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INTEGRATED APPROACHES IN ACTION

A COMPANION TO THE INTERNATIONAL GOOD PRACTICE PRINCIPLES FOR SUSTAINABLE INFRASTRUCTURE

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ABBREVIATIONS AND ACRONYMS

TERM	DEFINITION
ADB	Asian Development Bank
AfDB	African Development Bank
AIIB	Asian Infrastructure Investment Bank
BCA	Building and Construction Authority
BRI	Belt and Road Initiative
CONADI	National Corporation for Indigenous Development
CoST	Infrastructure Transparency Initiative
CO2	Carbon dioxide
DARPAN	Decision Analysis for Research and Planning
EFSI	European Fund for Strategic Investments
EIA	Environmental Impact Assessment
EIB	European Investment Bank
EITI	Extractive Industries Transparency Initiative
EU	European Union
EUR	Euro
FAO	Food and Agriculture Organization of United Nations
FIT	Feed-in Tariff
FOEN	Swiss Federal Office for the Environment
FONAG	Quito Water Fund
FORAGUA	Regional Water Fund in southern Ecuador
GDP	Gross Domestic Product
GGBS	Ground Granulated Blast Furnace Slag
GIS	Geographic Information Systems
GW	Gigawatts
ICQHS	International Center on Qanats and Historic Hydraulic Structures
ICT	Information and Communications Technology
IEA	International Energy Agency
ILO	International Labour Organization
IMF	International Monetary Fund
IRP	International Resource Panel
ITRC	Infrastructure Transitions Research Consortium
ITU	International Telecommunication Union

IUCN	International Union for Conservation of Nature
kWh	Kilowatt-hours
MET	Mass Engineered Timber
NAP	National Adaptation Plan
NDCs	Nationally Determined Contributions
NIPP	National Integrated Planning and Programme Unit
NISMOD	National Infrastructure Systems Model
NUS	National University of Singapore
OCP	Open Contracting Partnership
OC4IDS	Open Contracting for Infrastructure Data Standard
OECD	Organisation for Economic Co-operation and Development
OFC	Optical Fiber Cable
PAGE	Partnership for Action on Green Economy
PMGSY	Pradhan Mantri Gram Sadak Yojana
Powi	Wind farm Poysdorf-Wilfersdorf V
PV	Photovoltaic
RCA	Recycled Concrete Aggregates
R&D	Research and Development
SDE4	School of Design and Environment 4
SDGs	Sustainable Development Goals
SIP	Sustainable Infrastructure Partnership
SMEs	Small and Medium-sized Enterprises
S4H	Solar for Health
TNC	The Nature Conservancy
UNDESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Programme
UNDRIP	United Nations Declaration on the Rights of Indigenous Peoples
UNEA	United Nations Environment Assembly
UNEP	United Nations Environment Programme
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations International Children's Emergency Fund
UNOPS	United Nations Office for Project Services
USAID	United States Agency for International Development
USD	United States dollar
WHO	World Health Organization
ZEB	Zero Energy Building

EXECUTIVE SUMMARY

Integrated approaches to sustainable infrastructure have been well conceptualized, but good examples at the systems-level are less commonly found around the world. With "mega trends" emerging in investment, natural resource and energy use, a normative framework is required to guide and illustrate priority directions.

This collection of case studies illustrates some of the salient aspects of the *International Good Practice Principles for Sustainable Infrastructure*. Documenting integrated approaches in action, it provides real-world examples of the good practices set out in the principles. The report presents ten case studies with broad geographic representation, across sectors, covering diverse forms of infrastructure:

1. **SAINT LUCIA'S NATIONAL INFRASTRUCTURE ASSESSMENT**, highlighting cross-government planning and alignment with the United Nations Sustainable Development Goals and the Paris Agreement.

2. **DIGITAL INFRASTRUCTURE IMPROVEMENTS FOR CONNECTIVITY AND RESILIENCE IN AFGHANISTAN**, addressing the need for flexible solutions to provide citizens and enterprises with opportunities in the face of crisis.

3. **LANDSCAPE-SCALE PLANNING TO SUPPORT CONSERVATION, NOMADIC LIVELIHOODS AND SUSTAINABLE DEVELOPMENT IN MONGOLIA**, detailing upstream measures to safeguard the multiple dimensions of sustainability.

4. **WATER FUNDS TO INSTITUTIONALIZE NATURE-BASED SOLUTIONS IN ECUADOR**, demonstrating the benefits of prioritizing nature for a quality infrastructure service.

5. **SINGAPORE'S GREEN BUILDINGS**, incorporating circularity into construction materials, green technologies and building designs.

6. **"SOLAR FOR HEALTH" IN ZIMBABWE**, integrating two critical sectors to ensure that both social and economic priorities are inclusively balanced.

7. **THE COMMUNITY BENEFITS OF IRAN'S TRADITIONAL *QANAT* SYSTEMS**, revisiting an ancient form of culturally appropriate, sustainable infrastructure that underpins local livelihoods.

8. **DEVELOPING WIND FARMS WITH FISCAL SUSTAINABILITY IN AUSTRIA**, as an example of mobilizing private finance within sound policy and regulatory frameworks.

9. **BALANCING NATIONAL PRIORITIES WITH LOCAL CONCERNS THROUGH TRANSPARENCY AND CONSULTATION IN CHILE**, underscoring the importance of meaningful public participation involving all groups and regions.

10. **INFRASTRUCTURE DATA INNOVATIONS IN MALAWI**, tracing progress in storing and analysing data, and creative ways of sharing it with all stakeholders.

The planet and its people will be shaped by infrastructure investments on an extraordinary scale in the coming decades. The good practices, challenges and lessons learned to be found in the combination of case studies can provide inspiration as governments look to accelerate a green recovery from COVID-19, build resilience to crises and drive towards the 2030 Agenda for Sustainable Development.

INTRODUCTION

INTEGRATED APPROACHES AND THE INTERNATIONAL GOOD PRACTICE PRINCIPLES FOR SUSTAINABLE INFRASTRUCTURE

The concept of sustainable infrastructure is gaining traction globally[1]. As countries seek to address urgent infrastructure gaps, build resilience to crises and boost economic recovery from COVID-19, many are recognizing the need to align plans with the 2030 Agenda for Sustainable Development and the Paris Agreement. Yet "grey" infrastructure has historically dominated the investment landscape. It still represents the majority of current recovery infrastructure spending (Vivid Economics 2021), hence the need for sustainable examples to provide inspiration worldwide.

This report serves as a companion to the *International Good Practice Principles for Sustainable Infrastructure*, highlighting "mega trends" and documenting ten diverse country case studies that illustrate the Principles. The *International Good Practice Principles for Sustainable*[2] *Infrastructure* sets out ten guiding principles for integrating environmental, social, and economic sustainability over the entire infrastructure lifecycle (United Nations Environment Programme [UNEP] 2021). In doing so, it aims to help governments move from simply "doing infrastructure right" to "doing the right infrastructure" that best meets service needs in a sustainable way (UNEP 2021).

Bringing together real-world governance and policy examples as well as technical innovations, this collection of case studies demonstrates good practices and integrated approaches in action, while also noting practical challenges and key insights for policymakers. Both publications underline how integrated approaches can take account of the interlinkages between infrastructure and the UN Sustainable Development Goals (SDGs). Indeed, infrastructure either directly or indirectly influences the attainment of all the SDGs, including 92 per cent of the 169 individual targets (Thacker *et al.* 2018). Furthermore, integrated approaches recognize the complex relationships among sectors, institutions and communities, across space and time, and between different phases of the infrastructure lifecycle (UNEP 2019). They are essential for maximizing synergies and avoiding unnecessary tradeoffs.

FIGURE 1: UN SDGS

Source: UN Development Programme [UNDP] 2020

[1] Sustainable infrastructure systems can be defined as those that are planned, designed, constructed, operated and decommissioned in a manner that ensures economic and financial, social, environmental (including climate resilience), and institutional sustainability, over the entire infrastructure lifecycle (United Nations Environment Programme 2021).

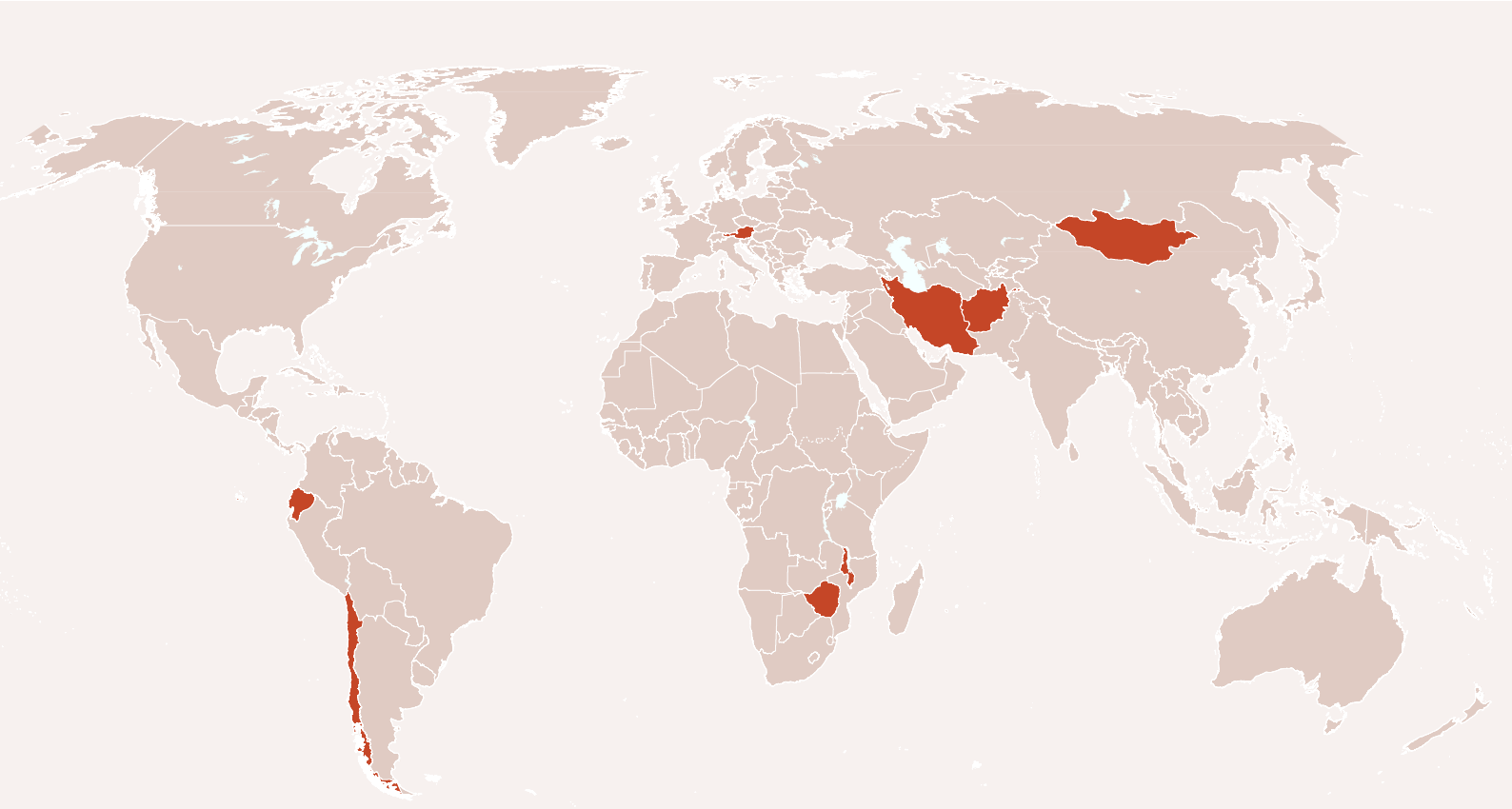
[2] Referred to hereafter as "the Principles"

TEN CASE STUDIES FOR TEN GUIDING PRINCIPLES

The ten country case studies of Afghanistan, Austria, Chile, Ecuador, Iran, Malawi, Mongolia, Saint Lucia, Singapore and Zimbabwe were selected based on their alignment with the ten corresponding guiding principles. Each case highlights specific aspects of the relevant principle (presented at the beginning of each case study). They analyse how the good practices shown can provide inspiration to other countries, as well as challenges and opportunities for advancement or replicability.

The cases were identified and developed during a process involving desk research, consultations with Member States and partner contributions through the UNEP-led Sustainable Infrastructure Partnership (SIP). The report has been prepared for delivery, along with the Principles, at the 5th session of the UN Environment Assembly (UNEA), as part of the implementation of the Sustainable Infrastructure Resolution adopted at the 4th UNEA (UNEP/EA.4/L.6).

The case studies denote broad geographic representation, with a focus on developing countries across different regions. They cover diverse sectors and forms of infrastructure, showcasing innovative modern solutions as well as traditional ones; natural infrastructure as well as built infrastructure; and both "hard" and "soft" infrastructure. Systems-level good practices are examined, as opposed to individual project-level examples, exploring the networks of assets, environments, institutions and knowledge that comprise a complex infrastructure system. The cases therefore illustrate good practice at scale and "upstream" in the decision-making process. As outlined in the Principles document, upstream, systems-level interventions are an intrinsic feature of the integrated approaches that are required to achieve wholly sustainable infrastructure.



MEGA TRENDS

Over the coming decades, large Asian countries will be the epicentres of unprecedented levels of infrastructure spending. An estimated 46 trillion USD will be invested in infrastructure across the continent as a whole over the next two decades (Global Infrastructure Hub 2019). The region has already recently experienced widespread population growth and economic transformation and, as the GDPs of China and India are set to resume strong growth (International Monetary Fund [IMF] 2021), their governments are expected to spend up to 8 per cent or more of GDP on infrastructure (Fay *et al.* 2019). With the Belt and Road Initiative (BRI) as a *chapeau* and additional driver of many ongoing and projected investments, infrastructure is being promoted as a tool to unleash an era of trans-continental connectivity, trade, productivity and growth.

In this context, many infrastructure investments across the region have focused on large projects in the transportation, energy and telecommunications sectors. For example, China built the world's largest power station in the Three Gorges Dam and is significantly expanding its construction of data centres and 5G networks (China Dialogue 2020a). In India, major ports such as that of Vadhavan have been approved to support the shipping industry and facilitate manufacturing activity. The new 20-metre deep-draft facility – a necessity if a port authority intends to accommodate the largest container ships in the world – has a projected capacity of 15 million metric tons per year by 2023 (Business Standard 2020a). The capacity will hit its peak of 254 million metric tons per year by 2038 (Business Standard 2020b). India is also positioned as the third largest

country in the world in terms of energy investments; coal still dominates electricity generation but solar occupies an increasingly significant space in its energy mix (Sarangi 2018, pp. 3-16). In Southeast and Central Asia, urban and built infrastructure is being rapidly introduced to meet the needs of changing demographics.

