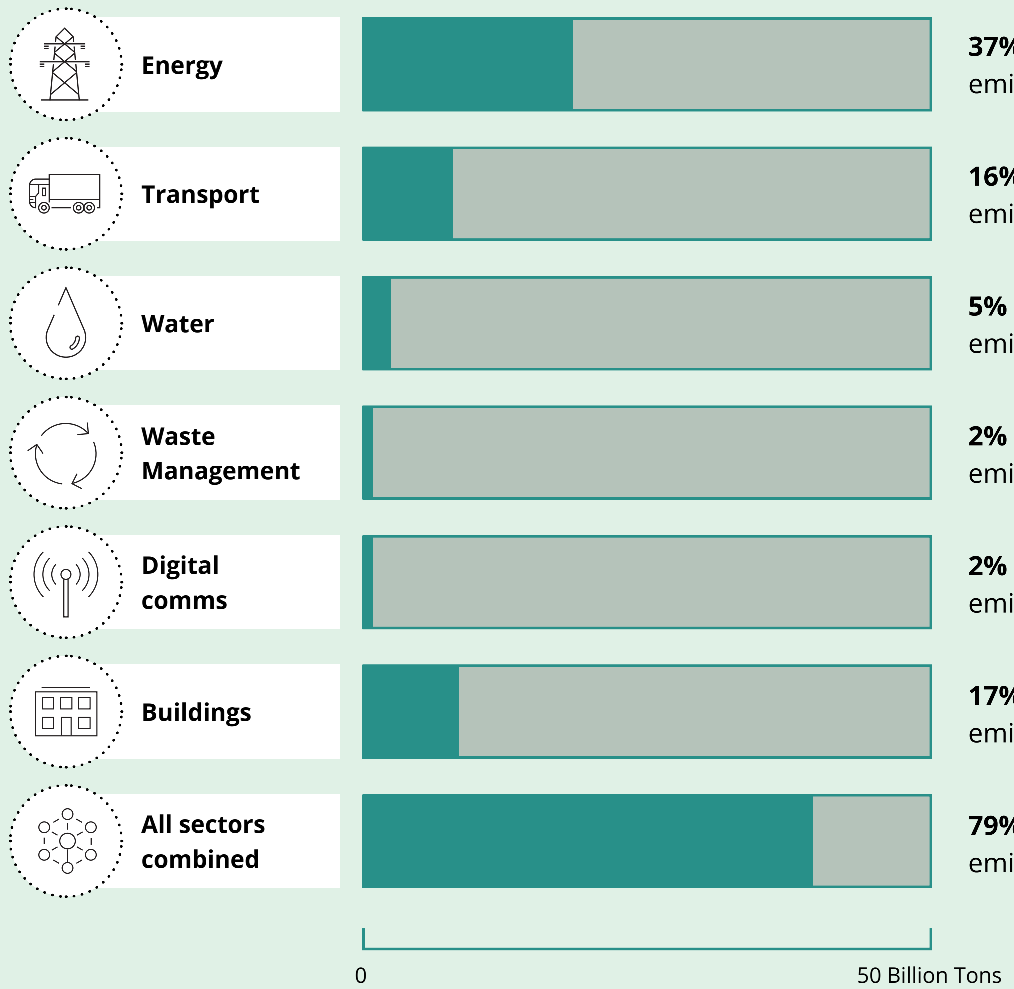
Infrastructure and climate mitigation

Infrastructure plays a critical role in enabling long-term development. Despite these benefits, it is responsible for the vast majority of greenhouse gas emissions worldwide, estimated at 79 per cent of total emissions, with most associated with energy, buildings and transport (Figure 2). These originate from various stages of the infrastructure lifecycle: emissions embodied in infrastructure construction materials such as cement and steel; the energy required to transport materials and workers to building sites (sometimes from other parts of the world); operation of the asset itself; and finally, the use of equipment required for its maintenance and eventual decommissioning.

These increased emissions have resulted in a rapid acceleration of global anthropogenic climate change and unequivocal warming of the climate system in recent decades.[13] Climate change is associated with a greater frequency and intensity of extreme weather events and shocks as well as chronic changes to climate patterns that have affected the availability and distribution of natural resources such as water and fuel.

In addition, climate change has been shown to undermine development outcomes, with progress towards at least 16 SDGs verifiably threatened by its impacts.[11] Although efforts to combat climate change can broadly reinforce all 17 SDGs, climate mitigation measures must be carefully designed to manage trade-offs with factors such as economic and industrial growth potential, agricultural productivity, poverty and social and gender equality. There is thus a need to decarbonize to avoid locking in high-emitting infrastructure for decades to come, whilst doing so in an integrated way across sectors and economies.

Figure 2: Infrastructure sector contribution to total GHG emissions.[14,15,16]

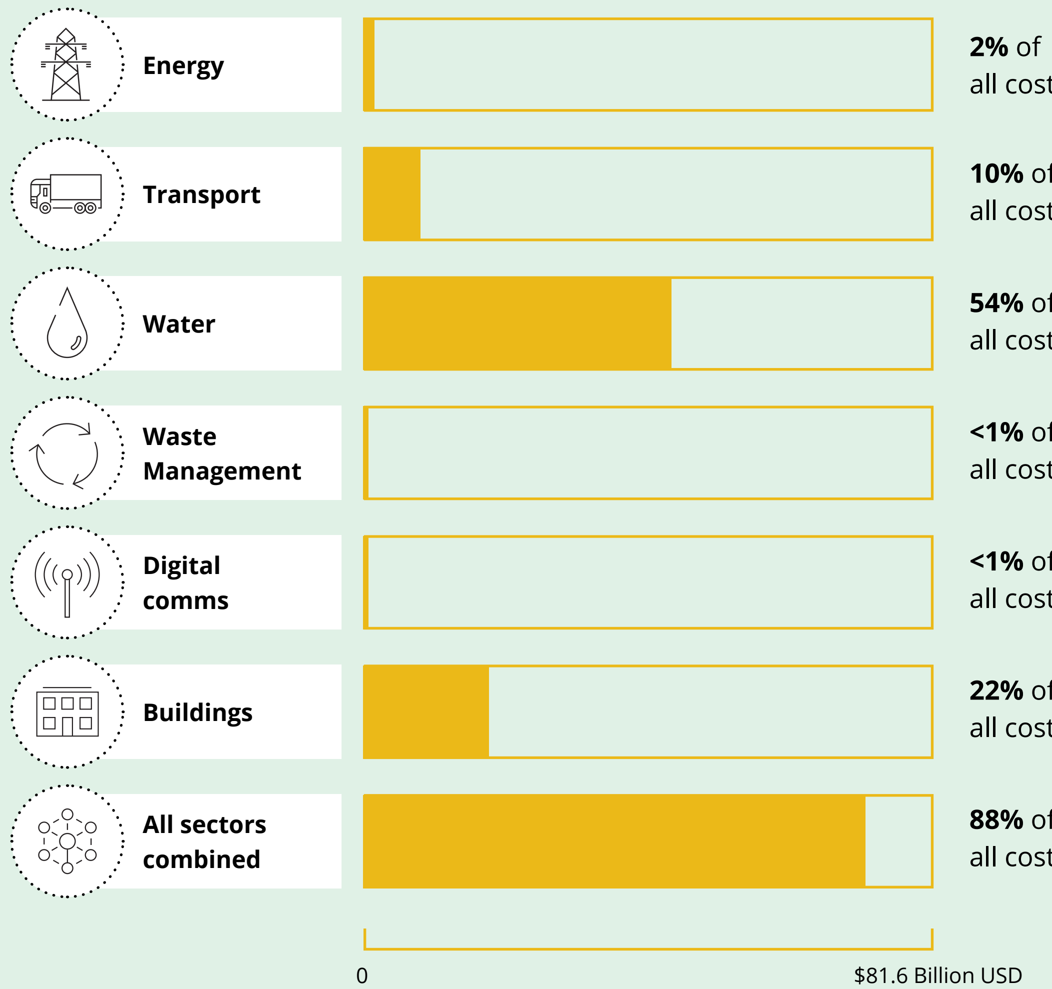


Investment in sustainable infrastructure comprises a major component of mitigation strategies across the NDCs, in addition to other considerations such as forestry and land use. These represent a range of actions across all sectors, including renewable energy development, electrification and power plant efficiencies (energy), clean lighting, eco-efficient appliances and standards (buildings), public transportation and electric vehicles (transport), methane capture and landfill reduction (waste), and wastewater treatment and anaerobic digestion (water). These mitigation actions can directly influence SDG targets on clean energy (SDG 7), infrastructure and innovation (SDG 9), sustainable cities (SDG 11) and climate action (SDG 13). Consideration of mitigation impacts in infrastructure decision-making will thus be pivotal to achieving the various targets and objectives of both the Paris Agreement and the SDGs.

Infrastructure and climate adaptation

Despite efforts to mitigate climate change, its impacts are already being felt and will continue to intensify in the years to come in the form of droughts, heatwaves, floods, storms, and other extreme events. Therefore, measures to reduce vulnerability to these hazards are necessary in order to protect the lives and livelihoods of people and communities. Developing countries are especially vulnerable to the impacts of climate change due to factors such as hazard exposure, low resilience and adaptive capacity. In such contexts, climate impacts can undermine development gains that have taken years to achieve and entrench vulnerability to future events. Small island countries in particular, despite their lower relative contributions to global GHG

Figure 3: Infrastructure sector share of global climate adaptation costs (2010-50 estimates).[19]



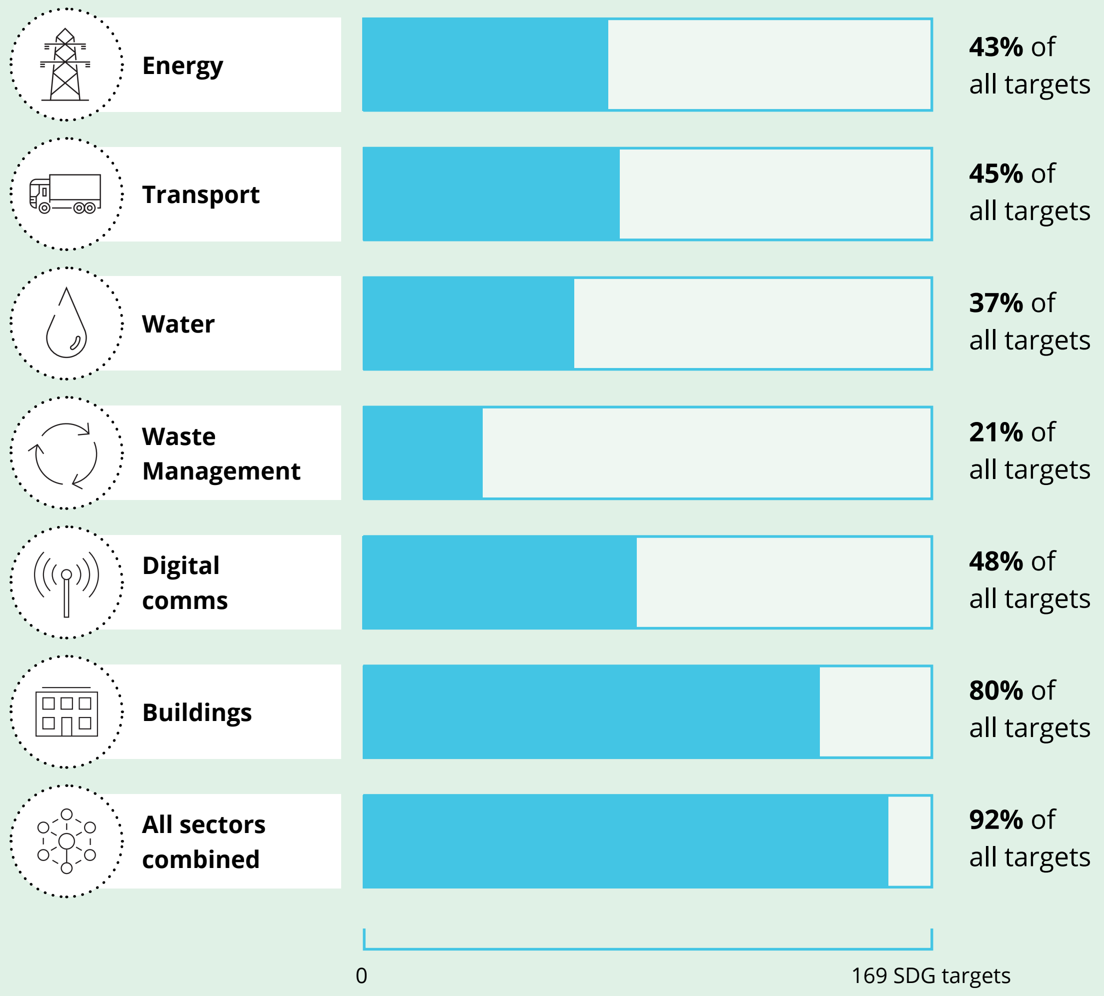
emissions, are faced with the urgent and existential threat from sea-level rise and increased storm surges, having to allocate significant resources towards adaptation actions to protect their populations and economies.[17]

As with climate change mitigation, infrastructure plays a central role in climate change adaptation, due to its ability to safeguard the provision of essential services and protect communities from harmful climate change impacts. Figure 3 shows that infrastructure accounts for the vast majority (88 per cent) of the forecasted global adaptation costs, with the majority of costs originating in the water and building sectors.

