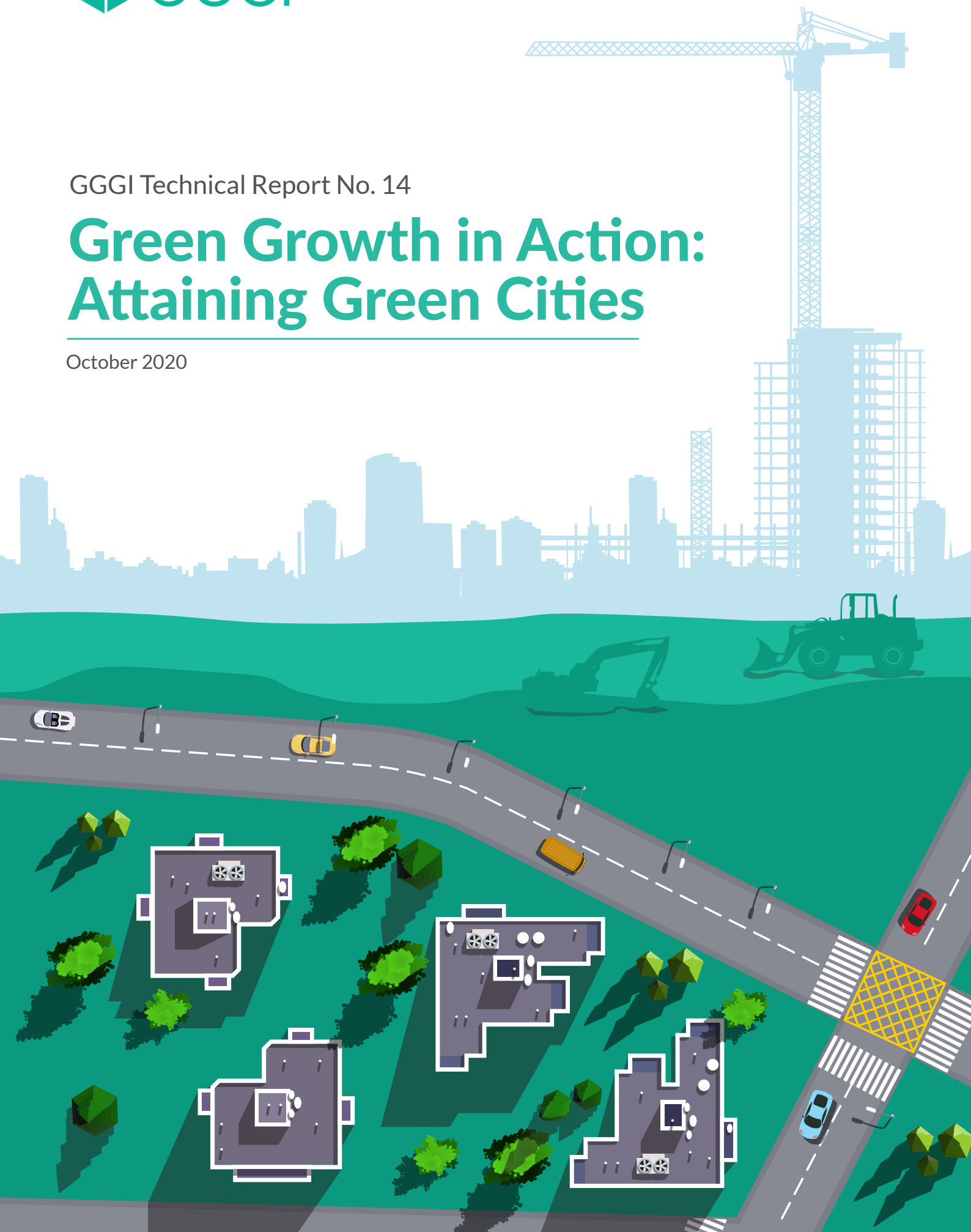




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Green Growth in Action: Attaining Green Cities

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2. Policy Recommendations on Energy for Productive Uses in Rural Areas of Senegal, Dereje Senshaw, 2017.
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4. Meeting Global Housing Needs with Low-Carbon Materials, Christina Cheong and Donovan Storey, 2019.
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About this report

Achieving Global Green Transformation is a collection of GGGI flagship reports highlighting the economic foundations of green growth and key approaches for developing green growth policies and plans and for implementing and financing scalable projects and programs in a number of key sectors.

This publication addresses Attaining Green Cities.