While such investments promise significant economic benefits, the natural resources and land required to fuel and accommodate the trends are vast, as indicated in Figures 8 and 9. Equally, the direct environmental and social impacts of large built infrastructure projects will be profound. In addition to immediate physical impacts, if investments lock countries into unsustainable infrastructure, technology and patterns of resource extraction, they will have long-lasting negative impacts that may undermine countries' ability to achieve the SDGs. However, among the huge sums of money being spent, there are good examples of integrated approaches to sustainable infrastructure across the large economies in the region, which represent infrastructure at scale but with a careful focus on the future.

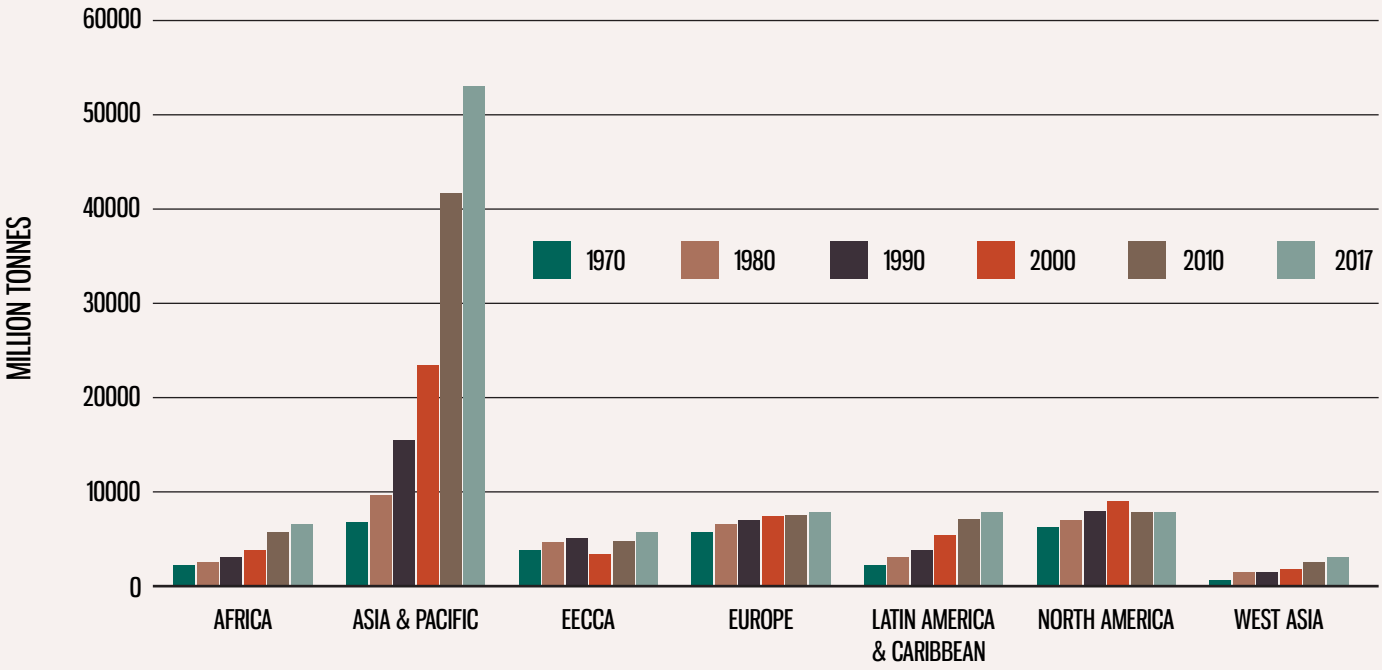


FIGURE 2: REGIONAL MATERIAL EXTRACTION, 1970-2017, MILLION TONNES

Source: adapted from International Resource Panel [IRP] (2017, p.29)

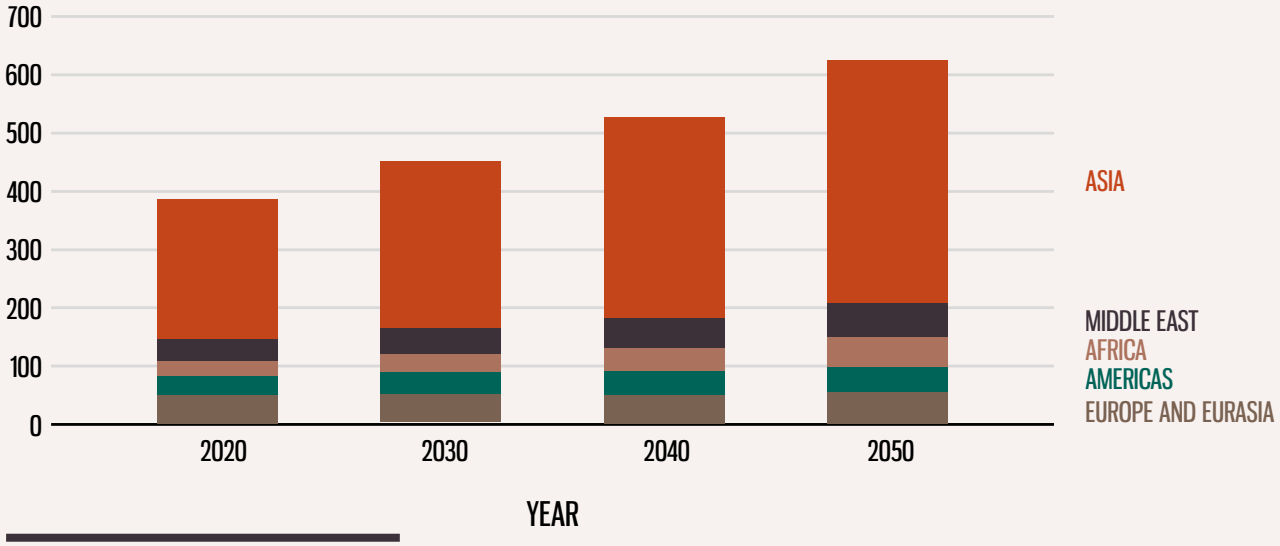


FIGURE 3: PROJECTED GLOBAL PRIMARY ENERGY CONSUMPTION BY REGION, 2010-2050 (QUADRILLION BRITISH THERMAL UNITS)

Source: based on United States of America, Energy Information Administration (2019)

To set a framework for China's continued growth and infrastructure expansion, the government has developed a comprehensive land use planning system, covering ecological needs, agriculture, cities and major infrastructure. For example, between 2010 and 2020, the government designated over a quarter of China's land as lying within ecological conservation red lines. This forms part of an effort to protect endangered species and their habitats, with simultaneous benefits in terms of the prevention of natural hazards and provision of ecosystem services (China Dialogue 2020b). The red lines and the wider land use planning system should help ensure that ongoing construction does not lead to biodiversity losses and other negative environmental impacts.

Similarly, India has formulated renewable energy planning tools in the context of its energy investments. These are designed to optimize the siting of renewable energy infrastructure assets since, per unit of energy, renewables are still associated with substantial terrestrial footprints. The Center for Study of Science, Technology and Policy developed the Decision Analysis for Research and Planning (DARPAN) tool, which integrates economic and technology criteria and will incorporate environmental and social criteria when evaluating the impact of policy choices concerning renewable energy infrastructure siting (The Nature Conservancy [TNC] 2018). The updated tool will analyse dimensions including forest cover, low-carbon development, biodiversity and energy access. For transport infrastructure, the Pradhan Mantri Gram Sadak Yojana (PMGSY) programme has improved social inclusion and contributed to poverty reduction via all-weather road connectivity and maintenance on a national scale (International Labour Organization [ILO] 2017). Over 600,000 kilometres of resilient roads[3] have been constructed (India, National Informatics Centre 2020), covering all states, and increasing the employment rate in some by 5.5 percentage points between 2009 and 2017 (in habitations connected after 2009) (World Bank 2019, p. 41).

[3] Roads have been engineered with environmentally optimized and climate resilient designs, and bring dependable connectivity to services and markets.

Among Indonesia's growing urban centres, there are inspiring examples of cases where planners have eschewed grey, resource-intensive solutions in favour of effective natural infrastructure. In northern Java, mangrove ecosystems have been protected and restored along 20 kilometres of coast for flood defence (Kapos *et al.* 2019). "Hard" infrastructure such as dams and sea walls had proven expensive and ineffective due to ground conditions. Instead, complemented by financial incentives for the restoration measures, the programme successfully helped protect residents and aquaculture infrastructure from storms, floods and sea-level rise. At the same time, the natural infrastructure delivered co-benefits of increased fisheries productivity and associated incomes, as well as enhanced biodiversity and carbon sequestration, while also saving costs in the process (Kapos *et al.* 2019).

Finally, as part of connectivity efforts across the region, Uzbekistan has been electrifying railway routes served by high-speed trains (Asian Infrastructure Investment Bank [AIIB] 2020; UN 2020). This cleaner mode of public transport has reduced travel time between major and distant cities, cut transport costs, and reduced emissions. For example, travel time from Bukhara to both Tashkent and Khiva will be cut by more than half (AIIB 2020). The upgrades also support trade into the future, with investments targeting a regional corridor carrying 1.6 million tons of humanitarian relief goods to Afghanistan (UN 2020). This efficient and integrated approach highlights how one form of infrastructure can simultaneously deliver multiple social, economic and environmental benefits.

Of the total urban infrastructure projected to exist worldwide in 2050, over 60 per cent has yet to be built, presenting an extraordinary opportunity to shape the future (IRP 2018, p. 4). The challenge will be to ensure that the types of examples outlined here, and in detail through the ten individual case studies, become the norm in those parts of the world where infrastructure investment will be most intense.

CASE STUDIES

SAINT LUCIA'S NATIONAL INFRASTRUCTURE ASSESSMENT

GUIDING PRINCIPLE 1: STRATEGIC PLANNING

Infrastructure development decisions should be based on strategic planning that is aligned with global sustainable development agendas and supported by enabling policies, regulations and institutions that facilitate coordination across departments and both national and sub-national levels of government and public administration.

BACKGROUND

The small island Caribbean country of Saint Lucia faces major challenges to ensure its future prosperity. In the face of increasing climate risks, the island's geography means it is exposed to natural hazards including flooding and landslides. These threats pose a particularly high risk to the lives and livelihoods of those living in low-income or more vulnerable communities. On a national scale, the country faces persistent economic challenges common to small island countries (Adeoti *et al.* 2020), such as limited fiscal capacity and flexibility to address investment requirements, due to its size and reliance on imports (Saint Lucia, Ministry of Education, Innovation, Gender Relations and Sustainable Development 2019). Threats to its natural environment may also have serious social or economic consequences that can undermine long-term aspirations for sustainable development. For example, the impact of Hurricane Tomas in 2010 cost 43.4 per cent of Saint Lucia's Gross Domestic Product (GDP) (Saint Lucia, Ministry of Education, Innovation, Gender Relations and Sustainable Development 2018, p. 18).

Central to addressing these challenges is the country's infrastructure, which provides services including energy, water, transport, waste management and flood protection, as well as facilities such as schools, hospitals and markets. However, the long-term demand for these services is projected to change with population growth and the pursuit of economic objectives in key sectors, including tourism and agriculture. The COVID-19 pandemic has disrupted the island's tourism as well as shipping and aviation, and exemplifies how future uncertainties could greatly impact Saint Lucia's national development.

The need for integrated long-term planning across infrastructure sectors is recognized by the national government and has been formalized through the creation of the National Integrated Planning and Programme Unit (NIPP) within the Department of Finance in 2018.

NATIONAL INFRASTRUCTURE ASSESSMENT

Saint Lucia has developed a framework for a "National Infrastructure Assessment", which equips decision makers in government with a robust approach to infrastructure planning (Adshead *et al.* 2020)[4]. It is designed to ensure that social, economic and environmental needs are all met in a range of future scenarios. The assessment is based on the National Infrastructure Systems Model (NISMOD), developed by the University of Oxford-led Infrastructure Transitions Research Consortium (ITRC). It consists of a series of steps which assess a country's current and future infrastructure needs and then provide recommendations on how those needs can be met.

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The National Infrastructure Assessment estimates Saint Lucia's future infrastructure needs using cross-sectoral analysis, informed by data collected and strategically prioritized in collaboration with stakeholders. The assessment delivers recommendations for how these needs can be met in alignment with national priorities and international commitments, such as the UN Sustainable Development Goals targets and climate change mitigation commitments under the Paris Agreement. Additionally, the assessment provides a means to prioritize adaptation measures across the island, using spatial data on climate change-driven hazards. This is achieved by assessing the risk that these hazards pose to economic, social, and natural environment assets, and the extent to which they may impede progress toward the SDGs.

STRATEGIC INFRASTRUCTURE PLANNING

Long-term strategic planning in Saint Lucia focuses on four interdependent infrastructure sectors: energy, water supply, wastewater and solid waste. It analyses future changes in demand for these sectors determined by trends in the resident population and tourist arrivals. For the first assessment during 2019-20, comprehensive data were collected on a set of defined infrastructure assets in Saint Lucia, and the government determined the key drivers influencing the provision or demand for infrastructure. Modelled outcomes then provided the basis for decisions and recommendations concerning the type, capacity, location and sequencing of proposed infrastructure interventions.

Saint Lucia is beginning to move away from siloed infrastructure governance towards an integrated approach, whereby national priorities and targets can be more effectively pursued with the input of different stakeholders in government, research institutions and the private sector. Integrated modelling of infrastructure performance allowed decision makers in Saint Lucia to better assess and account for efficiencies and trade-offs in achieving national development objectives. For example, Figure 2 shows increased demand across the infrastructure system from projected tourism growth through the expansion of two international transport hubs. It illustrates potential cross-sectoral solutions which would reduce pressures on resource use and the island's existing solid waste, energy, water supply and wastewater sectors.

[4] This case study is a summarized version of the UNOPS publication cited here.