Climate change impacts are increasingly being felt and are concentrated in urban areas, which are expected to grow by two-and-a-half times by 2050.[18] This will have major implications for housing, traffic, pollution, flooding, employment, inequalities and health outcomes, among others. In addition, many cities are located on rivers or in coastal areas, directly exposing vast amounts of social and economic infrastructure to hazards. Decision-makers must therefore make important choices between measures that protect this infrastructure, accommodate increased hazards, or retreat from and avoid exposed areas for new infrastructure.

Substantial investments in infrastructure across sectors are required to achieve adaptation commitments involving water supply resilience as well as coastal and marine resources (water), early warning, measurement, and monitoring systems (digital communications), emergency and health infrastructure (buildings) and others. These actions have the ability to influence several SDG goals,

Figure 4: Infrastructure sector influence on the targets of the SDGs. [20]



including resilience of the poor (SDG 1), cities and urban settlements (SDG 11) and adaptive capacity to climate hazards (SDG 13). As such, adaptation to climate change has the ability to both advance SDG achievement and safeguard already attained development gains.

Infrastructure and sustainable development

Infrastructure provides development benefits through the services it enables: energy and water supply to households and businesses; environmentally sound management of wastes and wastewater; connective infrastructure such as transport systems and digital communications that link users to services and to each other; and the buildings, facilities and venues that house institutions and provide social and economic services. People, households, businesses and communities thus rely on well-functioning infrastructure systems to meet a wide range of sustainable development outcomes.

In addition to mitigation- and adaptation-focused SDG outcomes, infrastructure has a much broader potential to influence development. Through systematic assessment of all 169 SDG targets, infrastructure systems have been shown to influence the achievement of all 17 SDGs, including up to 92 per cent of its targets.[20] This influence may be direct, through improving water accessibility (SDG 6), promoting renewable energy (SDG 7) or more generally enhancing infrastructure and innovation (SDG 9). It may also be indirect, in for example providing schools and facilities that enable the equitable attainment of quality learning and skills (SDG 4). Furthermore, to make these outcomes

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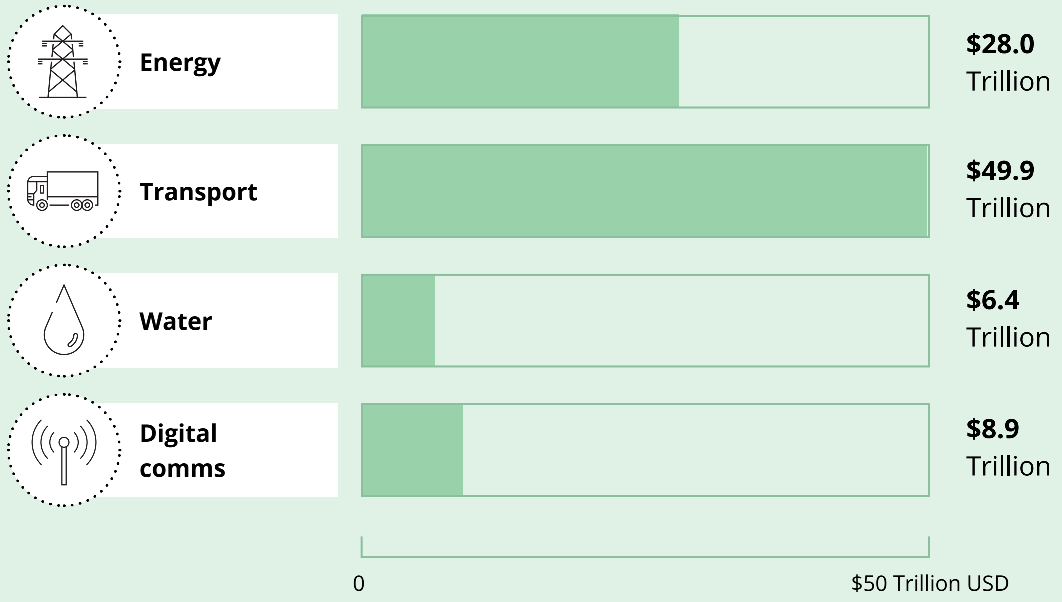
Figure 5: Infrastructure sector investment needs by sector (2016-2040).[22]



gender-sensitive (SDG 5) requires additional considerations, including transportation that is equally convenient to all genders and facilitates access to schools, as well as improved water and sanitation facilities that enable safe menstrual hygiene and ensure girls can consistently attend school. Figure 4 provides an overview of the influence that each infrastructure sector has on the achievement of the SDG targets.

At the same time, infrastructure systems, when not planned or built sustainably, can negatively impact ecosystems and human health, hindering the achievement of several SDGs. For example, around 7.3 million deaths per year (almost one in 10 deaths in children under five years of age) are caused by air pollution - which is heavily associated with infrastructure sectors such as energy and transport.[21] With so much at stake, it is essential that infrastructure development averts negative side effects and harnesses opportunities to foster sustainability.

The infrastructure investment opportunity

This is a moment of unprecedented opportunity for infrastructure to shape the sustainable development of our planet, driven by the urgency of the climate crisis. At the present time, more infrastructure is being built around the world than at any other time in history. Across major infrastructure sectors such as energy, transport, water and digital communications, trillions of dollars of additional infrastructure spending is needed over the coming decades to meet key targets (Figure 5). This sheer amount of new infrastructure investment provides a unique chance for governments to accelerate sustainable development and climate action.

However, this wave of infrastructure investment also poses multiple potential risks if new infrastructure is not well-designed or suited to purpose, which can lock in unsustainable practices for decades to come. History provides many examples of where such development has accelerated environmental degradation, climate impacts and socioeconomic vulnerabilities due to poorly planned infrastructure. This is driven by the complex and interdependent nature of infrastructure that makes it difficult to align with sustainable development progress without a strong integrated approach. This highlights the need to address these challenges in a strategic, systematic, and integrated way and to ensure that **we develop the right types of infrastructure based on proven international good practices and sustainable norms.**

The right infrastructure done well

To address the challenges faced by practitioners, and to deliver on the potential of infrastructure for climate compatible development, it is essential that *the right infrastructure is done well.*

Choosing *the right infrastructure* requires an integrated approach that takes into consideration the performance of existing infrastructure alongside future needs to develop long-term strategies that address national sustainable development priorities and enable progress towards international commitments. It relies on an integrated understanding of infrastructure systems and how they are interconnected and operate in an interdependent manner to provide essential services while ensuring social, economic, and environmental sustainability. Based on this understanding, investment decisions should be designed to maximize positive outcomes on national and sub-national targets and priorities and minimize negative impacts. Figure 6 illustrates how integrated infrastructure development can address performance targets and support the achievement of national objectives in alignment with the Paris Agreement and the SDGs.

Doing *the right infrastructure* also requires that we move past the traditional perspectives of infrastructure as simply *built* assets and evolve towards a perspective of infrastructure as integrated systems. This includes recognition that many services delivered by built infrastructure can also be delivered by ecosystems from the *natural* environment and that the right mix of enabling laws, policies and institutions are required for the built and natural environments to function in synergy (Figure 7).

Once the *right infrastructure* projects have been identified, infrastructure practitioners have the possibility of *doing them well* by enhancing co-benefits and managing negative trade-offs in relation to their climate impacts throughout the infrastructure lifecycle. There are opportunities for action across the whole infrastructure lifecycle, which is interconnected and involves a series of different practitioners, including planners, designers, financiers, contractors, operators, decommissioning and repurposing specialists, amongst others. Table 1 illustrates the primary roles and responsibilities of key stakeholders in planning, delivering and managing a sustainable, resilient and inclusive infrastructure system.

Figure 6: Integrated infrastructure development as a driver to achieve national sustainable development objectives.

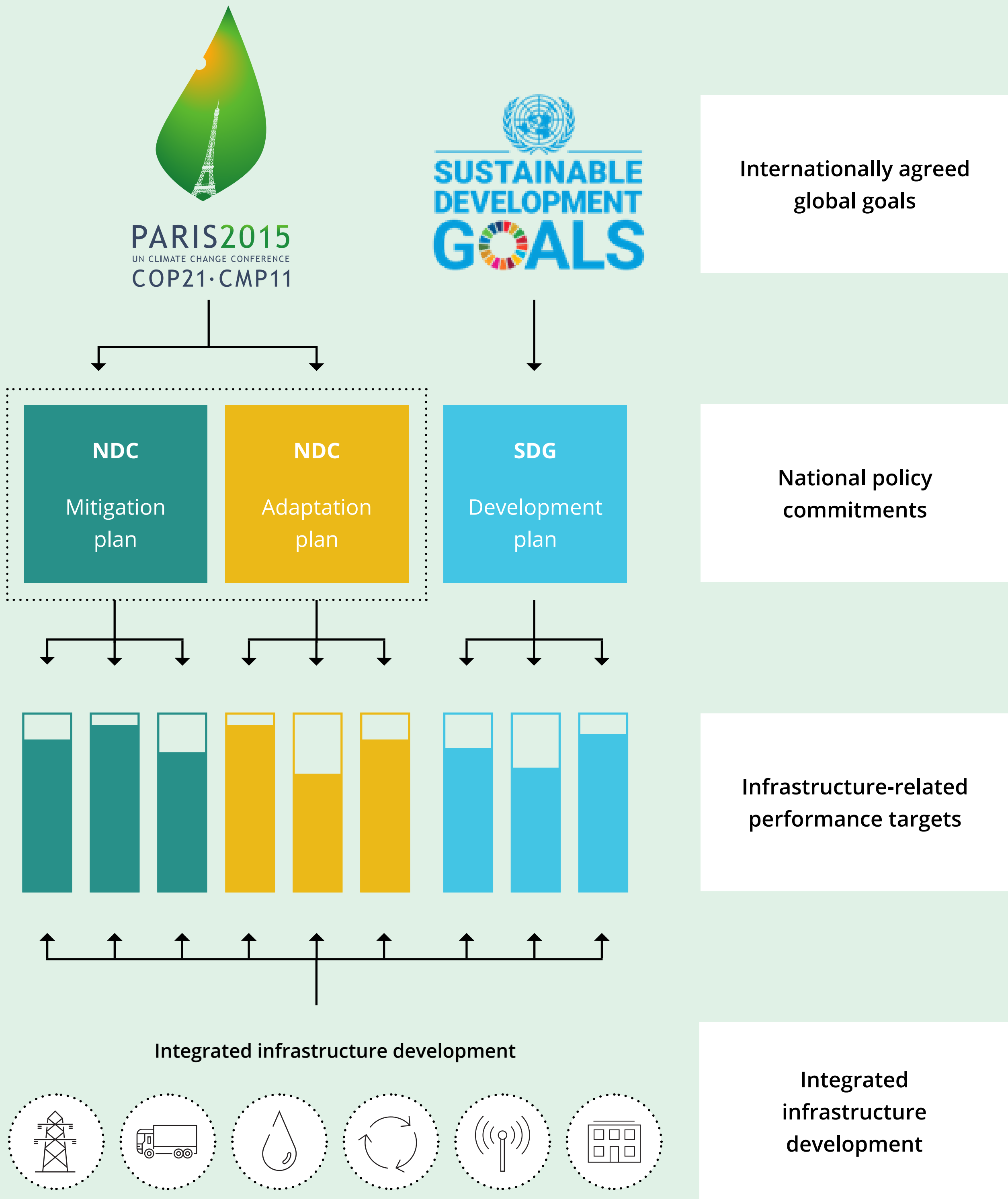


Figure 7: Infrastructure as a system that bridges the built, natural and enabling environments.