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Acronyms and Abbreviations

BRT	bus rapid transit
CO₂	carbon dioxide
CO₂e	carbon dioxide equivalent
EV	electric vehicle
GBMCS	Green Building Minimum Compliance System
GCF	Green Climate Fund
GGGI	Global Green Growth Institute
ICT	Information and Communications Technology
IPCC	Intergovernmental Panel on Climate Change
LDC	Least Developed Countries
MDG	Millennium Development Goals
MININFRA	Ministry of Infrastructure
NDC	National Determined Contribution
NMT	non-motorized transportation
OECD	Organisation for Economic Cooperation and Development
OSR	Own Source Revenues
PPP	public private partnerships
SDG	Sustainable Development Goal
SEZ	Special Economic Zones
SIDS	Small Island Developing States

An aerial photograph of a river valley in a mountainous region. The river flows through a deep valley, surrounded by steep, forested hills. The river is light-colored, possibly due to sediment. In the foreground, there is a small village with several buildings and a road. The overall scene is lush and green, with some brown patches of earth visible along the riverbanks.

Executive Summary

Catalyzing a Global Green Transformation

This century will bear witness to a profound global transformation—critical decisions will determine the direction of that transformation. Across the world, countries are rethinking their options for long-term prosperity given rising concerns about the global environment, the need to sustain and protect their domestic environment and natural capital, and the desire to promote strong inclusive social development. Recognizing that conventional, resource-intensive economic growth can undermine their resource base and social progress, governments are increasingly turning to green growth as their best option for long-term sustainability, social well-being, and economic prosperity.

Executive Summary

Many countries are already taking serious action in starting a green transformation across their economies and industries, in cities and rural areas, and at the international level in adopting the Sustainable Development Goals (SDGs) and the Paris Agreement on climate change. However, much more needs to be done. Through green growth, countries are now working towards a new, green transformation that can lead to a brighter, more prosperous, and sustainable future.

Embracing Green Growth

Green growth is the optimal choice for our future. It is no longer a new concept, and an increasing number of countries have been taking steps to adopt green growth as the primary—and essential—model of national development for the long-term.

The Global Green Growth Institute (GGGI) defines green growth as a development approach that seeks to deliver economic growth that is both environmentally sustainable and socially inclusive. GGGI's definition emphasizes that economic growth is of central importance for development and reducing poverty, and that achieving environmental sustainability and social inclusion are equally important and necessary to ensure that economic development is sustainable over the long term.¹

Green growth consists of four fundamental underlying dimensions to the concept of the green growth economy:



efficient and sustainable use of resources, including energy, water, land, and materials;



protection of natural capital and recognition of the limits of Earth system processes;²



green economic opportunities for investment, trade, employment, and innovation; and



inclusive growth, which ensures access to basic services and resources, health and safety, social equality, and social protection.³

In this technical report, GGGI has identified several critical issues for the successful transition to a green growth model of development. These issues are based on low- and middle-income countries' experience around the world, pursuing green growth with GGGI and partners' support.

Achieving Green City Transformation

Embracing green growth in cities is one urgent priority for addressing the environment and climate emergency. In this report, we address some of the challenges and opportunities in achieving green growth in cities.

Cities are central to the global sustainability agenda and green growth transition. Smart, integrated urban planning, infrastructure, and mobility solutions are a core part of this transition.

The world's cities have a critical role to play in supporting global sustainability and climate change ambitions and the realization of green growth pathways. While urban areas are at the forefront of national and global wealth accumulation, they must urgently address their unsustainable planetary footprint. Linking ambitious green city planning with high impact projects and climate and green finance provides a significant opportunity for change, including to support Nationally Determined Contributions (NDCs).

It is imperative to mainstream the concept of green growth into urban planning, management, and finance at the sub-national level for cities if they are to achieve green transformations. Such policies and plans must be supported by the national government and relevant ministries. GGGI has worked with line ministries and municipal governments to develop green city plans and frameworks in **Nepal, Senegal, Rwanda, and Cambodia**, and has delivered training materials to support project origination linked to climate finance and bilateral assistance. This work has created a stronger enabling environment, a more predictable policy framework, and robust institutional capabilities to support green transitions at the local level.

¹ GGGI, *GGGI Refreshed Strategic Plan 2015-2020: Accelerating the Transition to a New Model of Growth*, (Seoul: GGGI, 2017), <http://gggi.org/site/assets/uploads/2017/11/GGGI-Refreshed-Strategic-Plan-2015-2020.pdf>.

² As defined by the International Geosphere-Biosphere Programme (IGBP), "The term "Earth system" refers to Earth's interacting physical, chemical, and biological processes. The system consists of the land, oceans, atmosphere and poles. It includes the planet's natural cycles — the carbon, water, nitrogen, phosphorus, sulphur and other cycles — and deep Earth processes."

³ GGKP Research Committee on Measurement and Indicators, *Measuring Inclusive Green Growth at the Country Level: Taking Stock of Measurement Approaches and Indicators*, (working paper, Geneva: GGKP, 2016), <https://www.greengrowthknowledge.org/resource/measuring-inclusive-green-growth-country-level>.

Executive Summary

To ensure sustainability in the long term, environmental and social sustainability criteria needs to be systematically incorporated into all investment and project planning and in government procurement processes. Close and well-coordinated collaboration between different actors—such as national and local governments, development banks, and the private sector—is essential in developing innovative financing mechanisms and demonstrating project bankability and potential to support green city development.⁴ **Senegal**, for example, has established a green, sustainable, smart, and resilient cities platform with GGGI's support, bringing together representatives from the national and local government, the private sector, academia, and international agencies.