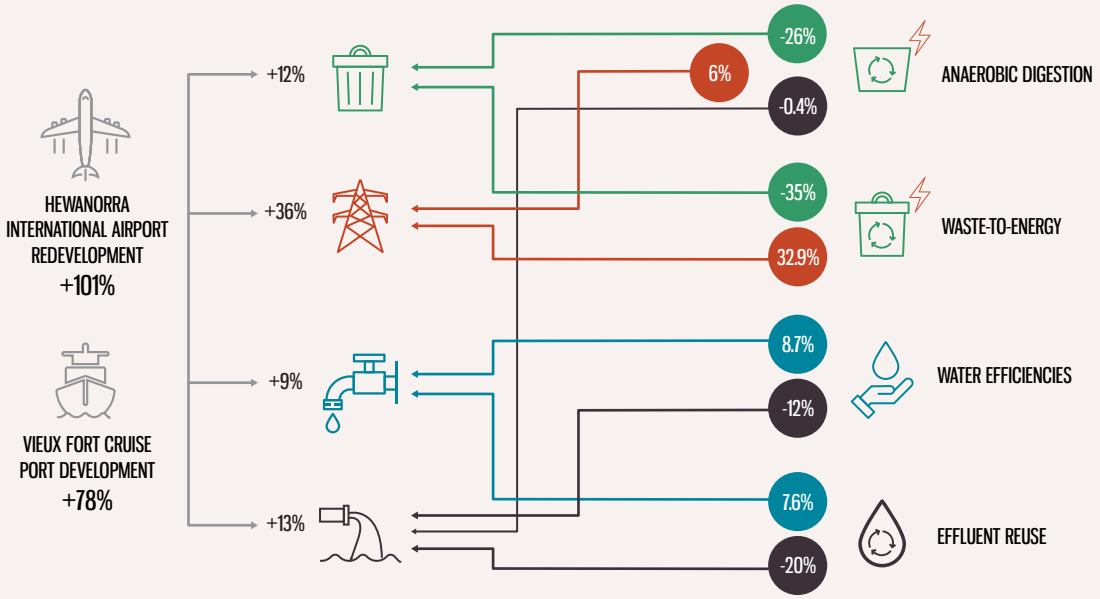

FIGURE 4: IMPACT OF SAINT LUCIA'S AIR AND CRUISE PORT EXPANSIONS ON VISITOR NUMBERS AND INFRASTRUCTURE NEEDS BY 2050, AND POTENTIAL CROSS-SECTORAL SOLUTIONS

Source: Adshead *et al.* (2020)

ALIGNMENT WITH GLOBAL SUSTAINABLE DEVELOPMENT AGENDAS

The National Infrastructure Assessment provides a basis for Saint Lucia's future development vision and helps to define the infrastructure investments and policies that may be required to achieve it. The infrastructure modelling used to develop long-term, cross-sectoral infrastructure portfolios was undertaken using key targets set in alignment with national objectives, as well as the SDGs and the Paris Agreement.

To take account of mitigation targets, the model included Saint Lucia's stated emission reduction targets in its Nationally Determined Contributions (NDCs). These define the type and size of interventions that could be implemented in a long-term sustainable infrastructure strategy. To facilitate the integration of climate change adaptation into development planning, Saint Lucia has developed a National Adaptation Plan (NAP), containing 271 adaptation measures aligned with the SDGs. As a result of the National Infrastructure Assessment and accompanying stakeholder training, these measures can be better prioritized and implemented based on the latest data and evidence.

While in the broader sense infrastructure has the potential to influence 92 per cent of SDG targets (Thacker *et al.* 2018), the recommendations made as part of the assessment are directly relevant to the achievement of several SDG targets focused on energy and water provision, the natural environment, poverty reduction and sustainable waste management (SDG targets 1.4, 6.1, 6.2, 6.3, 6.4, 7.1, 7.2, 11.6 and 12.5). In addition to the main analysis, the long-term infrastructure needs for several planned focus projects were assessed. These projects have the potential to contribute to the achievement of a broad range of SDG targets relating to economic growth, health and inequality (SDGs 2, 3, 8, 9, 10, 13 and 17). Figure 5 shows the SDGs potentially influenced by actions within the National Infrastructure Assessment.

Source: Adshead *et al.* (2020)

FIGURE 5: SDGS POTENTIALLY INFLUENCED BY ACTIONS WITHIN SAINT LUCIA'S NATIONAL INFRASTRUCTURE ASSESSMENT

COORDINATED POLICIES, REGULATIONS AND INSTITUTIONS

The assessment includes recommended policy and regulatory measures across all sectors, including energy efficiencies through building codes and appliance labelling; measures to improve metering and leakage reduction in the water supply network; and charges and deposit refunds designed to reduce waste generation by over 12 per cent (Adshead *et al.* 2020, p. 31). The implementation of such policies, along with revised building codes, will contribute to increased resilience.

Due to the different mandates and agendas of Saint Lucia's infrastructure-related ministries, cross-ministerial coordination initially posed a challenge for the country. However, the creation of the NIPP as a nodal agency helped facilitate the assessment process in an integrated manner. The NIPP is now responsible for defining the overarching vision, strategy and roadmap for the development of Saint Lucia's national infrastructure agenda. During the 2019-20 assessment, contributions from a variety of institutions were incorporated, including ministries, other government agencies, academia and the private sector. Continuous on-the-job training was provided to the NIPP team during the assessment, such that the study was co-produced with them, in order to facilitate national ownership. A training workshop on the analysis tools was delivered to around 30 government officials from the Ministry of Finance and other departments, with the aim of building the government's overall capacity for sustainable, long-term infrastructure planning.

There was limited available data for some areas of interest, such as the costs associated with selected infrastructure portfolios. Best estimates were used for the purpose of the assessment. However, training on the use of the tool enables government officials to incorporate new data as and when it becomes available and should therefore strengthen future assessments.

REPLICABILITY

NISMOD methodology is replicable and has been applied successfully in different contexts – including Curaçao (Adshead *et al.* 2018), Palestine (Ives *et al.* 2019) and the United Kingdom (Hall *et al.* 2017) – in order to support governments moving towards integrated national infrastructure planning. It has also been used to support resilience planning in Argentina, China, New Zealand, Tanzania and Viet Nam.

The Saint Lucia experience demonstrates the instrumental role of integrated, strategic infrastructure planning in helping countries undertake evidence-based decision-making. The National Infrastructure Assessment addresses uncertainty by projecting a range of different growth scenarios into the future, and the ongoing disruption to the tourism, aviation and shipping sectors caused by the pandemic can be incorporated in the model to inform decision-making and economic recovery from COVID-19. The targets aligned with national objectives and international development agendas are adaptable to changing national priorities, such as a sharper focus on health or economic indicators to combat the devastating impacts of the pandemic.

KEY INSIGHTS

> The National Infrastructure Assessment equips the government with a step-by-step framework to prioritize and achieve long-term development visions.

> The National Integrated Planning and Programme Unit (NIPP), within the Department of Finance, is now responsible for coordinating Saint Lucia's infrastructure agenda across institutions.

> The National Infrastructure Assessment includes policy and regulatory recommendations across all sectors, which achieves two critical goals: 1) it reinforces the degree to which infrastructure supports national and global objectives; and 2) it promotes an enabling environment where sustainable infrastructure can flourish.

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DIGITAL INFRASTRUCTURE IMPROVEMENTS FOR CONNECTIVITY AND RESILIENCE IN AFGHANISTAN

GUIDING PRINCIPLE 2: RESPONSIVE, RESILIENT, AND FLEXIBLE SERVICE PROVISION

Infrastructure planning and development should be based on a good understanding of infrastructure service needs and informed by the diverse options available to meet those needs. This includes understanding and managing the changing demand, and meeting needs through renovating or rehabilitating existing infrastructure before investing in new infrastructure. Systems-level planning of Infrastructure projects should promote synergies for improved connectivity, which can lead to improved productivity, efficiency, sustainability, and spillover benefits of investment. Flexibility and resilience should be built into infrastructure plans to allow for changes and uncertainties over time, and plans should be updated.

BACKGROUND

As a landlocked and mountainous country, Afghanistan faces significant connectivity challenges. Around three quarters of the population live in rural and often remote areas (World Bank 2019), and only 11 per cent of the population use the internet (World Bank 2017). The cost of the internet itself also represents an ongoing issue. Since Afghanistan is landlocked and without submarine cables, it has been subject to transaction fees from neighbouring countries: Pakistan, Iran and Turkmenistan (International Telecommunication Union [ITU] 2018).

After decades of protracted conflict and limited access to markets, many citizens cannot access government services, and face limited livelihood options. In recent years, in an effort to meet service needs and provide economic opportunities, Afghanistan has begun integrating digital infrastructure into strategic national planning and has taken steps to increase connectivity. In contexts of crisis – including conflicts and pandemics – digital infrastructure holds the potential to provide sustainable and flexible solutions and foster resilience if developed in a sensitive and culturally appropriate fashion.

Improvements in digital infrastructure in Afghanistan feed into the wider "Digital Silk Road" concept – a thread of the BRI which seeks to improve connectivity across continents through infrastructure investments. The Digital Silk Road aims to expand the regional knowledge economy in Central, South and Southwest Asia. In Afghanistan, through government planning and implementation of projects such as "Digital CASA", the focus of "hard" and "soft" digital infrastructure improvements is on four components (Afghanistan, Ministry of Communications and Information Technology 2019a): domestic and regional connectivity, e-government, enabling environment (policy and regulatory frameworks) and strengthening institutions.

ADDRESSING THE NEED FOR CONNECTIVITY

The region's economic and political actors have established that cross-border trade in knowledge, e-commerce and services across Central and South Asia holds significant economic potential. However, these economic activities require supporting digital infrastructure. Afghanistan has identified the need to connect priority sub-national regions and groups to affordable internet, bring down the overall cost of internet services and connect public institutions digitally (Afghanistan, Ministry of Communications and Information Technology 2019a). One short-term goal has been to connect the remote Badakhshan and Bamyan Provinces with the national Optical Fiber Cable (OFC) Network.

Importantly, to take advantage of new digital infrastructure, citizens and small and medium-sized enterprises (SMEs) also require the necessary education and skills, after consultation. Currently, Afghanistan's adult literacy rate is only 31.7 per cent (UNDP 2020). At the end of 2019, the Ministry of Communications and Information Technology launched an "Empowerment Training Program for Women in the Digital Era" through collaboration with universities, to equip women with digital skills and knowledge and to enhance economic opportunities (Afghanistan, Ministry of Communications and Information Technology 2019b).

Afghanistan's mountainous and inaccessible landscape, and lack of transport infrastructure, also call for flexible solutions for public services and government operations. E-government forms a key component of Afghanistan's digital infrastructure improvement plans. The plans focus on establishing common e-services enablers to offer communities and SMEs access to information and government services through their mobile devices (Afghanistan, Ministry of Communications and Information Technology 2018, pp. 16-19). Similarly, the "Electronic Government Resource Center Phase II" project has already enhanced the policymaking capabilities of Afghanistan's Ministry of Communications and Information Technology. Through this project, the government has used information and communications technology (ICT) to improve operations, increase transparency, and promote efficient service delivery. The e-government solutions have made government offices more competent to respond to citizens' service requests, and allowed them to implement key legislative, policy and strategic reforms needed for a more vibrant private sector. The project has trained 300 Afghan government employees in e-government and information technology (United States Agency for International Development [USAID] 2019).

INTEGRATING DIGITAL INFRASTRUCTURE INTO STRATEGIC NATIONAL PLANNING

Afghanistan's infrastructure needs are well reflected in its national plans. ICT and regional connectivity stand as central pillars of the Ministry of Finance's national infrastructure plan (Afghanistan, Ministry of Finance 2016). The latest "ICT Policy for Afghanistan (2018-2022)" sets a "digital agenda for development and social change", laying out multiple uses for digital solutions – not only e-business and e-government, but also e-environment and natural resources management, e-agriculture, e-health and e-education (Afghanistan, Ministry of Communications and Information Technology 2018). This emphasizes an integrated approach, with digital solutions mainstreamed across multiple sectors. It represents progress from earlier ICT policies which did not, for example, detail environmental and natural resource applications (Afghanistan, Ministry of Communications and Information Technology 2008).

Moreover, Afghanistan has strived to create an enabling environment for these applications of digital solutions and ICT markets. This includes measures to harmonize regulations with neighbouring countries, removing monopolies and assessing and modernizing existing ICT legal frameworks, to "crowd in" private investment in the sector. The ongoing conflict, however, presents a significant challenge in achieving these aspirations, and continues to discourage investment and disrupt the implementation of projects (Asian Development Bank [ADB] 2020).

ENVIRONMENTAL MANAGEMENT AND RESILIENCE

The e-environment and natural resources management plans focus on applying digital infrastructure to enhance the planning, management and monitoring capacity of the Ministry of Mines and the Ministry of Environment (Afghanistan, Ministry of Communications and Information Technology 2018). The plans also set out objectives to develop environmental databases and Geographic Information Systems (GIS) repositories and maps for use across government, with a view to managing the country's natural resources more efficiently.

Digital infrastructure brings its own environmental sustainability challenges, including those associated with increased demand for natural resources such as lithium (needed for mobile device batteries), energy requirements, e-waste and the potential environmental impacts of cable networks. In developing the required "hard" digital infrastructure, OFC networks were designed to be co-located among existing and future roads. This has minimized the development of physical assets in new areas, avoiding potential negative environmental impacts such as vegetation removal, biodiversity loss and interruption of hydrological regimes and animal migratory routes, as well as damage to Afghanistan's rich cultural heritage sites (Cabral 2017). Overall, the plans for OFC networks in the Digital CASA project cover 3,132 km of cable, consisting of 1,401 kilometres for provincial connectivity and redundancy in the domestic network, and 1,731 kilometres to provide network redundancy for regional connectivity (Cabral 2017, pp. 88-89). This built-in redundancy is an important aspect of resilience to shocks and crises, in a context where physical infrastructure is often damaged by climate-related hazards and conflict.

REPLICABILITY

Afghanistan's digital infrastructure projects are in the process of implementation and face significant challenges, but the good practices in its national plans and systems-level interventions also have broader relevance. Many countries in the world still lack digital infrastructure and internet coverage; in some, just 1 per cent of individuals use the internet (World Bank 2017). This greatly constrains the types of jobs available to citizens, but also determines the flexibility of those jobs as well as of services such as education and healthcare.

The COVID-19 pandemic has underlined the importance of integrated planning for resilience, and demonstrates the value of investing in digital infrastructure for flexible working arrangements, among other benefits. Globally, millions of occupational and educational activities have successfully shifted onto virtual platforms, allowing people to continue to pursue livelihoods while potentially reducing the need for forms of built infrastructure with larger ecological footprints such as offices and transport infrastructure.

Digital infrastructure improvements can be incorporated further into countries' strategic plans as part of a green and resilient economic recovery from COVID-19. With rigorous sustainability and viability assessments, digital solutions may offer alternatives to physical infrastructure assets. At the same time, the potential negative environmental and social impacts associated with digital solutions – such as consumption of natural resources and energy, or loss of traditional jobs and practices – must also be fully assessed and mitigated in Afghanistan and other countries.