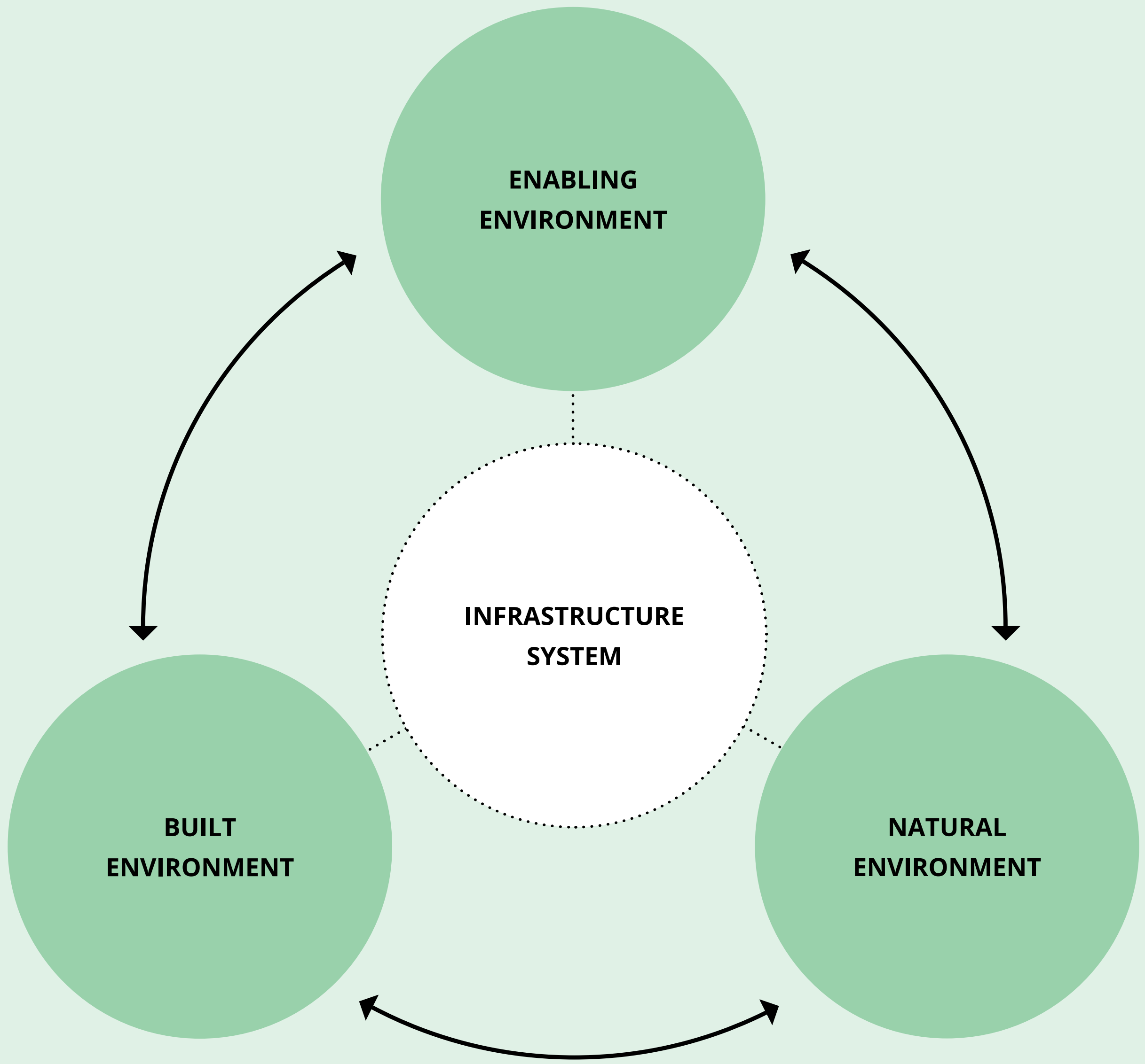


Table 1: Infrastructure practitioners and their roles in supporting climate compatible development

PLANNING **Planners, & Designers & Specialists**	At the national and sub-national level, government planners set strategic policies, regulations and standards, using levers to incentivize sustainable development pathways and to restrict development that may lock in unsustainable outcomes and practices. Planners develop national and sub-national infrastructure plans to shape new developments. These plans look to the long-term, articulating and exploiting interdependencies between multiple sectors and spatial areas. To help guide these plans, strategic impact assessments may be carried out to understand what a region needs and can support. Within this stage, pre-feasibility and feasibility studies are undertaken to explore options and to test economic, social and environmental implications and trade-offs of a project. Solutions are designed to comply with relevant standards in order to balance trade-offs and ensure quality and maximum benefit realization over the lifespan of the asset. Infrastructure is designed considering equitability and accessibility for all. Project proposals seek to minimize impacts on the environment while taking into account the climate and other hazards. Specialists are consulted to analyze and advise on climate and environment risks. At the project level, planners and designers undertake environmental and social impact assessments on their designs. Good practice incorporates social safeguards from the beginning of the planning and design processes (e.g., inclusive, gender-responsive grievance redressal mechanisms, inclusive and meaningful stakeholders engagement, free, prior and informed consent related to upholding rights of indigenous populations where and if applicable, and information disclosure).
DELIVERY **Financiers & Contractors**	Financiers support owners to secure capital and/or operating costs for the lifecycle of infrastructure. Investment from the public and private sector is coordinated, and new delivery business models are facilitated. Costs and risks (including exacerbation of social and gender inequities) associated with a project lifecycle are considered as part of the business case. Contractors have the role of implementing infrastructure, along with skilled professionals across different domains. Construction is implemented to the standards and specifications established during the design phase. During the construction process, care is taken to avoid negative impacts on the environment or local communities. Safe and equal working conditions provide important economic opportunities for women and local workers. Contractors can support the reuse of materials from the repurposing and decommissioning of assets by applying sustainable construction skills and knowledge.
MANAGEMENT **Operators, Decommissioning & Repurposing Specialists**	Operators are responsible for operating the infrastructure as per its design, to deliver the intended service at optimal efficiency. Many services are regulated to ensure that they are fairly provided to customers (including women, girls, youth, the disabled, and other socially excluded groups). Operators may also be responsible for monitoring the environmental performance of infrastructure systems—including the effectiveness of climate change mitigation and adaptation measures. Infrastructure maintenance ensures safety and prolonged performance across its lifespan and beyond the lifetime of a project/programme through inclusive, community-based and cost-effective operations and maintenance procedures. Specialists can advise on the end-of-life repurposing of infrastructure as early as the design stage, if possible. Materials can be reused through effective repurposing and decommissioning practices. During and after the decommissioning of assets, specialists are required to assess and mitigate any long-term negative impacts on the environment or local communities, including through workforce transitions. Continuity of the infrastructure services provided by the decommissioned assets must be assured by other means.

Supporting climate compatible development

This section outlines a practical blueprint for sustainable infrastructure development within the framework of climate compatible development. Using a sectoral analysis, it indicates specific actions that practitioners can take throughout the infrastructure lifecycle to address sustainable development objectives generally, and within those, climate mitigation and adaptation goals specifically. For each of these three dimensions, it provides examples of practical actions that can support the achievement of climate compatible development targets, directly or through co-benefits. The actions presented are non-exhaustive, and priority is placed on demonstrating diverse examples, with many applicable across several infrastructure sectors. Table 2 provides examples of these types of generic actions, some of which are further developed in the following sector tables.

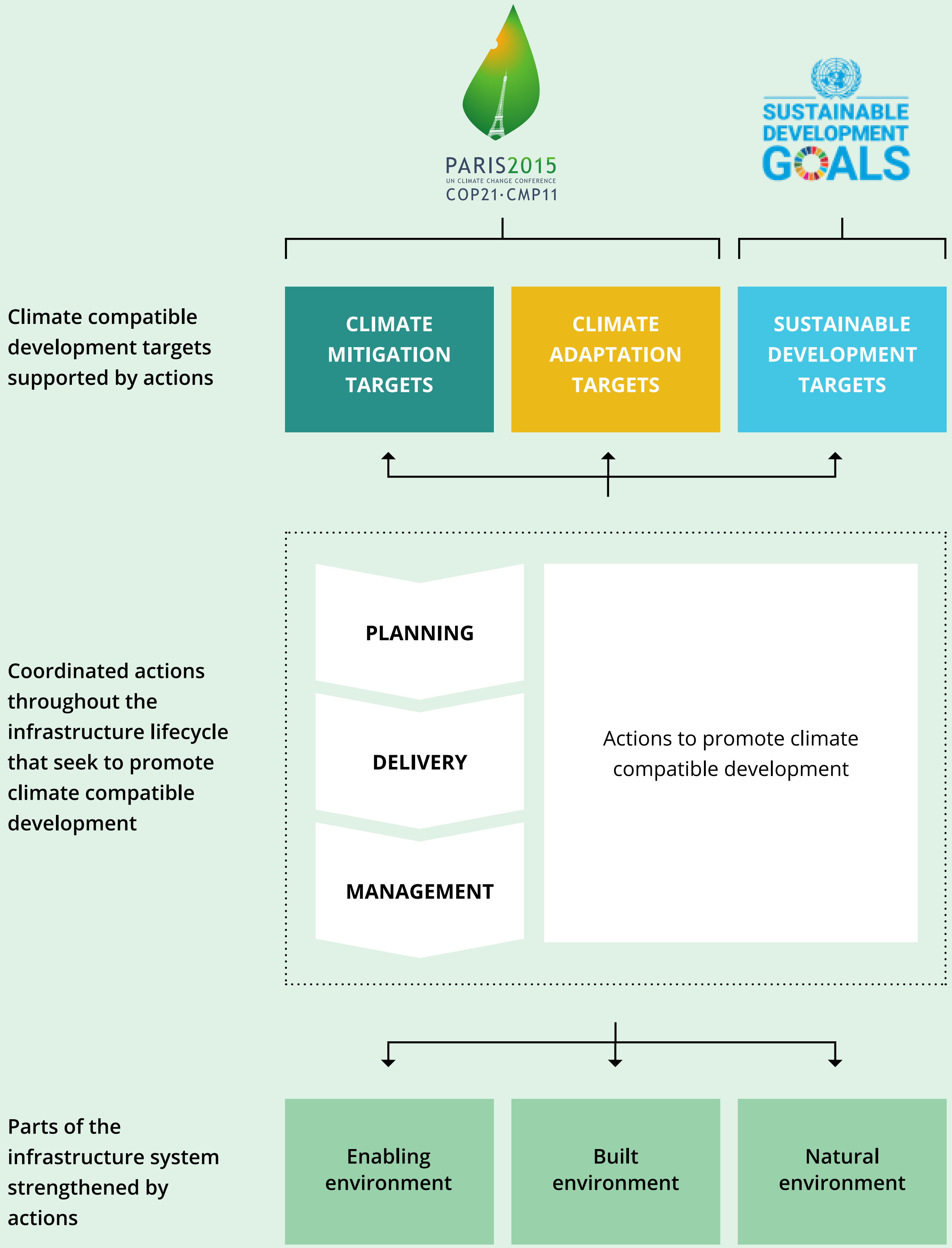
Actions taken to support climate compatible development often need to be addressed at multiple stages of the infrastructure lifecycle. Certain considerations around project financing and procurement, for example, will necessarily arise at the planning stage, although they are central to project delivery. Furthermore, actions must be coordinated throughout the infrastructure lifecycle, as no action can single-handedly enable the achievement of climate compatible development. For example, emissions reductions or avoidance enabled through sustainable procurement practices may be offset through inefficient or wasteful project design or construction. Figure 8 illustrates how coordinated actions throughout the different stages of the infrastructure lifecycle can support the achievement of climate compatible development while strengthening parts of the infrastructure system.

To illustrate a real-world application, the analysis of each sector is accompanied by a case study highlighting how an infrastructure project has successfully harnessed opportunities in the built, natural and enabling environments in order to contribute to the achievement of national commitments to the SDGs and the Paris Agreement.

Table 2: Actions to support climate compatible development in all infrastructure sectors

Stages of the infrastructure lifecycle	Actions to promote climate compatible development across all infrastructure sectors
PLANNING	**Considering interdependencies, systems planning and cross-ministerial cooperation:** Recognizing the importance of sectoral interdependencies and alignment between national and sub-national plans and policies. Infrastructure systems should be planned in an integrated way that exploits efficiencies and reduces risks among them. **Contextual considerations in strategic infrastructure planning:** Infrastructure projects and interventions should be suited to local contexts to best exploit their potential and respond to needs.
DELIVERY	**Strengthening relationships with international and private sector funders, donors, and financial institutions:** Decision-makers should leverage the growing number of international and private finance and funding institutions available to address climate and development challenges. **Sourcing local materials and workforce where possible:** The use of local materials and gender-balanced (where possible) local workforce, in alignment with sustainable procurement practices, can help reduce greenhouse gas emissions related to transportation, foster employment and economic growth and enhance capacity development at the local level.
MANAGEMENT	**Conducting proactive asset maintenance:** Proactive and community-driven monitoring and maintenance can extend the lifespan of infrastructure assets, contributing to secure and long-term service provision while reducing the need for additional construction and its associated costs and emissions. **Restoring the natural environment after infrastructure decommissioning:** Actions to ensure that decommissioned infrastructure sites are fully restored supports the maintenance of healthy and productive ecosystem resilience.

Figure 8: Coordinated actions that promote climate compatible development while strengthening existing infrastructure systems.



ENERGY

Climate mitigation

The energy sector comprises the physical and non-physical structures that deliver energy services to consumers, consisting of multiple infrastructure-related processes including extraction, generation or conversion, storage, transmission, distribution, and consumption. Together, these processes are responsible for approximately 37 per cent of global greenhouse gas emissions (including emissions from electricity and heat in buildings, but excluding energy for transport and industry), making the sector the largest contributor to GHG pollution.[14]

Climate adaptation

Climate change can have a chronic impact on the resource base of renewable energy sources in a given location, for example by reducing water availability for hydropower generation or changing weather patterns needed for wind and solar energy.[23] Developing energy systems to be more resilient to climate impacts is particularly important for improving the adaptive capacity of vulnerable communities and ensuring their continued access to basic services. Climate adaptation measures in the energy sector represent two per cent of total adaptation costs and can have shared adaptation benefits with other sectors, such as through natural or built options to maintain the hydrological capacity and function of dams.[19]

Sustainable development

The energy sector can influence 72 SDG targets across all 17 SDGs (43 per cent).[20] While the sector itself is represented by SDG 7 (Affordable and clean energy), it has a much wider reach of indirect impacts across socioeconomic and environmental outcomes. This includes providing basic services to households and communities, improving overall health, supporting industrial and economic development, and supplying buildings and non-networked infrastructure with heating and cooling and the electricity required to provide critical health, educational and other community services.