Promoting sustainable mobility is a priority to advance decarbonization and clean air efforts. Sustainable mobility measures include adopting electric and other clean vehicles, reducing congestion, making public transportation systems more integrated and efficient, and supporting non-motorized transportation (NMT) solutions, including mixed-use urban planning that provides for safe and accessible public spaces.⁵ A policy priority for local governments is to encourage a modal shift towards cleaner transportation and incorporate significant externalities such as air pollution-related economic and health impacts, into the cost-benefit analyses of city-level projects.⁶ Urban transportation is directly linked to outdoor air pollution, one of the world's leading health concerns. Poor air quality causes approximately 7 million premature deaths annually,⁷ and costs around 1% of global GDP or about USD 2.6 trillion annually.⁸

In **Jordan** and **Fiji**, GGGI has been supporting alternatives to individual vehicles by providing the government with evidence-based recommendations on how to achieve a gradual shift towards cleaner and more efficient public transport. Recommendations take into account socioeconomic benefits and helping the government replace the diesel-based public transport fleets,

particularly buses, with electric vehicles. In **Lao PDR**, **Philippines**, and **Cambodia**, GGGI is looking to transform the critical motorcycle and tuk-tuk markets. They provide a significant entry market for the emerging middle class and the younger population, therefore an entry point for significant generational shifts towards electric mobility.

Cities are at the forefront of greening the infrastructure gap and supporting the transition to circular economies and thus play a vital role in global green transformation.

To succeed, the green transition must use the significant potential for greening infrastructure and construction, particularly in cities. An estimated 75% of the building stock in developing countries in Africa and Asia will be built between 2010 and 2060.⁹ Globally, cities account for 67-76% of energy use and 71-76% of greenhouse gas (GHG) emissions.¹⁰ About one-third of global energy consumption is from the buildings sector, largely due to rapidly increasing air conditioning use.^{11,12} Although significant major infrastructure has been developed over recent years, a lack of basic infrastructure in many parts of the world, particularly in Africa and Asia, remains a leading global challenge. To green the infrastructure gap, GGGI has successfully supported **Rwanda** in developing Green Building Minimum Compliance Guidelines, which are mandatory and applicable for upcoming large-scale commercial buildings, office buildings, public buildings, hotels, hospitals, and schools. This work illustrates the importance of standards and regulations in avoiding high-carbon infrastructure lock-in in developing countries. In **Mongolia**, GGGI supported the development of a green materials database to inform public and private sector decision-making on low-carbon materials for infrastructure development.

A stronger emphasis on mainstreaming resource efficiency and the development of more circular economies is also needed. Urban economic and demographic growth is generating significant increases and change in

⁴ GGGI, *G20 Background paper: Green growth to achieve the Paris Agreement*, (Seoul: GGGI, 2019), https://ggi.org/site/assets/uploads/2019/02/GGGI_G20-Background-Paper_FINAL-v2.pdf, p33.

⁵ Land use impacts on transportation: How land use factors affect travel behavior, Victoria Transportation Policy Institute, July 2017, vtpi.org.

⁶ World Bank and Institute for Health Metrics and Evaluation. 2016. *The Cost of Air Pollution: Strengthening the Economic Case for Action*. Washington, DC: World Bank, <http://documents1.worldbank.org/curated/en/781521473177013155/pdf/108141-REVISED-Cost-of-PollutionWebCORRECTEDfile.pdf>.

⁷ World Health Organization, News Release, 2014, https://www.who.int/phe/eNews_63.pdf.

⁸ OECD, *The Economic Consequences of Outdoor Air Pollution*, 2016, <https://www.oecd.org/environment/indicators-modelling-outlooks/the-economic-consequences-of-outdoor-air-pollution-9789264257474-en.htm>.

⁹ UN-Habitat, *Sustainable Building Design for Tropical Climates: Principles and Applications for Eastern Africa*, 2014, Nairobi: UNHabitat, 421.

¹⁰ Seto et al., *Human Settlements, Infrastructure and Spatial Planning – Climate Change 2014: Mitigation of Climate Change*, 2014. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge and New York: Cambridge University Press.

¹¹ Isaac, Morna, and Detlef van Vuuren. 2009. "Modelling global residential sector energy demand for heating and air conditioning in the context of climate change." *Energy Policy* 37, no. 2: 507–521. <http://www.sciencedirect.com/science/article/pii/S0301421508005168>.

¹² GGGI, *G20 Background Paper*, 2019, 29.