KEY INSIGHTS

> Amid challenges, Afghanistan has understood the shifting landscape of trade and education, and identified digital infrastructure as a critical foundation for economic opportunity across and within regions. The government has launched a digital training programme for women while also promoting e-government that is accessible to SMEs and citizens with mobile devices.

> The ICT Policy for Afghanistan sets a digital agenda for the country, promoting connectivity and synergies across multiple sectors.

> Afghanistan is harmonizing digital regulations with those of neighbouring countries, and has encouraged private investment in the sector. OFC networks will be co-located along existing and future roads, reducing environmental impacts while also contributing to a more resilient system.

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LANDSCAPE-SCALE PLANNING TO SUPPORT CONSERVATION, NOMADIC LIVELIHOODS AND SUSTAINABLE DEVELOPMENT IN MONGOLIA

GUIDING PRINCIPLE 3: COMPREHENSIVE LIFECYCLE ASSESSMENT OF SUSTAINABILITY

Infrastructure's environmental, social, and economic sustainability should be assessed as early as possible in the planning and preparation cycle, covering both financial and non-financial factors across interdependent projects, systems and sectors over their lifecycles. Assessments should consider the cumulative impacts on ecosystems and communities as part of a broader landscape, beyond a project's immediate vicinity, and take account of transnational impacts.

BACKGROUND

Located between China and Russia in northern Asia, Mongolia is the world's least densely populated and largest landlocked country: it has a total land surface of 1.564 million kilometres² and an estimated population of over 3.3 million (UNDP 2020). Approximately 32 per cent of the population is nomadic or semi-nomadic, while more than 60 per cent of Mongolians live in urban areas (United Nations Educational, Scientific and Cultural Organization [UNESCO] 2018, p. 3). Due to its unique and complex geology, Mongolia is a leading producer of commodities such as coal and copper. Exploration and extraction are associated with large-scale infrastructure development across the country, which is also linked to the China-Mongolia-Russia economic corridor (Zoï Environment Network 2020). On average, Mongolia's mining sector accounted for 23.03 per cent of its GDP for the last three years (Extractive Industry Transparency Initiative [EITI] 2020), although mineral exports were significantly impacted by COVID-19 (UN 2020).

Mongolia's landscape broadly divides into four regions: the Altai mountains in the west; the Gobi Desert in the south; the vast steppe in the east; and taiga forests in the north. These landscapes support a diverse and globally significant flora and fauna, ranging from medicinal plants to the Asiatic wild ass. Land degradation is the country's most serious environmental problem, accelerating desertification and affecting Mongolia's remarkable ecosystem integrity and biodiversity. Over 70 per cent of Mongolia's rangelands are degraded to some extent, and over 75 per cent of the country's pasturelands suffer from degradation (Nyamtseren *et al.* 2013, p. 9). Decreased carrying capacity and productivity of land resources directly impact the nation's productivity and its efforts to achieve equitable and sustainable development. The main causes of land degradation are mining, infrastructure development and overgrazing, exacerbated further by climate change.

LANDSCAPE-SCALE PLANNING

Despite Mongolia's low population density, infrastructure development for mining and transportation represents a significant threat to Mongolia's fragile, semi-arid ecosystems. Without landscape-scale planning and corresponding mitigation measures to protect headwater areas and wildlife corridors, the unchecked expansion of economic infrastructure is not sustainable. It also risks undermining traditional rural livelihoods which rely on healthy ecosystems for nomadic herding.

The Government of Mongolia, with the assistance of TNC, has developed landscape-scale plans for the country that take into account biological resources, ecosystem services, climate change considerations and projected development. These plans integrated multiple values and objectives from the outset. They were formulated in accordance with a mitigation and offset policy that is helping Mongolia minimize the impacts on wildlife habitats and guarantee the long-term delivery of ecosystem services, while still allowing key economic sectors to flourish through new infrastructure development.

UPSTREAM INTERVENTIONS FOR CONSERVATION AND MITIGATION

As part of upstream conservation planning, the Government of Mongolia carried out an ecoregional assessment process, using a stakeholder-driven, integrated approach that eventually established conservation priority-setting maps for the entire country. Ecoregional assessment is a transparent, data-driven tool for identifying a set of places or areas that, taken together, represent the majority of native species habitats, natural communities and ecological systems found within a given target area. The assessment can support landscape-scale plans to produce a conservation portfolio of priority sites for conservation planning (Cameron, Cohen and Morrison 2012; Goldstein *et al.* 2017).

This approach has supported Mongolia's conservation objectives and informs how future economic development can be planned and designed to avoid and minimize impacts across the landscape, consistent with the mitigation hierarchy (Heiner *et al.* 2019). Nomadic herders benefit from conservation planning, as their livelihoods and cultural heritage depend upon the pastures provided by Mongolia's sparsely inhabited steppe (ADB 2013). The government initially implemented the approach in the eastern steppe region, followed by the South Gobi region, which was facing significant economic development challenges. Two additional ecoregional conservation plans were developed by 2017 to complete the process for the whole country.

During the planning process, the government also developed regulations and guidance on mitigation for addressing infrastructure projects. In 2012, the Mongolian Parliament amended the Environmental Impact Assessment (EIA) law to require biodiversity offsets for all mining and oil development projects (Mongolia, Parliament 2012). In 2014, the Ministry of Environment and Green Development developed a Guidance Handbook for implementing biodiversity offsets. To further support transparent and replicable implementation, the Ministry of Environment and Green Development, with the support of TNC, has developed a web-based Mitigation Design GIS Toolset that identifies impacts and calculates mitigation and offset requirements (TNC 2016a). The toolset includes an offset siting function. This identifies potential offset sites by comparing the ecosystem composition of the development footprint with portfolio sites. The function allows for identification of sites with similar ecosystem compositions and within several possible spatial extents, defined by political units (districts/*soums*, provinces/*aimags*), within the bio-geographic study areas.

Mongolia's integrated planning framework moves beyond a reactive, project-by-project approach towards a proactive, regional vision that is consistent with broader conservation and sustainable development goals. It helps project developers avoid sensitive areas, creates incentives for companies to locate infrastructure in the least harmful areas, and allows government officials and the broader public to more transparently assess a project's impacts.

CAPACITY FOR RIGOROUS ASSESSMENTS

One of the main challenges found in developing and implementing a landscape-scale joint conservation and mitigation planning process is the availability of data. The process depends on existing data that is often coarse and incomplete, meaning that regular review of the planning process by an expert working group is essential throughout.

While the development of the Mitigation Design Tool provided a simplified method for evaluating project impacts and mitigation measures, capacity-building among government authorities in Mongolia remains a critical challenge, due to the high turnover of civil servants. However, over 100 government officials have been trained in mitigation requirements to secure the implementation of the rigorous environmental licensing procedures, and "train-the-trainers" programmes have been established to ensure knowledge continuity (TNC 2016b). Many economic development decisions worldwide can be made at a sub-national level. This means that effective planning processes need targeted capacity-building programmes to be provided for government officials at multiple levels, in order to ensure that plans can be implemented.

Building capacity for upstream, integrated, landscape-scale infrastructure planning can support several UN SDGs and their associated targets (UN 2020). Mongolia's efforts help protect freshwater (SDG 6 (Clean Water and Sanitation)) by identifying and safeguarding headwater areas and wetlands in order to maintain Mongolia's scarce water resources. By protecting grasslands and implementing offsets that support rangeland management, planning contributes to food security (SDG 2 (Zero Hunger)), reduces land degradation, and supports restoration and conservation (SDG 15 (Life on Land)). Mongolia's experience is also a good example of promoting strong institutions by increasing transparency of decision-making, reducing the potential for conflict, and strengthening government actions (SDG 16 (Peace, Justice and Strong Institutions)). The approach can also improve the siting of infrastructure, thereby contributing to SDG 9 (Industry, Infrastructure and Innovation).

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REPLICABILITY

Mongolia's experience with landscape-scale planning can serve as a model for other countries to expand protected areas and improve implementation of the mitigation hierarchy and offset policies. Countries can draw on Mongolia's processes to improve the sustainability of built infrastructure, while conserving natural capital essential for community livelihoods. Adopting landscape-scale planning offers a specific means of aligning economic recovery packages with social and environmental objectives in the post-COVID-19 era. It also helps to reduce or avoid habitat fragmentation, leading to lower rates of interaction between humans and disease-carrying animals.

TNC has adapted and created similar applications to support other governments including in Australia, India and Indonesia. All the landscape-scale planning approaches serve the same purpose: empowering decision makers with the information needed to assess proposed development projects for potential environmental and social impacts.

KEY INSIGHTS

- Mongolia's landscape-scale plans incorporate multiple categories of resources, which helps decision makers account for and minimize cumulative impacts from infrastructure development.
- The planning process has informed new Parliamentary regulations and guidance for avoiding, minimizing, and offsetting impacts from infrastructure projects.
- When implementing nationwide ecoregional assessments, a stakeholder-driven engagement process was essential to ensure citizens' needs were incorporated into conservation priority maps and long-term plans.

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WATER FUNDS TO INSTITUTIONALIZE NATURE-BASED SOLUTIONS IN ECUADOR

GUIDING PRINCIPLE 4: AVOIDING ENVIRONMENTAL IMPACTS AND INVESTING IN NATURE

Adverse environmental impacts from infrastructure should be minimized, and natural capital enhanced to the greatest degree possible. Construction should be avoided in areas important for the persistence of biodiversity or having high ecosystem service value. The development of physical infrastructure should seek to complement or strengthen, rather than replace, nature's ability to provide services such as water supply and purification, flood control, and carbon sequestration. Nature-based solutions should be prioritized.


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BACKGROUND

Ecuador's water supplies rely fundamentally on the smooth functioning of sensitive ecosystems. Many of the country's most populous settlements, including the capital, Quito, and Cuenca, obtain their water supply from the Andes mountains, where cloud forests and grasslands regulate water flows and help retain humidity during drier months (Echevarria 2002). However, these ecosystems have been threatened not only by climate change but also by land degradation associated with physical infrastructure development, including road networks. These developments risked reducing nature's ability to deliver a critical service to communities: a clean water supply. Water funds are designed to address these issues and are participatory institutions with financial mechanisms for prioritizing nature-based solutions.

Water underpins Ecuador's livelihoods and economic activity, but also holds important social and cultural value. Indeed, the indigenous Andean philosophy *buen vivir* – enshrined in the national constitution in 2008 – strives for balance between humans and nature and advocates community-based governance systems to manage natural resources such as water (Fatheuer 2011). In this context, water funds were created to address the growing demand for water amid environmental stress and limited government fiscal capacity.

WATER FUNDS

Since the year 2000, Ecuador has gradually developed water funds in different locations across the country, including Quito, Cuenca and Guayaquil and on a regional scale in the centre and south of the country. The funds use nature-based solutions for water security, by channelling user payments towards conservation efforts that ensure sustainable water management and supply. Water funds are therefore designed to promote environmental sustainability, but also address other dimensions of sustainability through innovative financing mechanisms and participatory governance structures. Furthermore, Ecuador's water funds represent an infrastructure "system" on a large scale (the watershed scale for entire cities' or regions' water supply, with institutional coordination), as opposed to an individual water management infrastructure project.

PRESERVING NATURE FOR HIGH QUALITY SERVICE DELIVERY

Conservation of nature lies at the heart of the water funds' approach to infrastructure service provision. In Quito, for example, 80 per cent of the city's water flows from three protected areas: the Cayembe-Coca Reserve, the Antiana Reserve and Cotopaxi National Park (Arias, Benitez and Goldman 2010, p.1). Despite the protected status of these areas, human activities still threatened the integrity of ecosystems in the reserves, compromising the ability of the native vegetation to provide water retention and slow release of freshwater. The sponge-like grasslands and cloud forests retain humidity and regulate water flows when snow from the surrounding glaciers melts, or low-level clouds and fog hover among the forest canopy (Browder *et al.* 2019). The precipitation is captured by the vegetation and soils, which also absorb pollutants – storing them or transforming them into less dangerous substances (Calvache, Benítez and Ramos 2012). Maintaining this "natural infrastructure" enables long-term freshwater retention and slow release into water bodies and wetlands, and the water can then be fed to different users.

Built infrastructure, including water purification plants, was initially proposed as a solution to improve water quality and supply, but did not address the root cause of the problem (i.e. increasing degradation of the ecosystems) (Arias, Benitez and Goldman 2010). Instead, water funds offered a means of prioritizing nature-based solutions, which include maintaining and improving the function of reserve watersheds through replanting the native vegetation species, riparian fencing, and purchasing land for conservation. Within five years, the Regional Water Fund in southern Ecuador (FORAGUA), for instance, had established 174,028 acres of municipal reserves, protecting and restoring watershed ecosystems that supply water for 432,196 individuals (Paladines *et al.* date unknown, p. 10).

The funds have led to improvements in water supply and quality, while safeguarding the intrinsic value of Andean ecosystems. For example, comparative analyses conducted in surrounding areas not managed by the Quito Water Fund (FONAG) showed a significant increase in the presence of suspended solids in water, compared to areas managed by the water fund in the same period (2014-2017) (Latin American Water Funds Partnership 2018). The high costs associated with removing the sediments highlight the financial benefits of this nature-based solution. The same study compared the projected cost of conservation over 20 years, finding a return on investment of 2.15 USD for each 1.00 USD invested.

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INTEGRATING CONSERVATION WITH INCLUSIVE FINANCE

The Regional and Quito Water Funds were established as 80-year trust funds that receive revenues from water users, public utilities, companies and non-governmental organizations to fund the nature-based solutions (Kauffman 2014). For all of Ecuador's water funds, independent trust managers invest the funds' assets in financial markets and distribute the income to different stakeholder groups to fund conservation and watershed management activities, which are detailed in the fund's contract. Decisions regarding where funds are directed are made by a board of directors, often with broad representation from local government, water users and other stakeholders. Contractual arrangements define relations between members and specify how funds are to be used.

The long-term nature of the trust mechanism provides a stable financial arrangement, which allows for planning and encourages investment from other entities (United Nations Water 2011). Water funds therefore successfully integrate environmental sustainability with financial sustainability. Their inclusive financing mechanism, drawing on user contributions, ensures that funding nature-based solutions does not rely solely on external contributions. At the same time, the mechanism avoids privatizing control of water resources in Ecuador; an important requirement in terms of *buen vivir* and in light of the country's political context.

GOVERNANCE AND A SYSTEMS PERSPECTIVE

Ecuador's water funds do not consist of one individual infrastructure project in one particular location. Rather, they represent a system of assets, nature-based solutions and institutions on a larger scale. Initially, there were barriers to creating water funds in Ecuador; a law on public financing prohibited government institutions (including local water utilities) from investing in such financial mechanisms (Browder *et al.* 2019). However, a change to this law altered the enabling environment for water funds at a national level.