Tables: Key actions to promote mitigation, adaptation and sustainable development in the energy sector, accompanied by illustrative examples

Energy - Planning stage

Mitigation	Adaptation	Development
Quantify targets and objectives in the sector: Setting meaningful, quantified and 'science-based' targets and objectives allows for transparency and accountability in developing national mitigation pathways. They provide a means to understand the scope of required transformation to meet global climate goals while facilitating easier identification of additional mitigation opportunities. In developing a sustainable energy strategy, policymakers should consider the design of targets and how they are expressed (e.g., in absolute, percentage or output terms), which can facilitate implementation by connecting them to specific measures and policies. Energy efficiency should be prioritized as the "first fuel".	**Enhance data and statistical capacity, including disaggregated socioeconomic data:** Disaggregated data collection and sharing can help identify vulnerable groups within communities facing adverse effects of climate change and inform actions to address their needs. Energy systems planning should be guided by accurate data, through household energy surveys on how individuals and groups acquire and use energy resources, so that those most vulnerable to climate impacts can be prioritized. For example, this can allow planners to better prioritize energy accessibility for poor households or those serviced by particularly vulnerable sections of the transmission network.	**Consider interdependencies, systems planning and cross-ministerial cooperation:** Recognizing the importance of sectoral interdependencies, infrastructure systems should be planned in an integrated way that exploits efficiencies and ensures resilience. Systems planning can reduce costs (and emissions) associated with energy projects due to economies of scale and accelerate the adoption of renewable technologies. For example, the development of solar energy systems in rural communities can also power water treatment systems for reuse and desalination - and reduce unit costs due to quantity discounts - if treatment plants are designed to operate with renewable energy (SDGs 1 and 7). Urban areas, in particular, have strong potential for integration and decentralization of energy systems due to the density of infrastructure across multiple sectors.
Infrastructure site selection and geographic considerations: All infrastructure has spatial and geographic considerations that should be fully accounted for at the planning stage – to harness local features, resources or conditions and to minimize negative socioeconomic or environmental impacts. To enhance the performance and cost-effectiveness of renewable energy, planners should incorporate robust studies on resource potential (e.g., irradiance, wind) and integration opportunities to optimize location planning.	**Conduct participatory impact assessments:** These assessments provide a mechanism to estimate the consequences of planned infrastructure projects on the local environment and adaptive capacity of local communities, including women, girls, youth and indigenous peoples. For example, hydropower project viability should incorporate the results of climate risk assessments detailing resilience impacts and trade-offs with regard to mitigation and community or agricultural uses of the river or reservoir.	**Provide forums for inclusive and holistic participatory stakeholder consultation:** Stakeholder consultation that recognizes the different infrastructure uses and needs of women, men, girls and boys, minority groups, as well as the disabled and elderly, whilst planning for new systems, can ensure that it is inclusive, accessible, and affordable. For example, where local social norms make it inappropriate for women to attend energy project planning workshops alongside men, separate workshops should be arranged. Separate forums help assess the impact of energy systems on different users (i.e., how electric water pumps influence time spent on domestic work) (SDG 5) and inform initiatives to enhance the adoption of clean energy solutions (SDG 3).

Energy - Delivery stage

Mitigation	Adaptation	Development
Implement hybrid solutions, including effective nature-based solutions: Hybrid infrastructure can allow natural carbon sinks to be built into urban environments, acting as natural mitigation measures. In the construction of new buildings, practitioners should investigate the potential role of green infrastructure components on energy demand - for example, by modelling its effects on urban heat islands and reduced cooling needs.	**Incorporate modularity and flexible design:** Flexible and inclusive design of infrastructure assets and facilities can increase resilience of supply and allow communities to more easily adapt service delivery to changing energy demand brought on by a number of different drivers. For example, solar off-grids or mini-grids can be designed so as to be scalable at a low cost, which may respond to increased numbers of users, higher per capita use or additional energy needs linked to climate hazards.	**Update tendering and procurement processes, making them less prescriptive and prioritizing accessibility of local suppliers and SMEs:** Simplified solicitation methods and more accessible and green procurement processes for infrastructure projects can encourage participation from small and medium enterprises (SMEs), including women-led or owned companies, which can strengthen local economies (SDGs 5, 8 and 10). Dividing large energy system procurements into smaller lots (e.g., procuring compatible solar photovoltaics, grid extension and related grid technologies from different suppliers) makes them more accessible to local SMEs that may not have the capacity to bid for the entire requirement.
Provide sufficient financial incentives and subsidies for no- and low-carbon development: The removal of inefficient subsidies on fossil fuels can redirect tax resources towards funding more environmentally-friendly, sustainable infrastructure solutions. Policy makers can optimize no- and low-carbon development potential at the financing stage by considering appropriate subsidies and incentives for the development of modern renewable energy and energy efficiency solutions instead. This may involve guarantees, low-interest loans, tax credits, direct investment, and grants to producers and consumers, including women and youth energy entrepreneurs across the supply chain, as well as for end users.	**Fund development of adaptive systems:** Strengthening relationships with international donors and the private sector can increase funding availability for research and development (R&D) and the diffusion of environmental technologies to achieve local adaptive needs. This can encourage the development of energy system designs that can cope with changing environmental hazards and temperatures or can function best in certain contexts (e.g., wind or solar loads).	**Support communities by strengthening education, green skills and inclusive employment opportunities:** Projects should engage local communities and provide equitable pay to workers and help support green skills development of the local workforce. When combined with on-the-job learning opportunities (for instance, on electrical checks, secure attachment of cable fittings or safe debris removal), the installation of PV systems can enhance the future employability of local workers while also contributing to improved operations and maintenance of the system (SDGs 4 and 8).

Energy - Management stage

Mitigation	Adaptation	Development
Conduct proactive maintenance: Proactive maintenance as part of an effective asset management strategy can extend the lifespan of infrastructure assets, reducing emissions associated with new or additional construction. Energy practitioners should follow best practice in inspecting electrical connections, inverters, panels, turbines, batteries and other system components at periodic intervals, to decouple the lifetime of the infrastructure from these specific components and reduce the need for system-wide replacement.	**Promote adaptive operating regimes:** Modifying operating regimes according to context-specific climate conditions and environmental factors will enhance the resilience of the local environment. For instance, hydropower operations should consider local ecosystem services, biodiversity, sediment load dynamics, and other factors to minimize resilience impacts to the natural environment.	**Ease workforce transition to sustainable infrastructure:** Ensuring that policies are in place to support workforce transition to more sustainable technologies and industries during decommissioning or site closure can decouple economic growth from environmental degradation. A 'green and just transition' policy framework accompanied by inclusive capacity building and technical training activities can ensure that workers in the fossil fuel industries develop the necessary skills for this transition, including reskilling to support employment opportunities in other sectors (SDGs 8, 9 and 10).
Integrate circular economy principles: Reusing, recycling, repurposing and refurbishing materials and products can greatly reduce global greenhouse gas emissions and should be a cornerstone of mitigation policy. Converting waste and waste by-products, such as methane, to usable energy can contribute to lowering a country's carbon footprint and making the energy sector more efficient. Capturing and reusing waste heat from buildings and industrial processes is also an important part of energy circularity.	**Restore the natural environment after asset decommissioning:** Obligating energy companies and utilities to conduct environmental restoration around decommissioned infrastructure can support healthy and productive ecosystem resilience. When a power plant is retired, demolished, or dismantled, environmental remediation should be conducted to restore the area. This involves the identification of areas of soil or groundwater contamination, toxic wastes and pollutants that must be cleaned up to support wildlife and ecosystem functions, ensuring that community members can access natural resource assets. Alternatively, the brownfield site may be identified and reused for future development.	**Sustainable deconstruction and dismantling:** Ensuring recycling or safe disposal of hazardous or toxic by-products from decommissioned infrastructure can reduce harmful environmental impacts. Panels from utility-scale solar PV facilities can be repurposed for smaller-scale community or household use where there is a need for low-cost energy solutions, extending their useful life and reducing ground contamination from the leaching of heavy metals such as lead in landfills. It is critical that appropriate waste management practices are in place at the destination to avoid associated environmental risks (SDGs 12 and 15).

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Accelerating investment in efficient and renewable district energy systems in Chile

Location: Chile

Duration: 2017 – 2023

Partners: Ministry of Energy, Ministry of Environment and Energy Sustainability Agency (all Chile), Global Environment Facility and Copenhagen Centre on Energy Efficiency (C2E2)

Since 2017, UNEP has been working with the government of Chile under the District Energy in Cities Initiative to raise the profile of district energy systems as an alternative clean solution to traditional woodstoves. Initially, ten pilot projects were established in ten cities across the country, involving rapid assessments for identification of potential areas where district energy projects could be technically and financially feasible.

In addition, the Initiative has supported the pilot city of Temuco in the development of a long-term investment roadmap for the deployment of district heating in the city, to help improve its air quality. The Initiative has developed a national strategy for district energy - "Heat Roadmap Chile" - along with other measures to improve the enabling environment for targeted investments, and further technical support and workshops to mobilize key stakeholders. "Heat Roadmap Chile" identified that district heating has the potential to cover up to 40 per cent of the national heating market. This would result in reducing PM2.5 emissions by 95 per cent, and would reduce primary energy consumption by 13 per cent and CO2 emissions by 20 per cent.

Contribution to Chile's NDCs

PARIS2015 UN CLIMATE CHANGE CONFERENCE COP21·CMP11

Key physical and non-physical actions from the project

Achieve GHG emissions maximum (peak) by 2025
- District energy incorporated in national policies and plans including the new Presidential Plan
- Creation of District Energy and Geothermal Unit dedicated to project preparation and accelerated investments

Reduce total black carbon emissions by at least 25 per cent by 2030, with respect to 2016 levels
- District energy highlighted in NDC as one of the solutions to improve the sustainability of buildings, reduce black carbon emissions and improve air quality
- Commitment by the Municipality of Temuco to launch an international call for tender to build one district energy project and improve air quality in the city

Strengthen institutional capacities at the sub-national level
- Provision of technical support to ten cities, for identification of district energy projects
- US$ 2.1 million secured for accelerating investment in efficient and renewable district energy systems, including to design an enabling regulatory framework at the sub-national level

Strengthen inclusion of non-governmental actors in the planning and implementation of adaptation measures
- Creation of a National District Energy Committee to provide overall guidance and strategic direction to the development of the district energy market in Chile, and to mobilize national stakeholders
- Signing of an MoU between UNEP, the Ministry of Energy, the Ministry of Environment and SOFOFA, the Chilean industry federation (comprising 100 per cent of national industrial activity and 30 per cent of GDP) in order to collaborate on district energy development

Targeted SDGs


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TRANSPORT

Climate mitigation

The transport sector comprises the facilities, networks, assets, vehicles and institutional structures responsible for the movement of people and goods and can be split into several subsectors, including road, rail, air, urban, maritime and inland water navigation. Given that fossil fuels remain the dominant source of energy consumption in transport, the sector is responsible for approximately 16 per cent of global greenhouse gas emissions, making it the third-largest contributor to GHG pollution after energy and buildings.[14]

Climate adaptation

Increased incidence and intensity of hazards linked to climate change threaten to disrupt and damage transport networks, including vital connections to economic, educational, health, or other opportunities or services. These impacts may fall most heavily on vulnerable populations, including women and girls, particularly in areas where availability of alternative routes or other transport options is poor. This necessitates adaptive measures to ensure continued function, accounting for ten per cent of global adaptation costs, and may include protective barriers, drainage, or natural buffers to protect roads, railways, airports and coastal infrastructure from increased flood hazards.[19,24] Other engineering or technology upgrades, such as the use of new or innovative materials, can protect transport infrastructure from the effects of higher average temperatures or increased rainfall.

Sustainable development

The transport sector can influence 76 SDG targets across all 17 SDGs (45 per cent).[20] Transport outcomes are directly represented in several goals, including SDG 3 (road safety), SDG 11 (access to public transport), and SDG 14 (marine conservation). Beyond that, transport infrastructure facilitates the achievement of many other SDG targets by connecting individuals to infrastructure services and to each other, providing communities with access to essential services and enabling the mobility of people and freight, including internationally. Transport infrastructure is thus essential to sustainable development and to regional, national and transnational cooperation and can improve a country or region's global competitiveness.[25]

Tables: Key actions to promote mitigation, adaptation and sustainable development in the transport sector, accompanied by illustrative examples

Transport - Planning stage

Mitigation	Adaptation	Development
Geospatial data and modelling capacity: Conduct modelling of projected needs for municipal transport services to reduce the emissions of cities. In the transport sector, capacity to undertake network and origin-destination model analysis can enhance low-carbon transport opportunities by identifying pedestrian, cycling and public transportation routes, and enabling the adoption of sustainable technologies such as electric vehicles.	**Incorporate redundancies into the system:** Reduce impacts of unexpected shocks due to climate hazards or disasters so that social and economic services can still be accessed. For example, plan for bus replacement services to be quickly deployed in the event of rail system failure.	**Integrate responsiveness to end users in project planning to enhance systems accessibility:** Identify and incorporate needs of vulnerable people and local communities at planning stage helps ensure that transport systems will cater to the differentiated mobility needs of different users and enable their equal access to essential services. For example, defining the location (distance from schools or villages) and design of bus stops (safety measures, seating arrangements, shade and reliable and uninterrupted electricity) based on the travel patterns and needs of school children help ensure the safe and equal access to schools by boys and girls (SDGs 10 and 11).
Consider geographical characteristics and prioritize lower-carbon solutions: Harnessing local topography, climate, soil, watershed and vegetation conditions can enable the identification and development of low-carbon infrastructure solutions. In the transport sector, exploiting local conditions such as natural watercourses can enable the development of low-carbon transport corridors and foster the use of ferries and non-motorized boats, which are likely to be more appropriate to the local context and energy efficient when compared to other transport means.	**Plan and coordinate role in inclusive response to emergencies such as natural disasters:** Develop a detailed plan of the sector's role and contribution to emergencies and disaster relief. Use appropriate network data and hazard assessments, to support rapid recovery with focus on vulnerable communities. For example, detail the role of the transport system in mobilizing aid and disaster response to affected areas across all modes (road, rail, air, water transport), and ensure that these critical assets are upgraded or retrofitted to withstand shocks and stresses.	**Conduct appropriate assessments to identify negative environmental impacts:** Undertake strategic impact assessments to estimate the potential for the natural environment to support the proposed infrastructure asset construction, as well as the implications for local communities. This could include the impacts of roads or urban developments on habitat fragmentation, threats to wildlife or ecosystem services, as well as the interventions required for habitat rehabilitation. Based on this information, ensure that design standards (i.e., freeway weaving and relevant geometric designs) will enable a reduction of GHG emissions and air and sound pollution associated with transport, helping protect local ecosystems and vulnerable households (SDG 15).