Executive Summary

consumption patterns – even in smaller and regional urban areas. Yet little more than 10% of global waste is recycled and cities remain far too dependent upon centralized systems and landfills, with accompanying negative impacts on urban health, ecosystems, and GHG emissions. The extraction of construction materials grew by a factor of almost 34 during the 20th century.¹³ The Organisation for Economic Cooperation and Development (OECD) reports that materials use will increase from 79 gigatons in 2011 to about 167 gigatons in 2060 under business-as-usual conditions. More than half of all GHG emissions, expected to be about 50 Gt CO₂e by 2060, are related in some way to materials management.¹⁴ As natural resources are finite, there is a sense of urgency to focus on resource efficiency, especially in response to rapid and increasing urbanization.

GGGI has undertaken waste-to-resource assessments in **Rwanda, Lao PDR, Jordan, Peru, Fiji, and Cambodia** to develop business cases for cities wanting to break free from the economic and environmental costs of business-as-usual waste management. **Uganda** has recently adopted the country's first National Urban Solid Waste Management Policy, with GGGI support, which underscores the importance of mainstreaming resource efficiency in urban environments into policy and regulatory frameworks. In **Peru**, GGGI is supporting the City of Lima, which lacks waste management infrastructure (especially for organic waste) and only recycles 3% of its waste, to explore innovations to its waste management systems. Innovations could include incentives for household waste separation and waste-to-resource approaches using organic waste as a resource.

For green cities, what promises to be a major shift towards electric vehicles has now begun. Governments should seize the opportunities that increasingly cost-competitive technologies present and use policy and regulatory frameworks to direct investment away from conventional systems and towards electric mobility. Disruptive ideas and technologies in transportation—such as mobility as a service, autonomous driving, and cooperative intelligent transportation systems (C-ITS)—have the potential to revolutionize the sector and reshape the way we travel, drive, and deliver goods and services. These disruptions also hold the promise of boosting economies and creating new jobs. As such, long-term strategic planning and investments in such disruptions need to be considered, alongside policy evolution in the management of e-Waste and cleaner sources of energy.

Similarly, substantial efforts are underway to integrate smart, innovative, and green approaches into urban sustainability agendas to support more efficient, affordable, and effective services for all. Integrated “Smart+Green” communication and information systems can link people to more effective and responsive services or use Big Data and Artificial Intelligence to improve urban planning and management. At the local level, smart solutions to waste management include smart sorting bins, sensor bins linked to collection systems, and the use of data to support rationalized and cost-effective collection systems.



¹³ European Environment Agency. 2015. Urban Sustainability Issues - What is a resource efficiency city? Technical Report, Luxembourg: European Environment Agency.

¹⁴ OECD, *Global Material Resource Outlook to 2060*, 2019, <https://www.oecd.org/environment/global-material-resources-outlook-to-2060-9789264307452-en.htm>.



01

**THE
URBAN
CHALLENGE**

The Urban Challenge

The world's cities have a critical role to play in supporting global sustainability and climate change ambitions, and realizing green growth pathways. Indeed, urban areas are at the forefront of the green growth agenda, as they are increasingly responsible for driving national and global wealth but, there is urgency to do so in a sustainable way that minimizes negative external impacts.

In 2019, 55% of the world's population lived in cities, and this is expected to increase to 68% by 2050.¹⁵ This means that an additional 2.5 billion people will be living in urban areas by 2050, with 90% of this population increase occurring in Asia and Africa.¹⁶ Significantly, the fastest-growing urban areas will be cities with fewer than 1 million inhabitants, which face acute problems of rapid growth, limited investment, and low levels of capacity.¹⁷ Smaller and medium-sized urban areas are now increasingly recognized for their contribution to national and global sustainable development agendas and climate change mitigation. These urban areas are critical to the global urban future as they have the potential to shape sustainability agendas today.

Urbanization drives national and global prosperity, as cities today generate around 80% of global GDP.¹⁸ Yet this positive contribution, as engines of national, regional, and global growth, cannot obscure the fact that urban development and prosperity comes at a considerable environmental cost. These problems must be addressed urgently. The Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) found in 2014 that urban areas account for between 67% and 76% of global energy use and between 71% and 76% of global CO₂ emissions.¹⁹ This is compounded by the increased vulnerability of cities to climate change due to the high risk of mortality and economic losses associated with natural disasters, particularly flooding and storm surges, droughts, heatwaves, and tropical cyclones.²⁰ Cities in the Asia-Pacific region are considered amongst the most vulnerable in the world to such disasters.²¹

There is a growing consensus that cities must grow and function differently and increasingly balance growth and sustainability. Figure 1 highlights the necessary transformations. The most critical of these challenges is the transition of policy frameworks and visions to support urban sustainability goals and targets. An estimated 65% of SDG targets require the support and capacity of local governments,²² but cities often have neither the mandate nor the capacity or resources to implement transformative projects and integrated urban regional planning, including for peri-urban areas. This lack of capacity, coupled with traditional institutional structures and project development, constrains efforts to develop innovative projects which link cities to Agenda 2030 and the Paris Agreement.

¹⁵ UNDESA, *World Urbanization Prospects: The 2018 Revision*, 2018, <https://population.un.org/wup/>.