Water funds themselves consist of decentralized governance structures that provide space for a broad range of stakeholders. The newer funds, in particular, have developed associated institutions such as Tungurahua's "Water Parliament", which provides oversight, sets priorities and ensures implementation of conservation activities. This participatory, systems perspective has helped develop a more effective system for water supply in multiple areas of the country (Kauffman 2014). In addition, the funds are based on grassroots social foundations; for example, the Tungurahua fund was set up via detailed consultation and negotiation among the province's three indigenous movements (Kauffman 2014). The funds therefore often reflect local knowledge and preferences from the outset, which has helped to build a sustainable and inclusive "water culture" (United Nations Water 2011).

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REPLICABILITY

Water funds have already been expanded across Ecuador since their inception, with the original fund model now evolving to fit local circumstances. Indeed, the first fund was established at a city level, and the model proved flexible enough to be used at a regional level with the Regional Water Fund, where slightly different arrangements and conservation activities were required. Water funds are now used in several Latin American countries, including Colombia, the Dominican Republic and Mexico. They provide an institutional framework for nature-based solutions which is also financially sustainable. This is essential in a global context where government finances are increasingly constrained and inequalities are rising. Since water funds are participatory – formed and shaped by local stakeholders – they are by definition not "one-size-fits all". They can therefore be replicated in other parts of the world with similar political economies, taking local contexts into account.

KEY INSIGHTS

> Water funds are decentralized and participatory governance structures that incorporate local knowledge by design. This arrangement helps conserve priority ecosystem services.

> The Quito Water Fund more than doubled its return on investment, improving watershed function, water supply and water quality. Prioritizing nature-based solutions can simultaneously improve economic and environmental outcomes.

> The inclusive finance mechanisms of the water funds draw on user contributions. Allocation decisions are made by a board with broad stakeholder representation which cultivates long-term accountability and sound financial management.

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SINGAPORE'S GREEN BUILDINGS

GUIDING PRINCIPLE 5: RESOURCE EFFICIENCY AND CIRCULARITY

Circularity and the use of sustainable technologies and construction materials should be planned and designed into infrastructure systems to minimize their footprints and reduce emissions, waste and other pollutants.

BACKGROUND

Singapore is one of the most densely populated countries in the world (United Nations Department of Economic and Social Affairs [UNDESA] 2019). As a city-state occupying just over 720 kilometres² of land, it also faces considerable natural resource constraints (Chew 2010, p. 196). Yet Singapore has one of the most carbon efficient economies in the world, and it seeks to green at least 80 per cent of its buildings by 2030 (Singapore, Building and Construction Authority [BCA] 2010, p. 3). To fashion a clean, efficient and liveable city, and reduce reliance on natural resource imports for construction, Singapore has introduced a series of innovations since 2005 to integrate environmental sustainability into its built infrastructure. Singapore's "green buildings" (including offices, university buildings, public transport buildings and other facilities) have adopted principles of circularity, using recycled materials and green technologies for building design. Importantly, these innovations are made possible at scale through an enabling environment which strives to promote the adoption of sustainable construction materials and practices.

INCORPORATING CIRCULARITY INTO CONSTRUCTION

The first key technical measure that characterizes Singapore's green buildings is the use of green and recycled materials for construction. For example, a Mass Engineered Timber (MET) construction system was used for a 12-storey academic block at the Eunoia Junior College (Singapore, BCA 2020a). MET is harvested from sustainably managed forests (Programme for the Endorsement of Forest Certification 2019) and MET buildings have a lower carbon footprint and net carbon emissions compared to steel or concrete buildings (Singapore, BCA 2020b). Another example is the Tampines Concourse, which is a three-storey office building built with green concrete. The green concrete uses less sand[5] by partially replacing it with copper slag, recycled concrete aggregates (RCA) and ground granulated blast furnance slag (GGBS) (Chew 2010).

Singapore's buildings incorporate circularity throughout the lifecycle, including the decommissioning or demolition phase. BCA established a Demolition Protocol which was later incorporated into the Singapore Standard - a set of procedures that, among other policies, maximize the recovery of waste materials for beneficial re-use or recycling (Singapore, BCA 2020c). These materials can potentially be used for other projects, such as the Samwoh Eco-Green building, made of concrete with RCA derived from construction and demolition waste.

GREEN DESIGN AND TECHNOLOGIES

Complementing the use of green construction materials, the Singapore Government also encourages use of sustainable building designs and green technologies to minimize' environmental impacts and maximize total building performance. These are promoted through the BCA Green Mark certification scheme, a framework for assessing the overall environmental performance of a building, including energy, water efficiency and indoor environmental quality, and environmental impacts over the entire lifecycle.

Accounting for the tropical climate, passive design strategies are frequently adopted for buildings and spaces, in order to reduce energy use and carbon emissions. For example, individual buildings have vernacular designs with careful orientation to maximize daylight or avoid direct heat gain from the sun. To bring nature into a dense urban environment, an increasing number of buildings are also incorporating ample greenery and trees, which provide shade and minimize urban heat island effects. Many have sun-shading exteriors such as overhangs to block solar exposure (Eco-Business 2011). Green roofs, with layers of planted vegetation, further mitigate solar heat gains. They provide a nature-based alternative to, and reduce the need for, "grey" solutions.

In terms of energy efficiency, the Zero Energy Building (ZEB) on the BCA Braddell Campus and the recently completed National University of Singapore (NUS) School of Design and Environment 4 (SDE4) building provide notable examples. ZEB@BCA Academy was Southeast Asia's first net-zero energy building, achieving nearly ten consecutive years of zero energy consumption since 2009. It functions as a test bed for the integration of green building technologies in existing buildings (Singapore, BCA 2020d). Customized for tropical conditions with careful attention to façade, orientation and massing, the NUS SDE4 features a "hybrid" cooling system with fans instead of a standard air conditioning system, resulting in a higher set point and lower energy consumption, while achieving the same thermal comfort. Since its opening in 2019, careful energy management paired with a sizeable rooftop solar PV array have resulted in net-positive energy performance. The Housing and Development Board has also introduced "smart" technologies, including "Smart Fans" at its Punggol Northshore development, which are activated in response to temperature, humidity levels and human movement (Singapore, Housing and Development Board 2015). These various solutions reduce the consumption of energy and natural resources, while making buildings more comfortable and useable from an occupant's perspective.

Other constructions such as Tuas Nexus exemplify circularity through integration of different sectors. Tuas Nexus will represent the world's first integrated waste and water treatment facility, housing the Tuas Water Reclamation Plant by Singapore's Public Utilities Board and National Water Agency, and an Integrated Waste Management Facility by the National Environment Agency. The construction will harness synergies across the water-energy-waste nexus to optimize energy and resource recovery while minimizing land take. For example, electricity generated by the waste-to-energy process will be used to power the operation of the facility as a whole, and excess electricity will be exported to the grid. Tuas Nexus will be energy self-sufficient as a result of the integrated approach. This is expected to result in carbon savings of more than 200,000 tonnes of CO2 annually, equivalent to taking 42,500 cars off Singapore's roads (Singapore, National Environment Agency 2020).

[5] Sand is an increasingly scarce resource associated with high levels of greenhouse gas emissions and negative environmental impacts, such as coastal erosion through its extraction.

AN ENABLING ENVIRONMENT

Critically, to support green building systems, the Singapore Government has provided an enabling environment with strategic policies and incentives, in order to achieve the target of greening 80 per cent of buildings (by gross floor area) in Singapore by 2030.

The Green Mark Incentive Scheme aims to "accelerate the adoption of environmentally friendly building technologies and building design practices through cash or gross floor area incentives" (Singapore, BCA 2020e). The scheme was complemented by legislation requiring all new buildings and existing buildings that undergo major retrofitting to meet a minimum environmental sustainability standard. The "Super Low Energy" programme is the next wave of Singapore's green building movement. Launched in 2018, it includes a suite of initiatives developed by the government in partnership with industry and academia to encourage the design and adoption of cost-effective Super Low Energy buildings (60 per cent improvement in energy efficiency over the 2005 building codes) (Singapore, BCA 2018, p. 10).

In addition to the environmental sustainability benefits, buildings designed with "Green Mark" standards reap net positive savings throughout the lifecycle[6]. Some have shaved 11.6 per cent off operating expenses (Yale University 2013). Other schemes include the "Building Retrofit Energy Efficiency Financing Scheme", the "Skyrise Greenery Incentive Scheme" and the "Quieter Construction Innovation Fund" (Green Future 2020), addressing a range of economic, environmental and social considerations relating to buildings. Alongside these measures, Research & Development (R&D) was jointly identified and promoted by government institutions as a key enabler for improving resource efficiency in Singapore's buildings (Eco-Business 2011), leading to the establishment of an integrated Green Buildings Innovation Cluster to advance energy efficient solutions and practices.

[6] An independent consultancy study on the BCA Green Mark Incentive Scheme was commissioned in 2019 (Singapore, BCA 2019). The study includes a detailed review and lifecycle cost analysis of 40 Green Mark projects.

REPLICABILITY

With an additional 2.5 billion people expected to be living in the world's cities by 2050 (UNDESA 2018, p. 1), continuing innovation to provide homes, jobs, public amenities and a clean environment for a growing urban population remains a crucial challenge. The success of Singapore's green buildings and broader urban infrastructure is often viewed as a model by other cities. Observers frequently refer to Singapore as a "City in a Garden" (UNEP 2018).

Singapore is testament to how a city and country can build a strong economy, while preserving a clean and green environment. Despite natural resource and land constraints, a series of technical and policy measures have enabled the design and implementation of sustainable infrastructure systems that serve human needs, while respecting environmental imperatives. Going beyond the "City in a Garden", Singapore now envisions a "City in Nature", that will require holistic planning and implementation to further integrate ecosystems with sustainable infrastructure in urban areas (Singapore, Public Service Division 2020).

As a high-income city-state, Singapore's case may appear to be unique, but its success does not rely solely on advanced technologies. Sound planning has prioritized sensitivity to the environment from the very start: the country decided early on that it could not afford to "pollute first and clean up later". It illustrates how, with appropriate policies and a commitment to principle, a densely populated city can achieve a high quality of life, foster a competitive economy and maintain a sustainable environment for present and future generations.

KEY INSIGHTS

- Singapore's population density and natural resource constraints have accelerated the government's adoption of innovative resource- and energy-efficiency measures. The result is a sustainable and nature-positive built environment that minimizes resource use.
- Green construction materials, designs and technology incorporate circularity in the infrastructure lifecycle. Singapore Standards are in place to guide builders to maximize waste material recovery for re-use or recycling, closing material loops.
- The country has established an effective enabling environment with a combination of incentives, certifications, standards, targets and R&D initiatives.

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"SOLAR FOR HEALTH" IN ZIMBABWE

GUIDING PRINCIPLE 6: EQUITY, INCLUSIVENESS, AND EMPOWERMENT

Infrastructure investment must be balanced between social and economic priorities. Infrastructure should provide accessible and affordable services equitably to all, with a view to promoting social inclusion and fostering economic empowerment and social mobility, and protecting human rights. It should avoid harm to communities and users (especially those who are vulnerable or marginalized), be safe and promote human health and well-being.

BACKGROUND

Zimbabwe's social infrastructure services have historically been constrained by persistent energy shortages. Erratic weather conditions, losses of experienced staff, a lack of investment, weak legal frameworks and parastatals operating at unsustainable losses for non-cost reflective tariffs combined to lead to a widespread energy deficit (African Development Bank [AfDB] 2019). In recent years, Zimbabwe has experienced power cuts of up to 18 hours a day as drought reduced water levels for hydropower, and electricity imports were unable to fill the gap in supply (Moyo 2018).

Healthcare has been among the systems most affected by this massive power deficit. Health clinics, maternity wards, surgery blocks, medical warehouses and laboratories all rely on electricity to refrigerate medicines, power lights, operate life-saving medical devices and manage relevant data and information. Additionally, the lack of reliable energy sources has jeopardized financial sustainability due to increased energy costs arising from the use of diesel or petrol generators when the national grid is unavailable. These challenges have resulted in a deficient healthcare system that does not ensure accessible and affordable services for all. According to a national survey in 2019, 36.1 per cent of Zimbabweans did not access treatment for their illnesses, with affordability being the number one reason for not seeking medical treatment (Zimbabwe, National Statistics Agency 2019, p. 69).

"SOLAR FOR HEALTH"

To help address these issues, in 2017, Zimbabwe began implementing the Solar for Health (S4H) Initiative with the United Nations Development Programme, and with financial support from the Global Fund to Fight AIDS, Tuberculosis and Malaria. The initiative harnesses Zimbabwe's abundant yet previously untapped renewable energy resources for this critical form of social infrastructure (Mukeredzi 2019). The annual daily average solar radiation in Zimbabwe is 20 megajoules per square metre, which could produce 10,000 gigawatt hours of electrical energy per year (UN International Emergency Children's Fund [UNICEF] 2015, p.9), highlighting the potential for solar energy to power infrastructure such as health facilities.

As part of UNDP's global S4H Initiative, Zimbabwe has installed solar photovoltaic (PV) systems in over 400 health facilities, benefitting 6,525,000 individuals across the country (UNDP 2018a). These facilities now have reliable power throughout the day and patients receive the care they need, when they need it (UNDP 2020a). Before the S4H Initiative was introduced in Zimbabwe, more than two-thirds of the health clinics in Zimbabwe had access to electricity only for approximately four hours a day (UNDP 2018b, p. 12).

Source: adapted from UNDP (2018b)

FIGURE 6: INTEGRATED APPROACH OF THE S4H INITIATIVE

BALANCED PRIORITIES THROUGH AN INTEGRATED APPROACH

In connecting two vital sectors – energy and health – the initiative helps the government improve universal health coverage through developing sustainable infrastructure. It ensures that social priorities (health) are addressed in combination with Zimbabwe's important economic and environmental aspirations. The adoption of solar power by healthcare facilities in the country is an example of developmental leapfrogging, as Zimbabwe foregoes traditional and unsustainable practices for environmentally sustainable ones. The clean, renewable energy supply improves healthcare services, while providing economic and financial benefits and reducing harmful emissions. Figure 6 depicts how the initiative interconnects health, environment, development and return on investment.

The S4H Initiative has brought fundamental positive social impacts to participating communities. It ensures reliable energy supply to critical health facilities (including pharmacies, warehouses, cold rooms and laboratories), with improved lighting and temperature control of vaccines. The improved energy supply has also provided extended hours of operation, and facilitated retention and recruitment of healthcare workers in remote settings and improvements in data management for healthcare. The 405 clinics now enjoy uninterrupted power supply, allowing, for example, healthcare workers to reduce complications during and following pregnancy and childbirth. Deliveries no longer take place by candlelight, and life-saving procedures are not denied due to power shortages (UNDP 2020).