Transport - Delivery stage

Mitigation	Adaptation	Development
Ensure sustainable procurement using appropriate criteria: Incorporate emissions criteria in procurement and purchasing to minimize carbon footprint. For example, implement performance-based award criteria around energy saving, alternative energy use, or material reuse in contracting for road and rail works or other transport facilities.	**Build business case for adaptive infrastructure:** Understand the broader risks and benefits of system adaptation, and incorporate relevant selection criteria into the financial viability assessment for transport projects, including forecast rate of returns.	**Support communities through labour-intensive projects:** Projects that engage local communities, including women and youth, and provide adequate compensation to workers (with equal pay for equal work), can reduce inequalities and support skills development of the local workforce. Engaging local workers in the construction of rural roads contributes to income generation and benefits future employability if on-the-job training and capacity building activities are carried out (SDGs 5, 8 and 10).
Integrate circular economy principles according to design specifications: At the delivery stage, contractors can contribute to emissions reduction by applying their skills and knowledge in the adoption of circular economy principles (i.e., the reuse of materials from repurposing and decommissioning in the delivery stage), according to the design documents. In the transport sector, contractors' expertise in the use of recycled gravel, ash, concrete, and other waste materials can help reduce lifecycle emissions in the construction of highways, roads, or paths.	**Prioritize the use of Nature-based Solutions:** At the delivery stage, contractors can apply their skills and knowledge in the adoption of NbS (according to design specifications) that contribute to the system's resilience. In the transport sector, managing stormwater locally through contractors' expertise in the use of natural vegetation to create sustainable drainage systems in the construction of highways, roads, or paths can help protect the system from floods.	**Explore new financing mechanisms to enhance equitable service outcomes and enhance access to communities:** Encourage private operators to enter the market and meet service delivery gaps, particularly for vulnerable groups. This will encourage service to smaller or rural communities, increasing community members' access to jobs and opportunities (SDGs 5 and 8). Local financial institutions are often well adapted to financing projects at the local scale, and have vested interests in the communities they operate in.

Transport - Management stage

Mitigation	Adaptation	Development
Conduct proactive maintenance at regular intervals: Identify deficiencies or faults in assets that may be linked to increased pollution or emissions. In the transport sector, prompt or timely repairs to network assets can increase the efficiency of vehicle fleet operation, as well as asset lifetimes. For example, road surface maintenance can reduce emissions since road roughness will affect vehicle speed and fuel consumption.	**Conduct proactive maintenance:** Proactive maintenance as part of an effective asset management strategy can enhance assets resilience and ensure it will effectively respond to climate hazards. In the transport sector, regular drainage system clearance can mitigate the risk of flood hazard impacts on roads and surrounding infrastructure.	**Ensure human resource policies are in place for operators:** Protect workers' rights, e.g., working hours or safety protocols for train or bus operators (SDG 3, 8). Promote inclusive employment opportunities in the transport sector and ensure that human resource policies respond to all employee needs, including those with disabilities or mobility impairments.
Plan retrofits to existing assets: Reduce lifecycle emissions by repurposing assets at the end of their lifecycle. For example, retrofitting existing trams and buses to run on renewable energy.	**Explore low-cost maintenance of existing asset stock:** Maintaining certain low-use assets for added resilience instead of fully decommissioning them may add redundancy to networks in times of disaster. For example, airports out of mainstream usage can be mobilized to respond to natural disasters.	**Manage operation and maintenance costs to ensure inclusive access to public transportation:** At the planning stage, the appropriate infrastructure solution can be selected to minimize the maintenance and operation costs at the management stage. In the transport sector, this could mean the selection of road surface type based on the type of traffic (light vehicles versus heavy vehicles) and exposure to climate hazards, which will carry different operations and maintenance costs during the asset lifecycle. These costs must be closely managed to avoid unnecessary increases in usage fees, which are likely to reduce the mobility of the poor and other vulnerable groups (SDG 10).

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Enhancing the resilience of Ghana's national infrastructure

Location: Ghana

Duration: 2020 – 2021

Partners: Government of Ghana and the Global Centre on Adaptation

UNOPS, the University of Oxford, and UNEP are supporting Ghana's Ministry of Environment, Science, Technology and Innovation to ensure that national infrastructure systems are resilient to the impacts of a changing climate. This is done through the development of a roadmap of adaptation options across the built, natural and enabling environments for Ghana's infrastructure systems based on detailed quantitative and qualitative assessments.

Relating to the transport sector, the project assessed the potential impact of climate shocks such as flood and landslide events on road, rail, airport and port assets, as well as gender-differentiated impacts resulting from disruptions in transportation services. For the first time in Ghana, the project identified specific adaptation needs for Ghana's transport system and developed a roadmap of priority investments to meet them.

Capacity building activities with government personnel and local university students were carried out, to enable enhanced future infrastructure adaptation planning in the transport sector. In addition, based on the data from UNOPS' Sustainable Infrastructure Financing Tool, the project identified financing options and is supporting the Government of Ghana in attracting the necessary finances to accelerate the implementation of adaptation solutions.

Contribution to Ghana's NDCs

PARIS2015 COP21·CMP11

- lower its GHG emissions by 15 per cent relative to a business-as-usual (BAU) scenario.
- An additional 30 per cent emission reduction is attainable on the condition that external support is made available (finance, technology transfer, capacity building).
- Scale up sustainable mass transportation.
- Promote city-wide resilient infrastructure planning.
- Promote resilience for gender and the vulnerable (sector).

Key physical and non-physical actions from the project

- Assessment of potential nature-based solutions to support adaptation efforts and offset emissions from other sectors due to carbon sequestration
- Identification of financing options to accelerate the implementation of identified prioritized options
- Identification of adaptation options to enhance the resilience of the built and enabling environment in the transport sector
- Inclusive capacity building activities for government personnel and national universities on mainstreaming adaptation in transportation planning
- Assessment of the potential (gender-differentiated) impacts of climate shocks on transport infrastructure and creation of a roadmap to meet identified needs

Targeted SDGs

WATER

Climate mitigation

Greenhouse gas emissions in the water sector are linked to energy requirements for the construction and operation of system components such as extraction and pumping, as well as for energy-intensive water supply technologies such as desalination. In addition, the operation of wastewater and sewage treatment plants requires energy inputs, while the process produces additional methane and nitrous oxide emissions caused by the degradation of organic matter. Overall, the water and wastewater sectors account for around five per cent of global greenhouse gas emissions.[15]

Climate adaptation

The water sector is expected to require the most investment to adapt to the impacts of climate change, at 54 per cent of all adaptation costs.[19] This is largely due to extensive flood risk management infrastructure required to protect coastal cities from sea-level rise. Climate change also poses threats to water supply due to an increased risk of drought and desertification in many parts of the world. The impacts of this will be most acutely felt in many low-income countries where there is a high reliance on subsistence agriculture and abstraction of water from rivers or lakes for household consumption.

Sustainable development

The water sector can influence 61 SDG targets across 16 SDGs (36 per cent).[20] While the sector itself is represented by SDG 6 (Clean water and sanitation), it has a much wider influence on other SDG targets. For example, the provision of safe and quality freshwater as well as wastewater services to communities contributes to good health and wellbeing (SDG 3), preservation of life below water (SDG 14) and supporting overarching efforts to fight hunger (SDG 2).

Tables: Key actions to promote mitigation, adaptation, and sustainable development in the water sector, accompanied by illustrative examples

Water - Planning stage

Mitigation	Adaptation	Development
Align the sector with national emissions targets: Recognize interconnection between water and other sectors such as energy, waste and buildings. Setting targets for water sector energy needs separate from other use categories can enable the formulation of clearer mitigation actions in the sector.	**Provide forums for participatory stakeholder consultation:** Local adaptive capacity can be enhanced by creating responsive and inclusive, gender-responsive venues for stakeholder participation, where the needs of all community members and users can be represented in decisions on new infrastructure. Local residents have experience coping with climate hazards in the local context and thus should be included in forums to assess the risks, threats, and the viability of adaptive measures with regard to flood risk management as well as water supply and treatment.	**Assess gaps in development targets related to water systems and management:** Assess current indicators on water supply, wastewater treatment, and water ecosystem health. Determine the magnitude of performance gaps and where indicators are non-existent and should be developed (for example in water quality measures). Ensure the choice of indicators is informed by the requirement to meet all end user needs, including projected future needs, and recognize the role of local communities in not only preserving water ecosystem health, but also in promoting their active participation in sustainable water resource management (SDGs 6 and 14).
Develop a nexus approach to water at a community, national or catchment level: This can identify opportunities for future emissions reductions in the sector. Nature-based solutions may be most appropriate for reducing the carbon footprint of water treatment, such as through investment in watershed protection as an alternative to traditional water treatment. The water-energy-food nexus can identify opportunities to use wastewater outputs as fertilizers, which can reduce energy-intensive fertilizer production and its associated methane emissions.	**Design nature-based solutions where possible:** These types of natural infrastructure may be more resilient to extreme weather events than built structures and can reduce future risks associated with pollution or contamination. The use of natural solutions to treat wastewater such as wetlands or marshes can be effective in rural or remote communities. In addition, many types of nature-based solutions can provide flood protection at a lower cost than built solutions.	**Consider interdependencies and impacts across subsectors:** Coordination across various subsectors, including water supply, wastewater, and flood risk management systems is required to achieve integrated water resources management (IWRM). This approach is used to ensure the efficient and equitable use of water resources without compromising the sustainability of vital ecosystems, and will be critical to meet development goals (SDG 6).

Water - Delivery stage

Mitigation	Adaptation	Development
Integrate and regulate new and innovative technologies into system design: Encourage water companies to integrate network standards on water pressure and system leakage, as well as water monitoring components such as smart metering devices, to reduce usage and emissions associated with industrial water use and household water supply.	**Account for system redundancies in system design to increase resilience:** Ensure that infrastructure can be delivered by alternate means if climate hazards disrupt the primary source. In the water sector, supply can be ensured by incorporating more than one water source in the system design, using backup pumps, or ring mains. In some cases, water may be delivered to vulnerable communities by other means (e.g., trucks) if supply is disrupted by climate-induced or natural hazards.	**Finance measures to combat water insecurity through consumer incentives:** Provide grants, subsidies, or tax incentives to install household systems and components, such as rainwater harvesting tanks or efficient appliances such as low-flush toilets or water-saving showerheads. This can improve water security for cities, communities and households with implications for health, poverty, and other development outcomes (SDG 1, 3 and 6).
Tackle embodied carbon in building materials: Ensure materials for water sector assets such as sewers and pipelines are considered as part of a mitigation strategy for the sector. For example, explore materials such as polyethylene rather than traditional iron or copper piping.	**Engage with the local private sector:** Engaging with the local private sector in infrastructure delivery helps improve systems' operational efficiency, service quality and resilience in the long term. In the water sector, engaging small-scale private service providers with local know-how (such as mobile distributor operators) can foster private sector innovation while strengthening the local market, providing more resilient source-to-disposal water solutions.	**Provide compensation for communities negatively affected by asset construction:** The construction of dams and spillways can put downstream communities at risk of flooding during periods of high flow. Responsibility for compensation to affected communities, and relocation where necessary, should be borne by the responsible authorities to build the resilience of the poor and those in vulnerable situations (SDG 1).

Water - Management stage

Mitigation	Adaptation	Development
Apply circular economy principles: Explore means of resource recovery to reduce fossil fuel use and associated greenhouse gas emissions. For example, the recovery of thermal energy from drinking water distribution networks for non-consumptive uses such as industrial cooling, which relies on high amounts of electricity.	**Promote adaptive operating regimes:** Modifying operating regimes according to context-specific climate conditions and environmental factors (as defined at the planning stage and informed by a feasibility study) will enhance resilience of the local environment and contribute to longer-term investment returns. For instance, dam operation should consider local ecosystem services, biodiversity, sediment load dynamics, and other factors to minimize resilience impacts to the natural environment.	**Promote inclusive community-led management and governance measures:** Engage communities in developing locally-led solutions and governance mechanisms for managing local infrastructure, contributing to public awareness and enabling gender-responsive and climate-aware behavioural change. In the water sector, smart metering and water-user groups that include women and vulnerable groups can foster responsible water use (for instance, in agriculture irrigation) and help manage pressure on water resources (SDGs 2 and 5).
Adjust existing water system management to reduce overall emissions of the sector: For example, introduce measures to divert treated wastewater effluent from rivers to agriculture, or convert biosolids produced or collected during treatment into biogas, heat and electricity.	**Use natural protective measures to reduce maintenance requirements:** Nature-based solutions can safeguard infrastructure function against threats from increasing climate hazards and reduce the frequency and cost of required maintenance. For example, increasing vegetation along dam and reservoir banks limits sediment flow caused by surface water runoff, which can reduce the need to conduct costly dredging on a regular basis.	**Implement guidance to reduce risks to workers:** Implement recommendations for protecting workers exposed to wastewater or sewage from waterborne diseases. This includes enforcing basic hygiene practices, providing personal protective equipment, ensuring proper training on disease prevention, and providing appropriate vaccinations (SDG 3).