¹⁶ UNDESA, *World Urbanization Prospects: The 2018 Revision*, 2018.

¹⁷ African Development Bank, Asian Development Bank, European Bank for Reconstruction and Development, Inter-American Development Bank, *Creating livable cities: regional perspectives*, 2019, <http://dx.doi.org/10.18235/0001939>.

¹⁸ IPCC, "Human Settlements, Infrastructure, and Spatial Planning." Chapter. In *Climate Change 2014: Mitigation of Climate Change: Working Group III Contribution to the IPCC Fifth Assessment Report*, 923–1000. Cambridge: Cambridge University Press, 2015. <https://doi.org/10.1017/CBO9781107415416.018>.

¹⁹ IPCC, *Climate Change 2014: Synthesis Report*. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)], (Geneva, Switzerland: IPCC, 2014), <https://www.ipcc.ch/report/ar5/syr/>.

²⁰ UN-Habitat, *World Cities Report 2016*, <https://wcr.unhabitat.org/>.

²¹ Asian Development Bank, *A Region at Risk: The Human Dimensions of Climate Change in Asia and the Pacific*, 2017, <https://reliefweb.int/report/world/region-risk-human-dimensions-climate-change-asia-and-pacific>.

²² SDSN, *Getting started with the SDGs in Cities*, 2016, <https://resources.unsdsn.org/getting-started-with-the-sdgs-in-cities>.

Figure 1. Towards Green Cities: The 8 Key Transformations



The challenge is especially acute in secondary cities and regional urbanizing centers which lack planning and capacity for implementation. For example, in Asia, nearly half of urban residents live in cities of under 500,000 people. Significant opportunities to address secondary cities' needs lie in supporting 'smart'²³ and green urban planning and approaches to help them 'leapfrog' into more sustainable futures. Such opportunities rely on technological innovation and the sound management of financial resources. Emerging cities must also develop projects which match the scale, need, and financial and institutional capacities. Much more needs to be done to support this essential transition to avoid repeating past mistakes and to capture new technologies and green financial flows.

Cities must also become more compact and connected. They must address an ever-increasing spatial and material footprint. A recent OECD analysis²⁴ classifies 60% of the space in 1,100 cities as low-density. It recognizes the multi-dimensional aspect of this problem, reflecting how population density is distributed across the urban area and how urban land is fragmented. This affects access to service delivery and transportation footprints and degrades peri-urban ecosystem services. The OECD

recommends that policy changes through integrated planning should promote socially desirable levels of population density and minimize urban fragmentation. Better-connected cities have the potential to provide for social, economic, and environmental benefits. However, density must be 'positive' and demonstrate advantages in providing access to urban infrastructure and social services, supporting NMT, and dedicated green space.²⁵

Cities around the world, at all levels of development, face both a resource and waste crisis. As waste management is principally a local government responsibility, managing waste more effectively is an urgent priority for cities everywhere. A 2012 study by the World Bank showed that solid waste generation around the world is expected to grow from 1.3 billion tons in 2012 to 2.2 billion tons per year by 2025. The global costs of solid waste management will increase from USD 205.4 billion annually to about USD 375.5 billion in that timeframe.²⁶ The rate of waste generation will more than double over the next twenty years in lower-income countries alone. Cost increases will be most severe in low-income countries (more than five-fold increases) and lower-middle-income countries (more than four-fold increases). World Bank research shows that unsustainably managed waste through unregulated

²³ The concept of smart cities includes but transcends smart city concepts based upon IT solutions. In a broader sense, a smart city can also include one that is well managed and governed, inclusive, manages its resources sustainably, and is able to provide efficient, affordable, and effective services to the urban population. Such solutions may or may be supported through technology to a lesser or greater extent.

²⁴ OECD, *Rethinking Urban Sprawl: Moving Towards Sustainable Cities*, (Paris: OECD Publishing, 2018), <https://doi.org/10.1787/9789264189881-en>.

²⁵ Paul Jones and Donovan Storey, "Density, sprawl and sustainable urban development," in Bay J-H and S. Lehmann (eds) *Growing Compact: Urban Form, Density & Sustainability*. (London: Routledge, 2017).

²⁶ Daniel Hoornweg and Perinaz Bhada-Tata, "What a Waste: A Global Review of Solid Waste Management," Urban Development Series, Knowledge Paper No. 15, (Washington DC: World Bank, 2012), <http://hdl.handle.net/10986/17388>.

dumps or open burning impacts residents in developing countries more severely, especially the urban poor. These practices have serious health, safety, and environmental consequences and they also prove to be a massive financial and resource burden on local governments. Waste also increasingly contributes to GHG emissions. As of 2016, 5% of global emissions were generated from solid waste management alone, not including waste transportation.²⁷

Managing waste is also likely to become more complex from a capacity and regulatory perspective as waste composition shifts from predominantly organic towards greater volumes of non-organic and e-waste. Cities in developing countries rarely have the capacity, technology, and administrative framework to deal with non-traditional waste streams. City strategies need to manage this waste in a holistic manner. They can focus on the 3Rs (reduce, reuse, and recycle), waste-to-resource approaches shifting away from landfill-oriented solutions towards circular economies and deriving revenue, and creating green jobs, through innovative and inclusive waste management practices.