Integrating solar and health infrastructure in Zimbabwe has brought economic and financial benefits, too. For example, solar systems have helped reduce electricity bills by up to 60 per cent for some of the beneficiary health facilities, allowing clinics to reinvest the money saved in sustaining and improving facilities and services (UNDP 2018b). Budget savings can also be reinvested, for instance, to support national priority health programmes or further develop healthcare infrastructure. Estimates show that the return on investment in the S4H Initiative is fully realized within 2-4 years (UNDP 2018b). Furthermore, participating health facilities have the potential to provide improved energy access to nearby public facilities such as schools, public offices and libraries, or offer power stations for the use of the local community to charge their personal electronic devices. Broader

benefits include the creation of green jobs and the development of local service providers and markets for solar power.

The consistent source of energy provided by solar power also ensures that health systems are climate-resilient and are able to withstand droughts and other shocks that affect the traditional power supply (UNDP 2020). In addition, solar systems have facilitated water purification, which is a key achievement in a country where water-borne diseases such as cholera are widespread (UNDP 2020).

The S4H Initiative seeks to contribute directly to the 2030 Agenda for Sustainable Development and its commitment to "leave no one behind" by reaching under-served communities. Specifically, it supports efforts to achieve SDG 3 (Good Health and Well-being), SDG 5 (Gender Equality), SDG 7 (Affordable and Clean Energy), SDG 13 (Climate action) and SDG 17 (Partnerships for the Goals) (UN 2020). By improving maternal health and also training women as solar technicians, the initiative helps advance SDG 5 (UNDP 2020). Figure 7, below, depicts SDGs influenced through the S4H initiative.

Source: UNDP (2020)

FIGURE 7: SDGS POTENTIALLY INFLUENCED THROUGH THE S4H INITIATIVE

ACCESSIBLE SERVICES

S4H in Zimbabwe is a salient example of how infrastructure investments can help address inequalities and exclusion of the most marginalized and vulnerable communities. By providing reliable access to electricity for healthcare facilities in poor, remote and rural areas, S4H has promoted human health and well-being and accelerated progress towards universal health coverage. In particular, Zimbabwe has targeted communities affected by AIDS, tuberculosis and malaria, as well as pregnant women and children under the age of five. 3,915,000 women and children have benefitted from the S4H Initiative (UNDP 2018a).

By improving access to healthcare in rural areas, the initiative is also helping reduce urban-rural inequalities. It addresses the higher maternal mortality that exists in rural areas and among more impoverished communities (UNDP 2020). The introduction of solar energy has helped to solve IT challenges brought on by regular power cuts, which have an important bearing on the quality and accessibility of healthcare services. For instance, the provision of solar energy has enabled health facilities in Zimbabwe to collect and store data essential for managing patient files and ensuring adequate stocks of medical supplies. Moreover, integrating solar and health has improved the timeliness of transmission of health information for evidence-based decision-making, and has provided uninterrupted diagnostic services by powering laboratory equipment.

One broadly recognized limitation of the model used in S4H, however, is that it currently does not ensure adequate operations and maintenance, including safe management of waste, throughout the entire lifecycle of the solar energy system (usually spanning 10-15 years). Zimbabwe is in the process of developing a detailed maintenance plan, and conducting training in partnership with selected international companies and their local partners in order to help develop local skills and capacity for the maintenance of the systems.

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REPLICABILITY

The S4H Initiative has already been successfully replicated throughout Zimbabwe. This shows promise in terms of wider application in other S4H countries and for connecting solar and health systems more broadly. However, there remains a need to strengthen capacity among national authorities and local energy service providers, and to develop a more robust policy framework for distributed renewable energy. As a way forward, the government is processing key reforms aimed at improving the financial sector, land tenure and mortgage regimes, as well as the development of a coherent "Renewable Energy Policy" (AfDB 2019). The Ministry of Energy and Power Development has committed to achieve universal access to adequate and sustainable energy in Zimbabwe by 2030 (UNICEF 2015).

Throughout 2020, the S4H Initiative has sought to electrify an additional 642 health facilities, ensuring that nearly 70 per cent of all health facilities in Zimbabwe have sustainable and reliable access to electricity. Mobilization of private investment may be needed to scale-up S4H and ensure longer-term financial sustainability, but this is constrained by the current instability of Zimbabwe's economy and hyperinflation (Reserve Bank of Zimbabwe 2020).

Globally, the COVID-19 crisis has highlighted the importance of reliable and affordable electricity to enable health systems to respond to rapidly increased demand generated by the outbreak, and maintain essential healthcare service delivery (World Health Organization [WHO] 2020). Targeted and integrated investments for social infrastructure, such as those in Zimbabwe, will be key to building resilience to future crises.

KEY INSIGHTS

- The S4H Initiative in Zimbabwe illustrates a balance between social and economic priorities, ensuring allocation of resources to inclusive social infrastructure.
- Solar systems provide a stable, clean and reliable energy supply, even in the most remote locations, meaning more patients can access quality health services.
- Integrating the two important sectors, solar and healthcare, results in lower power bills for health facilities. These vital budget savings can then be reinvested to support other priority health programmes.

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THE COMMUNITY BENEFITS OF IRAN'S TRADITIONAL QANAT SYSTEMS

GUIDING PRINCIPLE 7: ENHANCING ECONOMIC BENEFITS

Infrastructure should create employment, support local businesses, and build amenities that benefit communities, thereby maximizing and safeguarding its economic benefits.


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BACKGROUND

Iran occupies a large expanse of predominantly arid or semi-arid land in West Asia. Of the country's 376 kilometres[3] average rainfall per year, an estimated 66 per cent evaporates before reaching the countries' rivers, and all streams are seasonable and variable (Food and Agriculture Organization of the United Nations [FAO] 2008, p. 3). In this geographic context, *qanats* – traditional water systems for transporting and distributing water from sources in upland areas to dry plains (Manuel, Lightfoot and Fattahi 2018) – have historically provided a solution that sustains livelihoods and economic opportunities. They bring a reliable source of water and employment (both directly and indirectly) to farms in the driest parts of the country, where livelihoods would otherwise be severely constrained.

QANATS

Qanat systems are based on a simple and resource efficient technology. They comprise an underground gallery and tunnel system for transporting large quantities of water by gravity, a series of vertical shafts and community institutions for water sharing. They may also incorporate watermills, reservoirs and *hammams*. Recycling and re-use of water is encouraged at different stages along the tunnels, and only the overflow of groundwater pours into the gallery and enters the system (Labbaf Khaneiki 2020). As a result, unlike tube wells, *qanats* do not draw down the water table (Manuel, Lightfoot and Fattahi 2018). The core concept of the *qanat* is "humans adjust themselves to the water available; not the other way around" (Labbaf Khaneiki 2020). The construction of *qanats* is labour-intensive, requiring traditional knowledge and craftsmanship, in addition to unskilled labour. Over time, their underground siting has made them resilient to natural hazards, as well as conflict.

The use of *qanats* spread across West and Central Asia, and to other parts of the world. Increasingly, however, they have been replaced by less sustainable pump systems. *Qanats* represent a timeless innovation that integrates local economic needs with cultural heritage and aesthetic considerations. They hold renewed relevance in a world where addressing climatic variability and livelihood creation are matters of utmost priority.

LABOUR-INTENSIVE DESIGN, CONSTRUCTION AND REHABILITATION

The construction of *qanats* requires skilled and unskilled workers, thereby creating employment for different levels and forms of enterprise. The underground tunnel system consists of a vast network for tapping aquifers at the heads of valleys and then conducting and controlling the flow of water to different settlements. Digging the tunnels involves significant manual labour, as well as engineering skills, while traditional knowledge is needed for design, maintenance and familiarity with local environments (Saberioon and Gholizadeh 2010). Many tasks are therefore appropriate for local workers and do not rely on external technologies. This helps to stimulate local economies and knowledge, and is also a useful dynamic in the context of supply chain disruption.

Qanats use a people-centred design with rest areas built in for workers (UNESCO 2016). They can take several years to construct, which represents a limitation where infrastructure needs are urgent. However, once established, maintenance is relatively low in cost when considered across the entire lifecycle.

Because of their sustainability, *qanats* have been used and rehabilitated for many centuries by private landowners as well as village cooperatives (Manuel, Lightfoot and Fattahi 2018). For example, in recent rehabilitation projects in the wider region, local people were hired to carry out refurbishment work which provided direct income generation, and

communities were trained in managing their *qanats* to guarantee the sustainable supply of water for multiple uses (UNESCO 2012). Integrating these traditional skills into modern contracting methods, along with vocational training for infrastructure, can ensure that the economic and cultural dimensions of sustainability are not traded off against one another.

SUPPORTING LOCAL LIVELIHOODS

In addition to the built infrastructure assets (including tunnels, reservoirs and watermills), *qanats* incorporate a broader system, based on principles of governance for equitable water sharing across different communities and sectors. This system safeguards livelihoods in challenging natural environments.

In the eastern and central areas of Iran in particular, *qanats* are a reliable system providing livelihoods and food security for local communities, in the absence of adequate rainfall and reliable surface water for irrigation. They have allowed those living in the deserts adjacent to mountain watersheds to create a large oasis in an otherwise stark environment (Saberioon and Gholizadeh 2010). For example, in Kashan, Isfahan Province, around 20,000 farmers are either directly or indirectly linked to a *qanat* (FAO 2014, p. 5). Here, *qanats* have supported the production of ancient varieties of pomegranate, fig, pistachio, apple, apricot and medicinal plants as well as many livestock breeds, all of which are central to the local agriculture sector and hold important biodiversity value.

Most farms in Kashan are smallholdings and family farms, with the average family farm being around 0.7 hectares in size (FAO 2014, p. 5). The *qanat* system is based on collective work, with local institutions determining the amount of water and land available for each member of the community (i.e. several small plots). Principles of governance that have evolved slowly over hundreds of years ensure equitable allocation and limit the number of water disputes (Labbaf Khaneiki 2020). As a result, the benefits brought about by *qanats* are inclusive and cover a relatively large number of people. Indeed, in Razavi Khorasan Province, for example, women play an important role in all stages of *qanat*-based saffron production, typically performing tasks ranging from harvesting to packaging (Iran, Agricultural Planning, Economic and Rural Development Research Institute 2018, pp. 79-80).

Due to the *qanats*' traditional design and aesthetic appeal, they also bring tourism opportunities. Eleven of Iran's *qanats* are preserved as UNESCO world heritage sites (UNESCO 2016). In Kashan, *qanats* are used as sites for tourism while in operation for agricultural and other uses. Furthermore, *qanat* infrastructure can be developed for generating energy, breeding fish, sanitation and air-conditioning (Labbaf Khaneiki 2020). These applications highlight the value of *qanats* as a form of multipurpose infrastructure which can be developed in a way that enhances economic benefits across different sectors. It also highlights the importance of careful and culturally appropriate design for long-term and diverse benefits.

REPLICABILITY

Qanats represent a culturally appropriate infrastructure solution for supporting livelihoods across arid and semi-arid regions. They were historically considered as viable solutions for communities across the Persian and Arab world, and variants of *qanats* were adapted in other parts of Asia, Europe and Africa. Today, building new *qanats* is constrained by the lengthy construction time needed. However, with attention from government, there remains value in rehabilitating and enhancing existing *qanats* to create new (and sustain existing) employment and livelihoods. The principles, skills and technologies embodied in these traditional infrastructure systems can also be incorporated into modern practices or integrated with nature-based solutions.

Flexible infrastructure projects that create economic opportunities are currently a priority for policymakers. More costly, modern solutions are not always required where traditional knowledge can bring sustainable solutions for new demands.

KEY INSIGHTS

> The sustainable delivery of water and other essential services through *qanat* systems has historically stimulated local economies with far-reaching co-benefits.

> *Qanats* hold potential for employment creation, requiring diverse skills for a construction and rehabilitation.

> As a form of multipurpose infrastructure, *qanats* have supported local enterprises and livelihoods in sectors ranging from agriculture to tourism.

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DEVELOPING WIND FARMS WITH FISCAL SUSTAINABILITY IN AUSTRIA

GUIDING PRINCIPLE 8: FISCAL SUSTAINABILITY AND INNOVATIVE FINANCING

Infrastructure development should be developed within frameworks of fiscal transparency, financial integrity and debt sustainability.

BACKGROUND

After the global financial crisis of 2007-2008, Austria and Europe faced significantly reduced levels of investment and growth, creating a need to improve the business environment for raising funds for infrastructure. As a response, in the European Union (EU) context, the Investment Plan for Europe of 2014 (also known as the Juncker Plan) and its successor (the InvestEU Programme) were adopted to reverse the downward trend of low investment on the continent with three specific objectives: to remove obstacles to investment; to provide visibility and technical assistance to investment projects; and to make smarter use of financial resources (European Commission 2016).

At a national level, Austria strengthened its policy and regulatory arrangements by building comprehensive frameworks for sustainable development, fiscal policy and environmental management. Broadly, Austria's "National Strategy for Sustainable Development" integrates sustainability into policies and actions at the national level through institutional cooperation mechanisms, management rules, indicators and monitoring procedures (Green Fiscal Policy Network 2017). One of the government's key environmental goals was to reduce greenhouse gas emissions by increasing investment in electricity generation from renewable sources, supported by frameworks including the "National Energy Strategy", the *Green Electricity Act,* the *Climate Protection Act and the Energy Efficiency Act* (Grantham Research Institute on Climate Change and the Environment 2015). Austria is projected to significantly reduce its greenhouse gas emissions from energy industries by 2035, as shown in Figure 8.

In this context, Austria has developed renewable energy infrastructure through projects such as the European Investment Bank (EIB)-financed "Windfarms Prinzendorf and Powi" which contribute to sustainable infrastructure development while ensuring fiscal sustainability.