Working with nature to protect Sri Lanka's population from floods

Location: Sri Lanka

Duration: 2012 – 2018

Partners: European Commission

UNOPS helped increase the resilience of local communities in the Mannar and Vavuniya townships of Sri Lanka through improved flood-control infrastructure, awareness-raising and capacity building activities. Working with local authorities, UNOPS conducted flood mapping and hydrological studies in order to establish the most effective drainage networks and water retention areas. Following the assessment, UNOPS was responsible for demarcating pond boundaries, rehabilitating water-retention ponds and the construction of drainage canal networks in selected catchments.

Preserving natural ponds to act as water storage and help with flood mitigation provided an economically appealing solution, as they were conveniently located at the lowest altitude where water would naturally gather. Furthermore, UNOPS carried out training to develop local capacity for ensuring the future operations and maintenance of the new measures and protecting the remaining ponds. Capacity building activities also sought to raise awareness of community members on their role and responsibilities in flood prevention and related emergency situations, increasing their resilience, self-reliance and independence from outside support.

Contribution to Sri Lanka's NDCs

PARIS2015 UN CLIMATE CHANGE CONFERENCE COP21·CMP11

- Reduce the GHG emissions against BAU scenario by 20 per cent.
- Reduce traffic congestion in order to reduce GHG emission.
- Control of vector-borne and rodent-borne diseases (dengue, malaria, and leptospirosis).
- Assess river floods and mitigation measures for possible flash floods, introducing flood mitigation structures.
- Mainstream climate adaptation in physical and urban planning and incorporate them into planning in development projects. Conserve wetlands and water bodies close to urban and settlement areas.
- Introduce a new water management system focusing on community awareness creation programmes and water supply plans.
- Develop disaster prevention and environmentally-friendly mechanisms, especially for floods, and incorporate them into the planning of development projects.

Key physical and non-physical actions from the project

- Harnessing existing solutions in the natural environment lowers demand for grey infrastructure development, reducing lifecycle emissions
- Improved network of drainage canals reduced the risk of road flooding and the consequent congestion in transport networks or the transmission of waterborne and communicable diseases
- Flood risk mapping and hydrological studies in order to establish the most effective drainage networks based on existing evidence
- Preservation of natural ponds for water storage and flood mitigation
- Capacity building activities to raise awareness of community members on their role in flood prevention and related emergency situations

Targeted SDGs

SOLID WASTE

Climate mitigation

The majority of greenhouse gas emissions from the solid waste sector are linked to the decomposition of organic material in municipal solid waste landfills. Other sources include transportation of waste, the combustion or incineration of non-hazardous solid waste and the industrial treatment of sludge from the wastewater sector. Overall, these account for around two per cent of global greenhouse gas emissions.[14] This amount is even higher if we consider the embodied carbon in waste materials; approximately 8-10 per cent of global GHG emissions are associated with wasted food, for example.[26] Due to the large amounts of methane produced as part of the anaerobic digestion process for many types of biogenic waste, gas capture can provide a clean energy resource, reducing the sector's impact on climate change.[27]

Climate adaptation

Climate change can impact the solid waste sector directly through destructive impacts on waste management facilities, or through disruptions in energy and transport networks on which the system relies. An increased incidence of flooding, landslides or inundation may threaten the containment of waste in landfills and dumpsites, and high winds can blow litter from landfills into surrounding communities and waterways. Extreme weather events can also generate waste themselves through the destruction of property and infrastructure. Those events pose risks to the terrestrial and marine environment and are likely to have negative impacts on neighbouring communities or the lives and livelihoods of socially-excluded groups working in landfills and dumpsites. In addition, poor waste management practices (including lack of waste collection) can lead to the clogging of drainage systems and increase the frequency and intensity of flood events. While adaptation in the solid waste sector represents less than one per cent of expected global costs, it is likely to be intertwined with adaptation measures in other sectors (such as water, energy and transport).[19]

Sustainable development

The solid waste sector can influence 36 SDG targets across 15 SDGs (21 per cent) and is the focus of SDG 12 (Responsible consumption and production), although it is represented across other goals such as SDG 3 (pollution and contamination), SDG 11 (municipal waste management), and SDG 14 (marine pollution).[20] The sector provides services related to the collection, disposal and treatment of various types of solid waste. In doing so, the solid waste sector plays a critical role in preventing environmental contamination, which threatens natural ecosystems and human health, and supporting sustainable consumption and circular economies via recycling and material reuse. This may have differentiated impacts on women and other vulnerable groups given different responsibilities, preferences and resources in relation to household and community waste management.

Tables: Key actions to promote mitigation, adaptation and sustainable development in the solid waste sector, accompanied by illustrative examples

Solid waste - Planning stage

Mitigation	Adaptation	Development
Develop cross-ministerial collaboration: Leverage cross-sectoral interdependencies between relevant infrastructure sectors to find efficiencies and reduce overall emissions. In the waste sector, conduct planning in collaboration with energy sector planners (waste-to-energy potential), water and agriculture (sewage sludge treatment and use as fertilizer), transport (collection routes and networks), and others.	**Integrate climate factors in spatial planning:** Ensure that sensitive or critical facilities are not built in areas of high climate hazards, where the negative impacts or externalities of a shock intersect with vulnerable communities. This is achieved in the waste sector by restricting the building of management facilities in locations susceptible to hazards, which may cause groundwater contamination for local communities and impact surrounding ecosystems, or building them at a safe distance from these communities.	**Adopt and formalize quality standards:** Ensure that waste management facilities and equipment abide by strict quality standards to minimize negative health or environmental externalities. For example, provide formal requirements for above-ground waste storage, such as those on drainage and containment, to avoid leachate generation or the spread of wind blown litter (SDG 15).
Engage the public: Information and awareness campaigns targeting households, schools and workplaces can contribute to lower emissions through more efficient resource use. Reducing the amount of municipal solid waste that goes to landfills and is instead reused, recycled or composted will cut emissions in the sector. In parallel, bans or taxes on materials such as plastic bags or packaging can reduce the generation of waste.	**Define a business case for waste:** With much organic material going to landfill, solid waste can be undervalued in terms of its reuse potential. Business opportunities in the sector should be emphasized to encourage activities such as composting, which adds resilience to the agricultural sector by improving soil properties, conserving water, and improving plant growth.	**Incorporate modularity and flexible design:** This provides the means to easily upscale infrastructure capacity to support changing demand brought on by demographic, social or economic change. This will be important to respond to growing needs for waste treatment capacity in a city or region brought on by urbanization (SDG 11). Hybrid or mixed service delivery models may be most appropriate in some contexts, with informally-managed waste collection at the household and community level, and government involvement focused on landfill management. Integrating decentralized components can enable a more rapid roll out of services.

Solid waste - Delivery stage

Mitigation	Adaptation	Development
Incentivize mitigation action through financial measures: Adopt policies that encourage projects to capture methane by favouring it as a source of fuel. Provide fiscal incentives for companies and technologies that use biogas or methane from the waste sector as an energy source. This may be particularly feasible in farming, food processing, or other industries with large waste outputs.	**Integrate climate-adaptive principles in facility design:** Climate impacts may reduce availability of water (e.g., drought) or interrupt electricity (e.g., floods or storms). Waste facilities can be designed to utilize technologies such as dry treatment, recycled water, or closed-loop power so as to maintain uninterrupted operation.	**Incorporate construction waste management:** Includes on-site treatment of pollutants and wastewater, elimination or minimization of waste where possible, and the reuse of materials where feasible. Integrating waste management into infrastructure construction can reduce landfilling needs and minimize negative environmental outcomes such as contaminated water runoff (SDGs 6 and 12).
Build inclusive capacity to locate markets for existing operators: Facilitate market entry in sub-sectors contributing to lower emissions, including small waste recyclers, which may specialize in certain types of materials (plastic, glass, construction waste). Promote integration between local recyclers and vendors (local or international) through the establishment of "waste exchanges" to encourage material reuse in production processes.	**Promote gender-sensitive capacity building during infrastructure delivery:** Ensuring that infrastructure delivery is accompanied by capacity building activities enhances the resilience of systems through improved management practices. Women should be able to access capacity building opportunities that promote improved waste management practices. Raising awareness and creating business opportunities around waste collection practices that prevent the blockage of sewer lines and drainage channels during storms.	**Simplify tendering and procurement processes, prioritizing accessibility of local suppliers:** Simplified solicitation methods and more accessible procurement processes for infrastructure projects can encourage participation from small and medium enterprises (MSMEs), including women-led and owned MSMEs, strengthening local economies. In the waste sector, initiatives to encourage registration of these enterprises as suppliers or service providers on government databases can increase their participation and engagement in a hybrid service delivery approach to solid waste management (SDGs 5 and 8).

Solid waste - Management stage

Mitigation	Adaptation	Development
Support proactive and regular maintenance: Ensure sustained financial and technical resources to maintain existing equipment and facilities. Projects such as landfill gas capture risk falling into disrepair if communities are not supported with the money and know-how to maintain operations.	**Monitor and evaluate vulnerabilities in system-level infrastructure risk assessment:** Consider the role of other sectors in waste management and continually monitor their exposure to climate-related hazards. Monitor the exposure of roads or electricity transmission lines to flooding and landslides, which are required for the collection and transport of waste, and the running of waste management facilities. Identify critical drainage systems and ensure that they are routinely maintained and cleared of debris to reduce flood risk.	**Ensure formalized labour laws:** Protect or introduce full rights of sanitation workers, including recognizing those in informal roles such as waste pickers and protect their livelihoods. Ensure that these often marginalized groups are empowered through ownership and fair pricing structures and are not displaced by privatization, contributing to equitable distribution of profits and poverty reduction (SDG 1, 5 and 8).
Identify opportunities for emissions capture: Assess existing infrastructure to identify opportunities that contribute to mitigation through retrofits. Identify waste management sites most suitable for the implementation of gas capture technologies, which can be used as an energy resource, for example to power the waste management facility.	**Material recovery and recycling for adaptation:** Extreme weather events can increase the volume of material waste arising from flood or storm damage. Instead of diverting this to landfills, opportunities for material recovery should be explored for a variety of adaptive uses, such as the construction of protective walls or barriers.	**Implement stringent safety protocols:** The waste sector requires the handling and movement of contaminated, toxic and heavy materials. Implementing safety measures and providing personal protective equipment to reduce exposure to hazardous material and ergonomic hazards can improve health and wellbeing for those in the sector (SDG 3).


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Integrated Yemen urban services emergency project

Location: Yemen

Duration: 2017 – 2021

Partners: The World Bank

With a holistic approach to solid waste infrastructure, UNOPS supported selected cities within the Republic of Yemen in adopting environment-friendly waste management practices. UNOPS conducted technical assessments of landfill sites and supported the rehabilitation of selected sites by constructing transfer stations and restoring solid waste collection and transfer services. Landfill site rehabilitation reduces the occurrence of fires (practiced in dumping sites) and enables gas collection and energy recovery, contributing to reductions in GHG emissions. Capacity building activities with a focus on technical skills for waste management were also undertaken. Landfill rehabilitation and local capacity building encouraged private sector investments in biogas power generation with gas production wells being constructed in the rehabilitated sites. In addition, UNOPS rehabilitated water drainage channels, providing grills to avoid blockages that lead to flooding and contamination from solid waste. Environmental safeguard mitigation measures were a critical component of the infrastructure works undertaken by private sector contractors to support capacity building and the revitalization of local economic activity.

Contribution to Yemen's NDCs

PARIS2015
COP21·CMP11

- Reduce one per cent of the country's GHG emissions by 2030 compared to a business as usual (BAU) scenario.
- Promote the wide use of natural gas for power generation, industry and other economic sectors.
- Promote landfill gas capturing for flaring or using for power generation.
- Strengthen institutional capacity for building resilience to climate change, including planning, programming, monitoring and resources mobilization.
- Promote disaster risk management including flood and drought management.

Key physical and non-physical actions from the project

- Landfill site rehabilitation reduced the occurrence of fires (practiced in dumping sites) and enabled gas collection and energy recovery, reducing GHG emissions
- Collaboration with the private sector and capacity building activities with focus on technical skills for waste management
- Rehabilitate water drainage channels, providing grills to avoid blockages that lead to flooding and contamination from solid waste

Targeted SDGs

DIGITAL COMMUNICATIONS

Climate mitigation

The digital communications sector requires vast amounts of energy to power data centres, access wired, wi-fi, and mobile networks and consumer devices (such as computers, smartphones and modems). Its carbon footprint is expected to grow rapidly as digital connectivity becomes more widespread and data traffic increases around the world. While the impact of the sector on greenhouse gas emissions is difficult to quantify, the information and communications technology (ICT) ecosystem as a whole has been estimated to contribute approximately two per cent of global greenhouse gas emissions, under a broad definition that encompasses personal digital devices, mobile-phone networks and televisions.[16] As a fast-growing sector, and with remote working and digital interactions increasing due to the COVID-19 pandemic, these figures are likely to increase further, potentially consuming up to 20 per cent of electricity and emitting up to 5.5 per cent of global carbon emissions by 2025.[16] At the same time, digital technology can help to improve the efficiency of service delivery in other sectors, which can contribute to a reduction in emissions.