Urbanization comes with increased demands for infrastructure and services such as sanitation, clean drinking water, and energy. However, many cities in the developing world have been unable to keep pace with such demand. If this infrastructure gap is not closed, and in the absence of adequate property rights, millions of urban dwellers will face living in informal settlements without basic sanitation, clean drinking water, energy, or waste collection.²⁸ Just as importantly, if these needs are met through conventional means and materials, cities contribution to GHG emissions will expand. It is therefore essential that cities find ways to 'green' new infrastructure and close service gaps.²⁹

²⁷ Silpa Kaza et al., *What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050*. Urban Development, (Washington, DC: World Bank, 2018), <http://hdl.handle.net/10986/30317>.

²⁸ Graham Floater et al., *Global Review of Finance for Sustainable Urban Infrastructure*. Coalition for Urban Transitions, 2017, https://newclimateeconomy.report/workingpapers/wp-content/uploads/sites/5/2018/01/NCE2017_CUT_GlobalReview_02012018.pdf.

²⁹ Christina Cheong and Donovan Storey, *Meeting Global Housing Needs with Low Carbon Materials*, Technical Report No. 4. (Seoul: GGGI, 2019), https://ggi.org/site/assets/uploads/2019/05/Report-Green-building-materials-for-low-cost-housing_circulated.pdf.



ECO BUS

02

**KEY STRATEGIES
FOR ATTAINING
GREEN CITIES**

Key Strategies for Attaining Green Cities

2.1 Greening Policies and Planning Frameworks

An enabling environment, including a strong policy framework and robust institutional capabilities, is vital to develop and sustain green city development. To deliver policies that attract private investments in infrastructure, countries and cities need to work together to create a stable and predictable policy and regulatory environment, including for public-private partnerships. They must simultaneously tackle fundamental issues, such as inadequate planning, corruption, and skills shortages. To ensure long-term sustainability, environmental and social sustainability criteria must be systematically incorporated in investment and project planning and in government procurement processes. Close and well-coordinated collaboration between different actors—such as national and local governments, development banks, and the private sector—is essential in developing innovative financing mechanisms and demonstrating project bankability and potential for green city development.³⁰

Mainstreaming green growth in plans and policies provides the necessary guidance and enabling environment for stakeholders and investors to undertake low-carbon and climate-resilient infrastructure projects. It is therefore a highly efficient and effective means of enhancing the implementation of green growth interventions. Local governments can incorporate green growth standards and objectives in strategic urban planning and land-use planning, while national governments can develop national strategies for green city development through National Urban Policies (NUPs) by providing guidelines to spur infrastructure investments. Infrastructure projects should incorporate climate parameters in their planning, design, maintenance, and implementation, which aim to reduce GHG emissions and climate risk. Furthermore, regulatory instruments that support energy efficiency in new and existing buildings and the use of low-carbon materials in construction—such as minimum performance standards, green labels, and certification—should be mainstreamed into building regulations and design codes. Governments can significantly improve the construction and energy efficiency of buildings in their countries by designing these regulatory policies. Lastly, development restrictions and transfer development rights are instruments that can be integrated into land-use planning to restrict development in climate risk areas.³¹

Governments can also provide economic incentives aimed at developing and strengthening sustainable infrastructure. These include tax incentives for the use of low-carbon building materials and energy-efficient buildings and appliances. Economic instruments can yield co-benefits such as the use of local raw materials, recycling and reusing materials, including job creation and re-training and small business development.

Box 1. Consolidating Government Leadership on Green City Development

Government and political leadership are critical enablers for urban green transformations. Many countries have taken steps to elevate urban development issues to the national level. In **Senegal**, a National Green Cities Technical Committee has been in place since July 2016, serving as a platform for discussions on programmatic issues. Composed of 16 relevant agencies, directorates, and institutional members, the role of the Technical Committee is to guide GGGI activities on the development of green cities. The Technical Committee is co-chaired by the President of the Senegal Mayors Association and the General Direction of Urban planning and Architecture. It provides technical assistance as a contribution to the deliverables of the GGGI projects and initiatives in Senegal for the development of green cities. The Committee meets every quarter. To complement this effort, GGGI has helped to establish a green sustainable, smart, and resilient cities platform which involves stakeholders representing the government, the association of mayors, academics, civil society, international agencies, and the private sector. The initiative serves as a framework for learning and capitalizing on best urban practices and innovations in Senegal. It provides an opportunity for exchanging information, consultation with partners, and capacity building to guide cities towards a sustainable development trajectory. The platform allows for three types of interventions: (a) knowledge sharing and capacity building; (b) development of tools and advocacy activities; and (c) partnerships and resource mobilization.