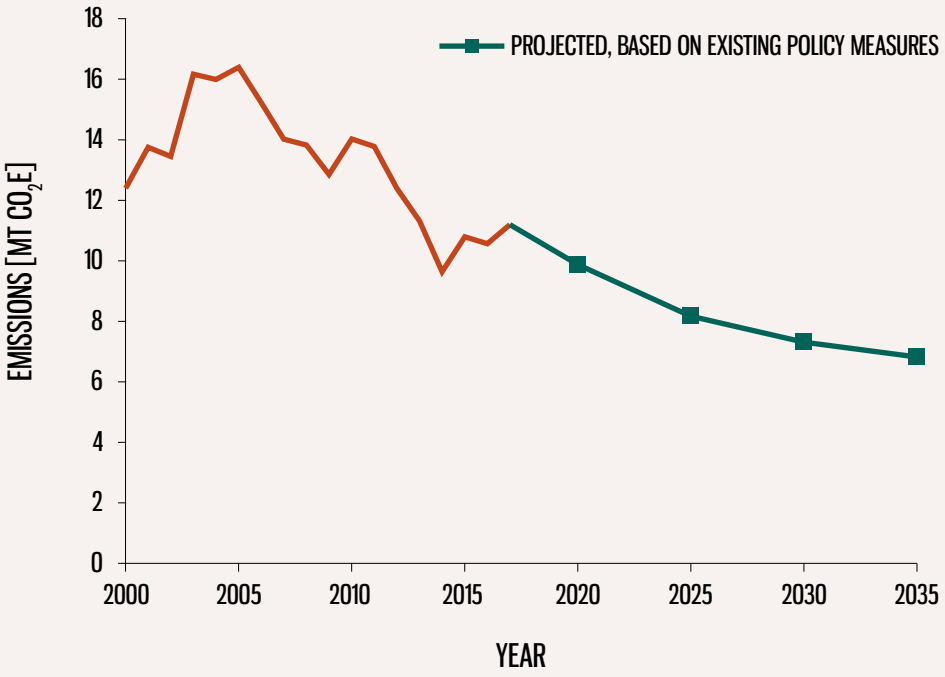

FIGURE 8: AUSTRIA'S GREENHOUSE GAS EMISSIONS, ENERGY INDUSTRIES

Source: based on Austria, Environment Agency (2019, p. 22)

"WINDFARMS PRINZENDORF AND POWI"

The "Prinzendorf and Powi" operation comprises the repowering and development of three wind farms in Lower Austria, with a grid-connected capacity of 58 megawatts in total, bringing clean energy to thousands more households. Under this operation, the new Poysdorf-Wilfersdorf V (Powi) wind farms will have 4 turbines, while the Prinzendorf III wind farm consists of 10 wind turbines that replace 9 old wind turbines (repowering). The EIB is providing 63 million EUR of finance for the construction and operation of the new wind farms. By providing long-term funding, the EIB support contributes towards mobilizing private investment, and reducing greenhouse gas and air pollution externalities.

The development of wind farm infrastructure aligns with national and international targets for renewable energy generation, with climate action being a priority EIB objective. Renewable energy represents a priority sector for EIB financing. According to the EIB's current Carbon Footprint methodology, by obviating the need for electricity generation from existing and new power plants in Austria (75 per cent operating margin and 25 per cent build margin), the total relative effect of "Prinzendorf and Powi" is a net reduction in CO2 equivalent emissions of around 48 kt CO2e/yr (EIB 2018, p. 3).

FISCAL SUSTAINABILITY

In this case, Austria has partnered with the EIB to help address infrastructure investment gaps sustainably. Such projects are implemented within Austria's comprehensive fiscal policy framework, which enables the development of sustainable infrastructure without generating untenable debt. In 2018, the IMF's debt sustainability assessment concluded that Austria's "public debt is sustainable within the medium-term projection horizon, though ageing cost pressures are looming in the longer term" (IMF 2018a, p. 29). Environmental taxes have become an important source of revenue for the government (Organisation for Economic Co-operation and Development [OECD] 2014), while subsidies are also commonly used to promote a green economy. For example, the *Environmental Support Act* provides direct financial assistance to local authorities, industries, farmers and households for investment related to renewable energy and energy efficiency (Green Fiscal Policy Network 2017). Like other European countries, Austria has a feed-in tariff (FIT) scheme, the costs of which are not borne by the taxpayer or a private investor but by the end consumer. The cost of the FIT is thus reflected in the price consumers pay for their electricity. In 2020, this accounted for around 10.1 per cent of the average household electricity bill (Austria, E-Control 2020).

At the same time, Austria has built strong fiscal institutions over the past decade – notably through budget reforms introduced in 2009 and 2013 – in order to ensure fiscal sustainability. According to the IMF, these efforts have resulted in sound fiscal transparency practices in Austria (IMF 2018b). Among the key good practices are public fiscal reports covering reconciliations between alternative measures of fiscal aggregates, which are published in a frequent and timely manner. Budgets and forecasts have a clear medium-term and performance-oriented focus, and are guided by specific fiscal policy objectives, compliance with which is subject to independent scrutiny.

GENDER BUDGETING IN AUSTRIA

Austria has established measures for integrating gender perspectives into budgeting using a gender needs assessment, baseline analyses, ex ante and ex post gender impact assessments, as well as gender-disaggregated incidence analysis (IMF 2017, p. 33). The government introduced an obligation to include a gender mainstreaming strategy in national policies (European Institute for Gender Equality 2020). To implement gender mainstreaming in budgetary processes, gender budgeting was included in the Austrian Constitution in 2009, leading to several resolutions being passed. All federal ministries are now required to consider gender equality in the planning, implementation and evaluation of budgetary measures (United Nations and the Rule of Law 2020).

MOBILIZING PRIVATE FINANCE, WITH HIGH ENVIRONMENTAL STANDARDS

The government has historically been successful in mobilizing private funding for research, development and innovation in the energy sector. For every Euro spent by the government, Austria mobilizes on average 2.5 EUR in private funding (International Energy Agency [IEA] 2020). The Prinzendorf and Powi operation is designed to crowd-in private sector financing and to increase commercial banks' confidence in the promoter's long-term financial sustainability.

The bulk of the financing is backed by a guarantee from the European Fund for Strategic Investments (EFSI), the central pillar of the Investment Plan for Europe. Much of this has gone directly to one of Austria's largest wind power producers (the promoter), which is also investing 21 million EUR of its own funds (EIB 2020). The remaining loan amount of 22.1 million EUR is being provided by a private Austrian bank, funded by the EIB. Under this plan, different public and private actors are working together as strategic partners to mobilize investment in sustainable infrastructure and boost the competitiveness of both the Austrian and the wider European economy. According to the EFSI assessment, the operation will help improve financing conditions in Austria, while generating sustainable growth and employment (EIB 2019). The arrangement also improves the counterpart's funding terms compared to market financing sources (through an interest rate reduction and/or the longer lending term). This helps to attract private investors through positive signalling effects, promoting synergies in co-financing with other public funding sources for renewable energy.

The promoter has successfully run wind farms, primarily in Austria, since the end of the 1990s and, along with its contractors, was assessed as having a strong environmental and social management capacity (EIB 2018). In 2014, the government of Lower Austria identified preferential zones for development based on a Strategic Environmental Assessment. The three wind farms are located inside such preferential development zones (EIB 2018). In line with Austria's *Environmental Impact Assessment Act*, the wind farms in the Prinzendorf and Powi operation underwent an EIA process, involving expert studies on key risk areas and public consultation. Given the presence of protected species in the project areas, each site also underwent an avifauna impact assessment. The studies concluded that the projects will not have significant negative environmental impacts post-mitigation.

Accordingly, the environmental permits were approved but made conditional upon obligatory mitigation and monitoring measures, such as establishing fallow areas to improve available habitats for birds and bats, and taking some turbines out of operation at defined ambient conditions to protect bats (EIB 2018). To access the EIB financing, the promoter needed to commit to demonstrating that (amended) permits were in place and in line with final project design. The Prinzendorf and Powi operation therefore upheld the strict environmental standards of the Austrian Government and the EIB in mobilizing private sector participation.

REPLICABILITY

The combination of Austria's sound regulatory and policy frameworks and EIB support has helped the country attract private investment into renewable energy infrastructure. The 14 new wind turbines will produce a total of around 160 million kilowatt-hours (kWh) annually. Renewables currently cover 29 per cent of Austria's total primary energy supply (IEA 2020), and there is significant potential to increase this figure, while decreasing dependency on imports of fossil fuels. In just a few years, the country was able to improve its business environment and promote sustainable infrastructure development, while ensuring fiscal sustainability.

Austria aims to provide 100 per cent of electricity consumption from renewable energy sources by 2030 according to the draft Integrated National Climate and Energy Plan (Austria, Sustainability and Tourism 2019, p. 13). In order to reach 2030 targets, the level of installed wind capacity needs to grow further from the 3.2 gigawatts (GW) level achieved in 2019. The Prinzendorf and Powi operation contributes to achieving this goal.

Globally, as national budgets become increasingly constrained due to COVID-19 demands, governments require innovative and inclusive financing solutions to share the costs and benefits of investing in sustainable infrastructure. Partnering with infrastructure and development banks can be a judicious option for addressing the urgent need to mobilize finance. As demonstrated, the EIB supports low-carbon infrastructure projects across Europe that are both bankable and meet strict environmental and social standards.

KEY INSIGHTS

> Austria's infrastructure is conceived within a framework that comprehensively takes account of debt, budgeting concerns and other fiscal vulnerabilities.

> Mobilizing private sector participation and long-term private finance for wind farms addressed the problems of complexity, risk and insufficient availability of long-term funding from commercial banks or public sources.

> The EIB "Windfarms Prinzendorf and Powi" operation contributes to key national targets, financing low-carbon infrastructure in preferential development zones.

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BALANCING NATIONAL PRIORITIES WITH LOCAL CONCERNS THROUGH TRANSPARENCY AND CONSULTATION IN CHILE

GUIDING PRINCIPLE 9: TRANSPARENT, INCLUSIVE, AND PARTICIPATORY DECISION-MAKING

Infrastructure development should be underpinned by transparent planning, information sharing and decision-making processes that facilitate meaningful, inclusive and participatory stakeholder consultation, and in the case of indigenous peoples, their free, prior and informed consent. National, sub-national, and project-level grievance mechanisms should be available for addressing stakeholder complaints and concerns.


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BACKGROUND

Chile is regarded as the most competitive economy in Latin America, achieving relatively stable growth since the 1990s (World Economic Forum 2019, p.15). At the same time, the country has established large national parks and other protected areas and has increasingly incorporated different dimensions of sustainability into public policy. It is home to nine indigenous groups: Aymara, Atacameño, Quechua, Diaguita, Kolla, Rapa Nui, Mapuche, Kawéskar and Yagán, and the regions they inhabit often lie hundreds of kilometres from the capital and national decision-making centre, Santiago. The government has taken significant steps to govern the economy and infrastructure with transparency, but Chile also has a history of territorial conflict concerning indigenous communities and more peripheral regions. There remains a need for greater territorial integration and social inclusion. Meaningful stakeholder consultation is therefore especially critical for developing more sustainable infrastructure.

Prominent sectors in the country include mining (especially copper) and forestry, which have helped fuel national economic growth. However, the infrastructure associated with these sectors, such as ports, railways and roads, also presents acute local challenges related to negative social and environmental impacts. The government has introduced specific mechanisms for transparency and consultation, including infrastructure monitoring platforms, creation of sub-national institutions to improve indigenous participation, and adoption of the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) in 2007. These represent essential measures to build more inclusive infrastructure systems. In addition to the important progress made, there are also lessons to be learned in balancing national economic priorities and the "common good" with territorial considerations via meaningful consultation.

TRANSPARENT SYSTEMS

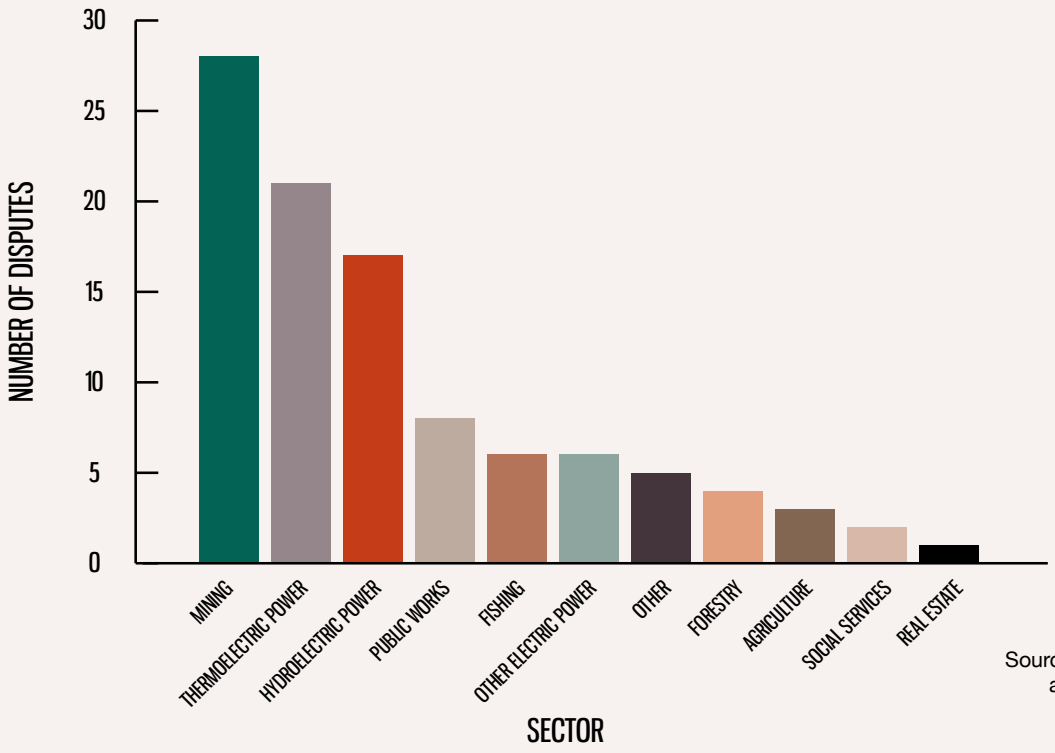
In recent decades, Chile has developed a business environment which is considered to be transparent and predictable for investors. The country is ranked 26th in the world for transparency; the second highest ranked country in Latin America after Uruguay (Transparency International 2019). To help build government transparency, a major piece of anti-corruption legislation was introduced in 2009 which created a national "Council for Transparency" to monitor the law's implementation and to guarantee citizens' access to public information (Schorr 2018, p. 6).

Chile's "National Investment System" now provides information relating to the status and cost of public investments across all sectors and regions, and it publishes methodologies for undertaking social evaluations (OECD 2017, p. 48). For example, an online "Integrated Project Database" managed by the Ministry of Social Development and Family allows civil society, the private sector and the general public to monitor investments in different regions across sectors, throughout their lifecycle. Furthermore, central government also publishes comprehensive information on concessions during each phase of the lifecycle of infrastructure projects, with independent review (OECD 2017, p. 48).