Climate adaptation

Similar to transport, digital communications networks link users to services and provide access to information, education, employment, recreation, and e-commerce. Digital communications infrastructure is also a key component of adaptation strategies, through, for example, early warning systems in exposed communities and provision of alternative access to services. While the digital communications sector is expected to account for less than one per cent of total adaptation costs, its resilience relies on adaptation investments made in other infrastructure sectors (such as energy and buildings).[19] For example, with government registries and records increasingly digitized, adaptation measures such as physical protection, decentralised record keeping (such as through blockchain), and back-up redundancy will be required to protect data centres and networks from destructive climate hazards.

Sustainable development

The digital communications sector can influence 81 SDG targets across all 17 SDGs (48 per cent), including SDG 5 (enabling technology for the empowerment of women), SDG 9 (access to ICT) and SDG 17 (technology development).[20] Digital communication infrastructure enables social connectivity and access to information, as well as to a variety of services worldwide. Consequently, the sector is critical to a country's economic activity and service provision in other sectors such as health, transport, tourism and education. Given the differentiated uses of digital technologies by men and women - for instance, in education, commerce or access to e-government services - transformations in digital communications should be designed so as not to increase existing gaps in gender or inclusivity outcomes.

Tables: Key actions to promote mitigation, adaptation and sustainable development in the digital communications sector, accompanied by illustrative examples

Digital communications - Planning stage

Mitigation	Adaptation	Development
Introduce legislation or standards to ensure longer product lifespans: Planned obsolescence in the digital communications sector shortens the duration of products, requiring more frequent replacement, which is linked to unsustainable rates of mineral extraction and disposal. Enforcement of international standards related to product durability can lead to reduced emissions in the sector. Modular design of communications systems can also allow for easier replacement or upgrading.	**Utilize big data and machine learning to adapt to climate change:** Advanced digital technologies can improve the resolution of forecasting in climate models, identify impacts of specific actions with greater accuracy, improve early warning systems, and should be integrated into the planning stage of large-scale infrastructure projects where possible.	**Facilitate the adoption of advanced digital technologies globally:** Promote international cooperation and knowledge sharing to facilitate the development, transfer, dissemination and diffusion of environmentally sound, low-cost, gender-friendly and easy-to-use technologies to developing countries (SDG 17).
Quantify targets and objectives in the sector: Setting meaningful, quantified and 'science-based' targets and objectives provides transparency and accountability in developing national mitigation pathways. They provide a means to understand the scope of required transformation to meet global climate goals while facilitating easier identification of additional mitigation opportunities. Emissions targets related to digital communications and data transfer, as well as potential emissions savings provided by the sector (e.g., through efficiencies), should be explored so as to link to clearly defined measures and policies.	**Design digital infrastructure to quickly adapt to overcapacity:** Plan digital systems to be able to rapidly accommodate high-capacity use brought on by unexpected shocks, which may be related to local or global events. For example, communications systems may see high demand in the event of a natural disaster, while at the same time capacity may have decreased due to physical infrastructure damage related to the shock.	**Enhance capacity and skills development:** Pursue education and training in modern digital technologies so as to provide domestic capacity to use and operate advanced digital communications infrastructure, and to reduce skills shortages, especially amongst women and girls (SDGs 5 and 4).

Digital communications - Delivery stage

Mitigation	Adaptation	Development
Accelerate green digital finance: Leverage the potential of digital finance to achieve sustainable outcomes through low-carbon and resource-efficient economies, while encouraging leapfrog technologies that bypass higher emissions pathways. Digital finance can better inform decision-making and unlock innovation by making data cheaper and more accessible for financiers. This can enhance opportunities for women-led or owned energy-efficient MSMEs and promote gender-responsive consumer spending.	**Digital finance for climate-resilient solutions:** Mobilize investors, funders, and entrepreneurs to support and unlock digital finance solutions to climate threats. Proactively coordinate and align climate resilience strategies with large funders and digital finance institutions.	**Integrate green digital finance into innovation "ecosystems":** Incentivize new and innovative solutions to sustainable development goals and challenges using digital technologies. Create sponsorships, reward schemes, and other funding incentives to address climate challenges within incubators and innovation hubs (SDG 9).[28]
Strengthen sustainability in the supply chain through ICT: E-procurement can be used as a tool for better informing supply and purchasing decisions to ensure sustainability across the supply chain. It allows for better information and more explicit identification of sustainability criteria, such as resource efficiency and low-carbon practices, in procurement decisions.	**Prioritize disused sites for infrastructure delivery:** The digital communications sector will require increased land use for data centres and other physical components. Prioritizing existing brownfield sites (such as former industrial or building sites) for new construction and developments contributes to the protection of ecosystem resilience by avoiding the destruction or modification of natural ecosystems.	**Improve the sustainability of construction management through ICT:** The use of information technologies, such as building information management (BIM), can enable the integration and analysis of sustainable design and materials in building construction, allowing practitioners to best integrate efficiencies and enhance their environmental performance (SDG 11).

Digital communications - Management stage

Mitigation	Adaptation	Development
Integrate circular economy principles and e-waste management: Explore recyclability and the environmentally sound disposal of ICT equipment at its end-of-life, as improperly discarded e-waste can release harmful pollutants into the environment. Promote opportunities for recycling valuable components such as gold and copper from discarded items, reducing needs for raw resource extraction and energy.	**Improve infrastructure resilience through robust systems and redundancy:** Use advanced digital systems to identify and adapt to climate threats, identifying and safeguarding critical communications hubs such as cellular towers. Add backup systems components and energy solutions to ensure continued functioning following climatic events.	**Improve socioeconomic data and statistical capacity:** Use of digital technologies to provide more extensive and inclusive data reporting and analysis can improve a wide range of sustainable development outcomes. This can provide disaggregated evidence for policy action in social (SDGs 5 and 10), economic (SDG 8), health (SDG 3), and environmental (SDGs 13, 14 and 15) domains.
Monitor systems-related risks and support transition to renewable solutions: Monitoring asset and system performance informs corrective operation or maintenance activities to reduce energy demand and can build a case for transitioning to green solutions. Monitoring energy use and systemic risk can help inform future investments in localized renewable energy solutions that support more resilient and sustainable operations of digital communications systems.	**Ensure fair pricing to end users to reduce the digital divide:** Price controls (through an improved regulatory framework, increased competitiveness or reduced costs associated with research and innovation, maintenance and operation) can help increase inclusive access to digital communications technology among women and excluded groups, having significant positive outcomes in disaster risk reduction. For example, the growing use of mobile phones and digital devices as well as the widespread use of social media can enable the timely dissemination of critical information, such as early warnings of imminent environmental threats.	**Ensure proactive maintenance and security to combat cyber threats:** Ensure advanced cybersecurity methods in place to prevent the use of digital communications systems for criminal activity and the protection of internet-connected systems such as hardware, software, and data. This includes the exploitation of vulnerabilities in the digital economy to engage in cybercrime through hacking, phishing, identity theft and other means (SDG 16).

Building a green data centre in Honduras

Location: Honduras

Duration: 2016 – 2023

Partners: National Institute for Retirement and Pension of Public Employees and Officials of the Executive Branch

In Honduras, UNOPS is supporting the National Institute for Retirement and Pension of Public Employees and Officials of the Executive Branch to establish an efficient and reliable data centre, which will be systematized by an integrated information system implemented by the project. More specifically, UNOPS is responsible for the design of the building where the data centre is housed, the procurement and supervision of the construction works, as well as the acquisition and start-up of the hardware and related computer, telecommunications and information security systems.

The design for the data centre facility demonstrated compliance with international standards related to infrastructure sustainability and resilience to shocks and stresses. Furthermore, it prioritized solutions that reduce negative environmental impacts and enhance positive impacts during the building's construction and operation. Green building considerations included the building's orientation to enhance the use of natural light and passive heating to reduce electric energy consumption while also reducing air conditioning usage in certain areas that remained protected from the sun. Moreover, radiation shielding panels were integrated in the building facade to prevent heat accumulation and the creation of green areas where vegetation contributes to creating a green indoor microclimate.

Beyond design considerations, procurement activities for air conditioning systems, the electrical generator and internal lighting also prioritized products and solutions that were energy efficient and enabled more sustainable operations in the facility.

Contribution to Honduras NDCs

PARIS2015 COP21·CMP11

- 15 per cent reduction in greenhouse gas emissions compared to the BAU scenario for 2030 for the set of sectors contained in this BAU scenario.
- Significantly reduce emissions related to energy while meeting the needs derived from the population and economic growth.
- To encourage low carbon development that is also resistant to the impacts of climate change, promotes adaptation and generates co-benefits to the population.
- To promote mitigation measures and actions that also increase the adaptation capacity of its population, as well as its natural and productive systems.
- Infrastructure is identified as a priority sector for Adaptation in Honduras NDC, in alignment with its National Strategy for Climate Change. The strategy encourages the design, development, construction and management of appropriate infrastructure and assets in terms of resistance and versatility in order to better adapt them to the current and projected effects of climate change. (p.7)

Key physical and non-physical actions from the project

- Green building considerations such as building orientation to enhance the use of natural light and reduce electric energy consumption, also reducing air conditioning usage in certain areas
- Prioritization of green areas with natural vegetation inside the facility
- Integration of radiation shielding panels to the building facade to block heat concentration inside the building, reducing air conditioning usage
- Data centre design in alignment with international standards related to infrastructure sustainability and resilience to shocks and stresses

Targeted SDGs

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BUILDINGS

Climate mitigation

The buildings sector is among the top contributors to global greenhouse gas emissions, accounting for approximately 17 per cent of global emissions.[14] Continued increases in building emissions are linked to the use of fossil fuels and carbon-intensive electricity for heating and cooking.[14] The implementation of energy efficient building performance standards, material efficiency strategies, and changes to user behaviour will be important factors in reducing the carbon footprint of this sector.

Climate adaptation

Climate adaptation in the building sector is expected to account for 22 per cent of global adaptation costs.[19] Measures such as bio-climatic design, dry-proofing, drainage, efficient heating and cooling systems, and integration of green infrastructure can increase the resilience of buildings and reduce their vulnerability to extreme weather events. This is particularly important to maintain the function of critical infrastructure such as hospitals, schools and markets. These adaptation measures can thus protect development gains and promote economic prosperity in exposed or vulnerable communities.

Sustainable development

The building sector includes infrastructure assets such as hospitals, schools and industrial facilities, which can influence 135 SDG targets across all 17 SDGs (80 per cent).[20] Buildings facilitate a wide range of services: public or community services such as healthcare and education; economic production, industry, and markets; government function and rule of law; housing and shelter; cultural and recreational activities; and so on. In order to provide these functions, buildings require inputs from other infrastructure sectors such as electricity, water and waste removal. Furthermore, they must be connected to users, and to each other, through transport or digital communication infrastructure.

Tables: Key actions to promote mitigation, adaptation and sustainable development in the buildings sector, accompanied by illustrative examples

Buildings - Planning stage

Mitigation	Adaptation	Development
Quantify targets and objectives in the sector: Setting meaningful, quantified and science-based targets and objectives provides transparency and accountability in developing national mitigation pathways. They provide a means to understand the scope of required transformation to meet global climate goals while facilitating easier identification of additional mitigation opportunities. In building planning, policymakers should consider how best to structure and link targets to specific measures and policies (e.g., in terms of energy use, consumption reductions, supply efficiencies).	**Adopt best practice design principles from other countries and contexts:** Transfer knowledge on design principles tried and tested to withstand climate hazards in other countries that already experience similar conditions, including structural design, ventilation, or energy or water systems. This includes integrating backup systems or redundant power supply to ensure that individual buildings and critical assets can continue to provide services in the event that demand increases unexpectedly or wider systems fail.	**Develop policies and sector strategies to align building construction standards to support national and local objectives:** Decisions on the location, size, and type of new buildings and building developments should be determined in alignment with national and regional policies on poverty reduction, housing, health and other areas, as well as with any local or urban development strategies (SDG 11).
Consider interdependencies, systems planning and cross-ministerial cooperation: Integrated infrastructure planning at the national and local levels introduces performance efficiencies into the system, among which is the reduction of greenhouse gas emissions. To reduce the carbon footprint of buildings, and cities in general, planners and other practitioners should coordinate their design and implementation with other sectors, including energy, transport and waste management. This can facilitate cross-sectoral approaches to mitigation through infrastructure system efficiencies.	**Address multiple hazards in design:** Exposure to different natural hazards may imply different design principles - for example, heavy/stiff structures vs. light/flexible structures, which are best suited to different hazards such as wind, storms, or earthquakes. With increased threats from more than one type of natural hazard, structural building design should consider these in an integrated manner.	**Acquire and apply knowledge on differentiated user needs in building planning and design:** Culturally appropriate design solutions help mainstream gender considerations and account for the unique needs of children, the elderly and persons with disabilities; supporting inclusive access to service provision. In the context of buildings, the design of hospitals, schools, commercial and government facilities should account for the specific access needs of users (i.e., provide separate entrances for men and women if culturally appropriate, for example including breastfeeding rooms in public or office buildings) to ensure that vulnerable women, girls, youth and other socially excluded groups will be able to access the facilities (SDGs 5, 10, and 11).