³⁰ GGGI, *G20 Background Paper: Green growth to achieve the Paris Agreement*, (Seoul: GGGI, 2019), https://gggi.org/site/assets/uploads/2019/02/GGGI_G20-Background-Paper_FINAL-v2.pdf, p33.

³¹ GGGI, *G20 Background Paper*, 2019, p34.

Box 2: Mainstreaming Green Growth into Urban Management

GGGI is working in many countries undergoing a rapid rural-to-urban transition. At the request of national and city governments, GGGI has conducted assessments, supported national governments in developing national roadmaps, and helped draft forward-looking green city plans. The purpose of these documents has been to help governments develop capacity on the concept of green growth at both the national and local level and identify action plans to mainstream green urbanization into urban management and planning. A few country examples highlighting this work are presented below.

In **Nepal**, GGGI initiated a Green Municipal Development Program through a consultative process and completed situational assessments in 7 out of 250 reclassified municipalities. The program addresses rural-to-urban transformation challenges that shift away from a business-as-usual approach to urbanization. It aims to localize NDCs and link local and international green urban frameworks. To ease the population pressure in larger cities and to develop alternative growth trajectories to business-as-usual, the program aims to instill a green growth approach at the outset of Nepal's rapid urbanization process.

In **Cambodia**, GGGI's Green Urban Development Program (GUDP) has provided strategic and technical advice to develop the Phnom Penh Sustainable City Plan (PPSCP) 2018-2030, which will serve as the foundation for mainstreaming green growth into sustainable urban planning and development in the city. Through a consultative process, GGGI in Cambodia will focus on project implementation in the waste sector in Phase II of the program (2019-2020) to move towards circular urban economies and sustainable waste management systems.

GGGI in **Viet Nam**, through the Urban Green Growth Action Project, has worked with the Ministry of Construction and the Ministry of Planning and Investment to mainstream green growth in all urban and investment policies while also supporting cities in their implementation. Through this work, the Ministry of Construction has passed a circular to track progress through a set of Urban Green Growth Indicators developed with GGGI support.

The Government of **Rwanda** aspires towards a green economy through the National Strategy for Climate Change and Low Carbon Development and Economic Development and Poverty Reduction Strategy (EDPRS II). GGGI has worked with the Ministry of Infrastructure (MININFRA) to develop the National Roadmap for Green Secondary City Development for six secondary cities.

In meeting the climate needs of Small Island Developing States (SIDS), GGGI has been working to identify significant drivers which can support and enhance Ecosystem-based Adaptation (EbA).³² SIDS are particularly vulnerable to extreme climate events and need a balanced approach in managing the expanding urban built environment in congruence with ecosystem services. In the **Eastern Caribbean**, resilient urban and social infrastructure is seen as essential to addressing the challenges of natural disasters, especially hurricanes, which threaten to undermine development gains over past decades. In **Papua New Guinea**, sub-national governments are looking at developing provincial and local plans to manage the projected impacts of climate change, including resilient regional cities and their broader environments.

³² GGGI, *Synthesis Report: Impacts of Urbanization and Solid Waste Management on Ecosystem based Adaptation in Fiji, Kiribati and Vanuatu*, 2018.

2.2 Capacity Building and Governance for Green Urban Growth

Cities need strong institutions that have the technical capacity to undertake the various necessary components of sustainable urbanization. These components include urban planning, management of municipal finances, and an adequate understanding of the use and implications of technologies and the implementation of circular economy and waste-as-a-resource measures to be able to deliver on green growth. As cities embark on green urbanization, it is important to identify and involve stakeholders in developing a shared vision for the city. Stakeholders include representatives of civil society, non-governmental organizations, technical experts, the private sector, indigenous people, and the urban poor.

A gender-balanced approach is essential for the success of any sustainability agenda. Therefore, gender-inclusive urbanization is vital. It is estimated that approximately 30%³³ of the world's urban population lives in slums and it is typically women and young girls who are most adversely affected by inadequate access to basic urban services.^{34,35} Recent agreements such as the New Urban Agenda recognize the disproportionate amount of time that women and young girls spend in providing for a decent standard of living. They call for greater emphasis to be placed on economic productivity, employment and decent work for all, with specific reference to women's needs for adequate access to basic urban services and quality of life.³⁶

Decision-making processes should also involve people inclusive of all urban society, as a lack of adequate engagement and representation ultimately undermines successful transitions. An inclusive approach is the foundation of the successful implementation of any project or policy. Including all relevant stakeholders is crucial to ensure the accessibility and affordability of basic services. This can be achieved through gender- and socially-inclusive urban planning that incorporates access to basic urban services along with sustainability and green growth in land-use planning.