TOWARDS MEANINGFUL CONSULTATION

While an emphasis on central planning and national-level transparency can bring economic stability and certainty, it can also impact the autonomy of sub-national government and present potential challenges for local participation in peripheral regions. Indeed, indigenous peoples are still not formally recognized in the national constitution, although a national plebiscite in 2020 approved a new Chilean Constitution, which is a promising sign that recognition will be achieved (Chile, Government 2020). The legislative branch has already approved reserved seats for indigenous people at the Constitutional Convention, ensuring their participation in the constitutional process (Chile, Senate 2020; Chile, Chamber of Deputies 2019).

However, territorial disputes – including those involving indigenous communities – persist, and are primarily related to infrastructure or extractive projects (see Figure 9 below). Some of these disputes are centred on the environmental externalities of infrastructure-related operations; some concern local heritage sites and the use of natural resources; while others arise due to perceived limited local participation in decision-making processes (Delamaza, Maillet and Martínez Neira 2017, p. 25).



Source: based on Delamaza, Maillet and Martínez Neira (2017, p.33)

FIGURE 9: DISPUTES BY ECONOMIC SECTOR IN CHILE, 2005-2014

In Chilean law, there is a general requirement to consult with indigenous peoples (ILO 2018), and the decentralized "National Corporation for Indigenous Development" (CONADI) holds official responsibility for promoting, coordinating and executing actions designed to foster the integral development of indigenous peoples (Chile, CONADI 2020). It seeks to increase the participation of the indigenous population in policy and legislative processes through dialogue, consultation and mass information. More widely, key steps forward in engaging all citizens in infrastructure development were achieved through *Law 20.500* in 2011 and the *Presidential Instructive for Participation and Public Management* in 2014, which provide for citizen participation, and require central government to maintain constant dialogue with the "Municipal Councils of Civil Society Organizations" (OECD 2017, p. 145). This highlights the efforts made to integrate decision-making across administrative levels.

Building on these arrangements, the Ministry of Public Works has established specific participation mechanisms through *Resolution 315* of 2015, which defines objectives and processes for bringing citizens closer to infrastructure, and for following a rights-based approach. According to the resolution, public participation must be ensured throughout entire projects, particularly in the early stages of planning, paying due regard to the specific selection and profile of citizens according to their gender, disabilities and indigenous self-identification. The implementation of the resolution has resulted in an increase in public participation among certain groups, though challenges remain. For example, indigenous women have participated in important public consultations but are reported to be excluded from other public spaces (Chile, CONADI 2016, p. 61). Indigenous consultation is further evaluated through the *Official Document from the Public Works General Directorate 539*, which specifies that an official request must be made to the Ministry of Social Development and Family to draw up the indigenous consultation. Projects of the Ministry of Public Works then proceed based on what the Ministry of Social Development and Family recommends.

The Ministry of Public Works also requires project proposals in a given region to address wider regional plans and synergies with multiple infrastructure projects. Since 2017, the Ministry has been developing a framework specifically dedicated to "sustainable infrastructure", and has experimented with the application of a project evaluation methodology with components covering inclusion, gender equality and indigenous and immigrant communities (Chile, Ministry of Public Works 2020).

REPLICABILITY

Chile has made important progress in integrating stakeholders into infrastructure plans and processes through transparency systems, legal instruments and the creation of decentralized institutions. Moving forward, it has acknowledged that better understanding of the "human" variable and infrastructure siting preferences can lead to improved infrastructure planning and service delivery. While there are consultation arrangements in place, there is still conflict when it is not possible to reconcile the national priorities for infrastructure and the concerns of local communities. To help overcome the challenges, Chile is seeking to adopt a systems perspective across government ministries and levels of administration, but requires tools, "soft" infrastructure and enhanced state capacity to do so.

Consultation and conflict issues relating to indigenous and other communities are common across many Latin American countries, as well as globally. As countries strive to rapidly create jobs and kickstart economic growth to recover from COVID-19, it is essential that transparency and consultation processes are not bypassed. Rather, they must be strengthened to ensure that infrastructure is truly inclusive and needs-based.

KEY INSIGHTS

> Chile has built transparent tools for monitoring infrastructure investments at the national level, with a dedicated "Council for Transparency" and "Integrated Project Database".

> The country has taken concrete steps towards inclusive and meaningful consultation, by approving and introducing specific legal requirements and creating decentralized institutions.

> Disputes represent an ongoing challenge, requiring a deeper systems perspective and further integration of communities and regions into infrastructure decision-making.

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INFRASTRUCTURE DATA INNOVATIONS IN MALAWI

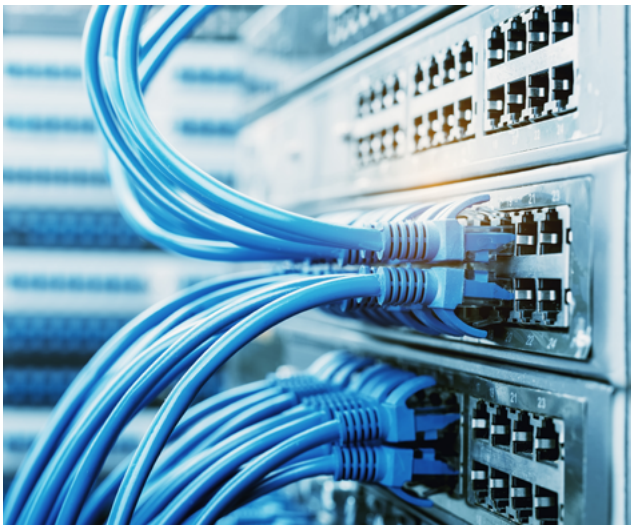
GUIDING PRINCIPLE 10: EVIDENCE-BASED DECISION-MAKING

The planning and management of infrastructure throughout the lifecycle should be informed by key performance indicators that should promote the collection of data, including data that is disaggregated by stakeholder groups. Regular monitoring of infrastructure performance and impacts is necessary to generate data, which should be made available to all stakeholders.

BACKGROUND

Malawi has prioritized infrastructure development as a key component in the "Malawi Growth and Development Strategy" (Government of Malawi 2017a). However, the perceived quality of infrastructure remains low, as are the measures for access and service delivery in the education, electricity and roads sectors in particular (IMF 2018, p. 17). Additionally, the country has faced issues surrounding data transparency and has ranked low in Transparency International's Corruption Perceptions Index, 123rd out of 180 countries (Transparency International 2019). This extends to infrastructure planning and management, where there has historically been limited accountability and data availability relating to major infrastructure plans and projects. Until recently, procuring entities failed to meet legal requirements for disclosing information to the public, and data was previously disclosed via paper-based systems rather than centralized electronic data storage systems, which can significantly impair citizens' access to this data (Infrastructure Transparency Initiative [CoST] 2018).

Over 80 per cent of Malawi's population live in rural areas (World Bank 2019), making effective information dissemination particularly important to ensure that communities are not disconnected from decision-making, infrastructure development and economic opportunities. Malawi has made notable progress with regard to infrastructure data over the past 10 years. Through its membership of CoST, it has introduced an online information portal, a Multi-Stakeholder Group, and several other innovations, which all help to ensure that data relating to the lifecycle of infrastructure is widely available and scrutinized.



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IMPROVING DATA COLLECTION AND AVAILABILITY

Since 2019, Malawi has established key tools to promote infrastructure data disclosure and accountability. Among these are the "Information Platform for Public Infrastructure" – an online disclosure platform that aims to bring infrastructure data closer to citizens. The platform, although still being upgraded, provides a centralized and digitalized storage system for procuring entities, making infrastructure data easier to find and readily available to the public. It is beginning to publish data relating to key stages of the infrastructure lifecycle by region and infrastructure sub-sectors. The government has also engaged CoST to train procuring entity officials on using the platform and for building their understanding of Malawi's legal regime on disclosure, which obliges entities to disclose data in accordance with the CoST Infrastructure Data Standard.

Besides launching the Information Platform for Public Infrastructure, Malawi has also used influential radio stations to reach citizens and raise awareness about the online platform. Radio jingles – a popular communications tool in Malawi – were broadcast to encourage the public to visit the new platform and access data. Similarly, since 2010, regular "assurance reports" have been published, which have validated and interpreted data disclosed on over 90 infrastructure projects to help highlight areas of good practice and key concerns about these projects (CoST 2018, p. 2). The data cover key sectors including education, electricity, roads, water, health and housing. The reports also compare performance across procuring entities. Combined with the Information Platform for Public Infrastructure, these measures will give citizens a better indication of how their taxes are spent on infrastructure (CoST 2018, p. 2).

INCREASED ACCOUNTABILITY

The improved use of data is reinforced by a Multi-Stakeholder Group with representation from government, the private sector and civil society. As with all CoST members, the group plays an important role in publicizing the key issues found in assurance reports. So far, it has used its influence to improve the quality of individual infrastructure projects, as well as spur action on broader reforms. For example, the Multi-Stakeholder Group was instrumental in Malawi's Parliament passing a revised Public Procurement and Disposal of Public Assets Act that legally mandates procuring entities to disclose infrastructure data (Government of Malawi 2017b).

As an additional mechanism to improve accountability and scrutiny of infrastructure delivery, radio outreach has enhanced citizens' awareness with respect to their right to engage with relevant stakeholders. This realization was particularly important during the run-up to Malawi's 2020 elections. Increased dissemination of information and heightened citizen engagement in Malawi prior to the election put accountability high on the political agenda, with major political parties including infrastructure accountability in their manifestos. This can be seen in the manifestos of the Malawi Congress Party (2019) and the United Transformation Movement (2019).

These structures and mechanisms contribute to a systems conception of infrastructure, focusing on the importance of knowledge and institutions in better infrastructure delivery. However, there is currently only limited environmental data available relating to infrastructure and its impacts in Malawi, which would play an important role in achieving SDG 13 (Climate Action) and SDG 15 (Life on Land).

SHARING INFORMATION THROUGH COMMUNITY AND VIRTUAL EVENTS

Before and during the COVID-19 pandemic, Malawi has developed innovative ways to strengthen public participation and provide data to stakeholders through community and virtual events. At events facilitated in Nsanje, Mzimba and Karonga, for example, district council authorities presented an outline of the local infrastructure development agenda, sharing information on infrastructure projects being constructed close to the communities, and offering an opportunity for residents to raise concerns. The events aimed to improve the participation of women and youth by making them accessible – for example by locating events close to residential areas. Female participation is also being monitored, and targeted media training has focused on increasing the attendance of female journalists.

The event in Nsanje focused on the planned construction of dykes to protect from perennial flooding. The authorities outlined construction impacts, including reforestation and the possibility of relocating some communities to higher areas. The communities shared their concern that information on these plans had not been forthcoming, and that they had been excluded during the initial planning. At the event, the authorities pledged to make improvements to address these issues and enhance greater public participation.

Similarly, at an event in Mzimba, communities queried the delay in completing a community centre and again highlighted a lack of data and involvement in the project. The authorities indicated that the delay was due to late payment from the government, which had prevented the main contractor from moving forward with the project. The communities urged government representatives to ensure that projects only begin when financing is available, in order to avoid delays in implementation, and stressed the need to keep beneficiaries abreast of such issues.

In Karonga, a meeting was held with communities on the maintenance of a key road leading to the border with Tanzania. Among other issues, the communities questioned the quality of the road, which had begun developing cracks before it was formally handed over by the contractor. The communities insisted that selection of contractors be conducted transparently, and that the responsible agencies ensure that projects are closely monitored and supervised.

While COVID-19 has hindered efforts to hold physical events, CoST Malawi has been using its positive experience in radio and other online means to enable communities to access data and interact with decision-makers. It has promoted the importance of infrastructure data availability in creating a fairer business environment, using the voice of the private sector representative in its Multi-Stakeholder Group to do so, including through media interviews.

REPLICABILITY

Under challenging circumstances, Malawi has taken important steps to make information relating to infrastructure publicly available. However, the need remains to improve capacity to collect, analyse and share data relating to specific environmental and social sustainability issues. To help address this, CoST is working with its partner, Open Contracting Partnership (OCP), to explore how their joint standard, the "Open Contracting for Infrastructure Data Standard" (OC4IDS) can be interconnected with environmental datasets (Open Contracting Partnership 2020). This internationally recognized standard brings together the existing standards of OCP and CoST to ensure robust data disclosure across the entirety of the project cycle and make data available in real time.

Malawi's Information Platform for Public Infrastructure drew on the experience of Honduras, where an award-winning online data portal was developed. Centralized, online data platforms can be replicated in different countries so long as the digital infrastructure is in place and the capacity of those using the platforms is strong. With huge sums being spent in COVID-19 economic recovery packages, widely available and comprehensive data will be essential to strengthen accountability and provide better value for money from infrastructure investment, and to give citizens a better understanding of the performance and impacts of their infrastructure.

KEY INSIGHTS

- Malawi's Information Platform for Public Infrastructure — a centralized data disclosure portal — will bring performance and impact data closer to stakeholders and enhance public accountability.
- Partnership between government, private sector and civil society representatives has been instrumental: using infrastructure data to improve individual projects, enacting reforms and establishing disclosure mandates for infrastructure contractors.
- Innovative, flexible and community-centred communication has helped connect the public and decision-makers.

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THE WAY FORWARD

This collection of case studies illustrates many of the good practices outlined in the *International Good Practice Principles for Sustainable Infrastructure*, and highlights key insights from diverse national contexts. Policymakers and other stakeholders can refer to and learn from the different cases to inform impending infrastructure policy and investment decisions.

The planet and its people will be shaped by a period of enormous infrastructure investment over the next 20 to 30 years. The infrastructure investments that dominate governments' COVID-19 recovery packages hold tremendous potential for growth and employment creation, but also equally significant potential for negative environmental impacts, which in turn bring economic and social losses. The case studies in this report take stock of what is working and what is not in different countries and regions, and should inform the next wave of infrastructure investment to ensure that sustainability and resilience are built in at the very outset.

Looking ahead, low and middle-income countries alone could see a 4 USD return for every 1 USD spent on infrastructure that prioritizes future-focused resilience (World Bank 2019). Among these investments, natural resource use can be reduced by 30 – 50 per cent across city construction, transport, energy and waste sectors alone by using more integrated approaches (IRP 2018, p. 24). The practical actions captured in this report can inspire governments and other stakeholders to take advantage of these opportunities. The combination of integrative governance, policy and technical measures documented must underpin any long-term green recovery from COVID-19, and will be integral to building resilience to future interconnected crises.

Additional case studies are required to broaden and deepen geographic, sectoral and thematic coverage, and to address knowledge gaps as they arise. To this end, UNEP aims to develop a sustainable infrastructure case studies database through the SIP, allowing many more cases to be accessible. Further such knowledge sharing relies on cooperation among governments and partners to help countries achieve sustainable infrastructure beyond the 5th session of UNEA, towards the 2030 Agenda and long into the future.

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