Buildings - Delivery stage

Mitigation	Adaptation	Development
Use prefabrication where possible: Infrastructure components made in factories and assembled on-site provide efficiencies in production, transportation and assembly, resulting in lower greenhouse gas emissions and less embodied carbon.	**Build a business case for natural infrastructure and nature-based solutions:** Natural infrastructure can support resilience in buildings and urban design, but its contributions are not always well-understood in economic terms. Practitioners should aim to convey these potential contributions to investors by assigning value to green or nature-based building components through cost-benefit analysis and assessment of monetary benefits over an extended payback period.	**Incorporate circularity into building design and construction waste management:** This includes the elimination or minimization of waste where possible and the reuse of materials where feasible. These measures can be integrated into building construction to reduce negative environmental outcomes and landfilling (SDGs 12 and 14).
Promote the use of low embodied carbon materials and buy and hire locally where possible: The use of local materials and workforce in infrastructure construction is supported by sustainable procurement processes and reduced embodied GHG emissions related to their transport. In new building developments, policymakers can implement local content requirements for materials as well as the use of local manufacturers and suppliers of components technologies. Community projects can be designed to boost inclusive employment and economic opportunities.	**Mainstream gender and inclusion in climate adaptation initiatives:** Making sure women participate as change agents and entrepreneurs in activities related to infrastructure delivery and climate adaptation is key to ensuring community resilience. In the buildings sector, women should be able to participate in economic activities related to green infrastructure (i.e., preservation of natural ponds for flood mitigation and water storage) upon which buildings' operational resilience rely.	**Ensure formalized labour laws:** Prevent exploitation of vulnerable persons in building construction, such as children or migrant labourers (SDGs 8 and 16).

Buildings - Management stage

Mitigation	Adaptation	Development
Implement monitoring and evaluation processes to improve decision making: Ensuring monitoring and evaluation of the carbon emissions associated with a building, and making data easily available, can improve institutional capacity to make future decisions to support climate change mitigation. For buildings, this includes assessing the alignment of the project with climate goals, its contribution to mitigation targets, the efficiency of resource use to achieve these targets, unexpected positive or negative consequences, and a longer-term outlook. Any lessons learned can be used to inform future decisions and increase building efficiency.	**Develop integrated long-term resilience strategies:** Regular risk assessment for the built environment should inform the development of resilience plans that include measures to safeguard existing buildings—including buildings in informal settlements—as well as new construction against climate hazards.	**Enact human resource policies in operations and maintenance:** Employee safety protocols that prevent incidents related to facilities management help protect workers. Frequent on-the-job training programmes for workers engaged in building operation and maintenance can raise their awareness of existing protocols and procedures, including the identification of health or safety hazards, evacuation procedures, and the function of mechanical and electrical systems (SDG 3).
Explore material repurposing for other uses: Materials from demolished buildings can be reused in infrastructure assets such as roads and buildings, reducing embodied emissions associated with the production of new materials such as concrete and steel.	**Promote asset retrofitting:** Retrofitting assets can allow vulnerable communities to build resilience to climate change. For example, retrofitting existing buildings with efficient appliances promotes more affordable and reliable access to basic services, which may be at risk of greater disruption due to chronic climate change. It can also protect buildings against the acute impacts of more frequent and intense climate shocks. For example, installing on-site energy generation, efficiencies and features such as water harvesting or green roofs can integrate adaptation principles into existing buildings.	**Prioritize disused sites for new construction:** Prioritize existing brownfield sites for new developments, rather than destroying greenfield sites. For example, the use of former industrial sites or disused airports for housing developments or social infrastructure (SDG 15).

Supporting the ‘Our Ocean 2020 Conference’

Location: Republic of Palau
Duration: 2019 – 2021
Partners: Government of Palau

UNOPS supported the Government of the Republic of Palau (Palau) in hosting the Our Ocean Conference in 2020-2021, an annual event that aims to catalyze global action on ocean conservation, hosted for the first time in a Small Island Developing State (SIDS). More specifically, UNOPS supported the government through the construction and rehabilitation of infrastructure facilities that were used to host the conference. Infrastructure works were informed by environmental assessments, mitigation plans and site environmental plans, and prioritized the use of energy-efficient (e.g., solar power lighting), natural and locally sourced materials in an effort to foster economic activity and reduce greenhouse gas emission in the infrastructure lifecycle.

Mangrove trees were used for rafters and roofing posts in the construction of summer huts in the conference venue. The aluminium roof structures, which were replaced by natural materials, were repurposed and dispatched to remote areas, where they were used in the roof structure of schools. Palm leaves were used for thatched roofing of the huts, and locally manufactured tiles and locally sourced clay were used in the construction of footpaths. Beyond their use in the conference, constructed huts will be converted into a community space for Koror City.

Contribution to Palau’s NDCs

PARIS2015 COP21·CMP11

- 22 per cent energy sector emissions reductions below 2005 levels by 2025, with additional reductions coming from the waste and transport sectors.
- Significantly expand Palau’s Cool Roof Programme.
- Increase the share of renewables in the energy mix and increase energy efficiency initiatives.
- Palau’s NDC is grounded in the Palau Climate Change Policy, which highlights the need to enhance adaptation and resilience to the expected impacts of global climate change across all sectors.

Key physical and non-physical actions from the project

- The use of locally-sourced materials reduces transportation-related GHG emissions
- Installation of solar power lighting for pathways
- Infrastructure works for roof improvements and replacements
- Use of mangrove trees and palm leaves for rafters, thatched roofing and roofing posts in the construction of huts

Targeted SDGs

Key action areas for policy makers

Our research offers the following policy recommendations and opportunities:

Traditionally, infrastructure investment has centered on built projects. It is increasingly recognized that natural infrastructure and the enabling environment are also key to delivering infrastructure services that are sustainable, resilient and inclusive. The natural environment, and potential nature-based solutions, will play an important role in providing, protecting and enhancing service delivery in many different sectors, and across the infrastructure lifecycle.

1. **Policies that protect nature and expand the use of nature-based solutions should be prioritized as a means of sustainable service delivery in different sectors, with co-benefits for climate and other aspects of sustainable development. This includes:**

- Protecting and managing natural habitats.
- Regenerating natural habitats that have been impacted by previous infrastructure development.
- Empowering institutions to protect and manage natural resources.
- Incentivizing the uptake of nature-based solutions as alternatives or complements to built infrastructure assets.
- Embedding climate and other environmental considerations into planning processes to understand the needs and capacity of an area to support development.

The enabling environment is important to ensure that infrastructure services are delivered efficiently and equitably throughout society, and that they drive sustainable, resilient and inclusive development.

2. **Interventions in the enabling environment should be prioritized as cost-effective means of creating impact across multiple projects in different sectors and throughout the life cycle. For example:**

- Ensuring that infrastructure service provision adequately meets needs, including among groups that may often be marginalized or excluded.
- Ensuring that there are adequate capacity and resources along the infrastructure lifecycle to realize infrastructure's intended performance.

Minimizing risks and environmental impacts around built infrastructure will be an important and necessary part of ensuring climate-compatible development.

3. **Policies that encourage environmental and social protection and risk reduction should be prioritized, such as:**

- Decarbonizing built infrastructure and the services it supports through integrated planning and working towards well-defined targets.
- Ensuring climate resilience is incorporated during the upstream phases of infrastructure planning and development processes.
- Ensuring that built assets are considered and planned using the principles of the circular economy to minimize embodied carbon, improve resource efficiency, and reduce waste and pollution.

There are opportunities to act across all sectors and the whole of the infrastructure lifecycle (planning, delivery and management) that are key routes to climate action and sustainable development. This involves the different types of practitioners and stakeholders that are involved at each stage, and who can all contribute towards action.

4. **Policies that enhance integration are required to ensure cross-sectoral collaboration**

- Action to establish cross sectoral government coordination of infrastructure in relation to strategic infrastructure planning and the coordination of performance to meet shared goals.
- Prioritization of sectoral interventions that can have positive effects in other sectors. For example, policies that promote energy efficiency and support the development of renewable energy can help to decarbonize other sectors.

5. **Policies (or activities) to ensure that all practitioners (across the lifecycle) are engaged, motivated, incentivized and empowered to target climate action and other sustainable development objectives. For example:**

- Embedding performance targets into plans and projects that are aligned with national development targets and international commitments.
- Exploring and developing best practice and peer learning between practitioners.

Looking across lifecycle stages, we see that most actions involve coordinated upstream interventions from the government.

6. **Policies to ensure that all areas of the life cycle operate effectively**

- Policies to embed a lifecycle approach to assessing and managing environmental, social and economic risks in upstream processes and practices.
- Policies to ensure that the performance of infrastructure is monitored and evaluated across the lifecycle.

Harnessing infrastructure opportunities

2020 marked the start of the Decade of Action to deliver on the Agenda 2030, calling for increased efforts to get countries back on track to meet the SDGs and accelerate recovery from the COVID-19 pandemic. It also marked the year in which parties to the Paris Agreement were requested to submit their updated NDCs, reinstating their commitments to fight climate change. At the national level, governments, financial institutions, businesses and civil society will need to coordinate efforts to fulfill national development plans and make progress towards sustainable development and climate action. This momentum provides an opportunity to steer infrastructure development in a way that supports climate compatible development, as infrastructure investments will be needed to stimulate economic recovery, close access gaps in service provision and protect communities from the impacts of climate change.

In an effort to raise awareness of the role of infrastructure in promoting climate compatible development, UNOPS, UNEP and the University of Oxford have collaboratively developed this publication, providing quantitative evidence of the influence of infrastructure on the achievement of sustainable development, climate mitigation and adaptation. Based on these influences, it advocates for an integrated approach to ensure that the right infrastructure is done well, and that investments in infrastructure development prioritize mutual benefits across these agendas. Through a sectoral analysis and presentation of case studies, this report identifies and demonstrates a variety of sector-specific actions that practitioners can take to foster climate compatible development throughout the infrastructure lifecycle.

UNOPS, the University of Oxford, and UNEP advocate that producing co-benefits across the Paris Agreement and the Sustainable Development agendas requires a shift from the traditional approach to infrastructure towards an integrated approach to infrastructure development. From planners, designers and financiers, to contractors, operators, decommissioning and repurposing specialists, every practitioner in the infrastructure lifecycle plays a role. Their decisions and actions have the potential to maximize gains across development, mitigation and adaptation targets, enhancing synergies and creating mutual benefits. This requires understanding of how the built environment interacts with the enabling and natural environments, offering opportunities to advance climate compatible development.

Tackling some of the world's greatest challenges will require ambitious actions, innovative solutions and integrated decision making. UNOPS, the University of Oxford, and UNEP are committed to the principles of climate compatible development and stand ready to support countries to build a more sustainable, resilient and inclusive future for this generation and the ones to come.

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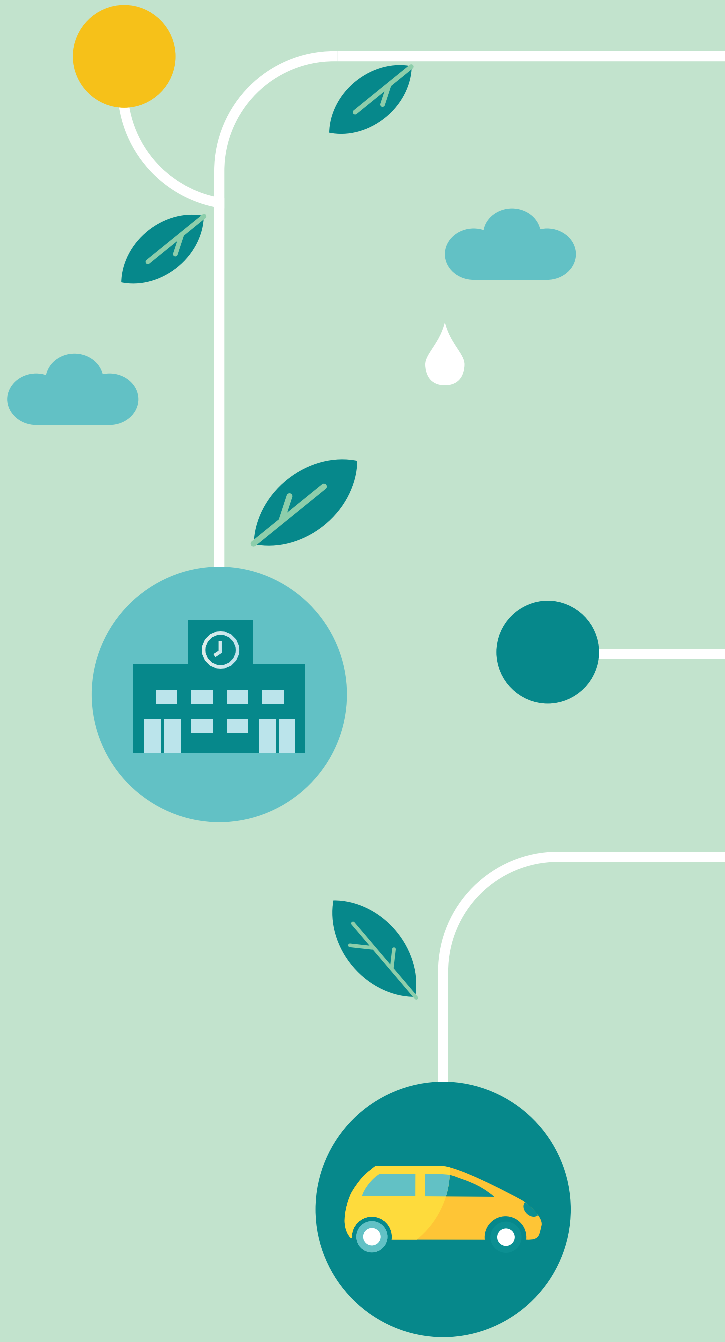

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