As cities develop, involving the informal sector is essential to delivering green urbanization. Especially in Least Developed Countries (LDCs), the informal sector is a primary supplier of services—whether through waste management and recycling, fecal sludge collection,

or informal transportation systems. In implementing inclusive green urbanization, the informal sector needs to be considered as a crucial partner and engaged in more sustainable systems and operations to bring in accountability and reduce revenue losses from informal systems. In **Lao PDR**, for example, GGGI's work on supporting waste management and a circular economy considered a role for informal collectors and pickers from the outset. Approaching informal sector workers as stakeholders in the system from the planning stage has facilitated their inclusion into solutions and approaches, alongside local government and the private sector as partners.

Box 3. Capacity Building to Deliver Green Urbanization

Governments often identify a lack of technical capacity to plan for and implement green growth as a critical gap. To ensure the successful implementation of its programs, GGGI has developed a training-of-trainers program to fill this gap. For instance, in **Rwanda**, GGGI collaborated with the Ministry of Infrastructure (MININFRA) to develop the National Roadmap for Green Secondary City Development.³⁷ To successfully implement the Roadmap, a training-of-trainers program resulted in training 50 officials from six secondary cities on green urbanization and providing them with the tools they needed to identify potential green city projects.

Noting the critical importance of capacity building for green city development, GGGI has also developed a training manual.³⁸ The modules cover topics such as waste-to-resource and circular economies, green buildings, municipal financing, low-carbon, and resource-efficient cities, and preparing project proposals for green cities. The manual was developed as an open-source tool to use as a starting point for governments and stakeholders that have a limited understanding of the issues and would like to undergo training before implementing green urban programs.

³³ World Bank World Development Indicators, *Population living in slums (% of urban population)*, (ID:EN.POP.SLUM.UR.ZS); 2014, <https://data.worldbank.org/indicator/EN.POP.SLUM.UR.ZS>.

³⁴ Cecilia Tacoli, *Urbanization, gender and urban poverty: paid work and unpaid care work in the city*. International Institute for Environment and Development, United Nations Population Fund, 2012, <https://www.unfpa.org/sites/default/files/resource-pdf/UEPI%207%20Tacoli%20Mar%202012.pdf>.

³⁵ African Development Bank, *Creating livable cities: regional perspectives*, 2019.

³⁶ United Nations, *The New Urban Agenda, Habitat III*, 2017, <http://habitat3.org/the-new-urban-agenda/>.

³⁷ Government of Rwanda and GGGI, *National Roadmap for Green Secondary City Development*, 2015, <https://gggi.org/site/assets/uploads/2017/12/National-Road-map-for-Green-Secondary-City-Development.pdf>.

³⁸ GGGI, *Green Cities Training Manual*, 2020, <https://gggi.org/report/green-cities-development-a-training-manual/>.

2.3 Smart and Green Cities: Linking the Agendas

In recent years there has been a growing interest in the application of “smart city” approaches and how they can support green city outcomes. The links are not automatic. Smart city applications and approaches often create a high energy demand and do not necessarily encourage shared knowledge for planning or inclusive “smart citizens” approaches. This can, therefore, lead to an increase in a city’s material footprint and can increase inequalities. Nevertheless, technologies ranging from basic communication via smartphones to very sophisticated artificial intelligence (AI) approaches can support smarter solutions to meet cities’ sustainability goals. To improve resource efficiency, cities need to be responsive and create efficient systems that are informed by real-time data, integrating information and communications technology where possible. Ensuring that these cities are smarter is critical for their long-term sustainability but a nexus between smart and green is required to integrate these important agendas to support city planning and investment.

GGGI defines a smart green city as one that is well-governed, inclusive, manages its eco-resources sustainably, and through information and communications technology (ICT) can provide efficient, affordable, and effective services to all through “smart approaches and systems.” Such a city can efficiently use finances and generate investment to support its plans. As such, there is no single model or strategy. Smart and green cities can be centralized or decentralized, technology-oriented or collaborative, public-oriented or private- and crowd-sourced. They focus on the built environment but also on managing and tracking urban ecosystems (such as the through the ‘Internet of Nature’). In several sectors, cities already generate data that can be captured and used more effectively. Smart and green cities share a focus on the integration and application of smart approaches and technology in supporting planning decisions and collective decision-making which results in tangible improvements and benefits for sustainability.

It cannot be assumed that smart city technologies or applications will, in themselves, result in more inclusive or sustainable urban environments. Access to information and communications technology is often unequal, especially in developing countries. When developing innovative solutions, it is thus necessary to address challenges such as the equality of technology accessibility and the inclusion of low-income groups³⁹ while also paying attention to environmental considerations, especially regarding energy.

Box 4: Transforming Cities through Innovative Technologies, ICT, and Business Models

Cities worldwide are increasingly embracing the use of innovative technologies, ICT systems, or business models to run everything from transportation networks to buildings to energy and waste management services.

The **City of Seoul, Republic of Korea**, has developed an integrated transportation system called TOPIS. TOPIS manages traffic in real-time using sensors and applications that aim to provide adequate mobility to the public, and thus reduce the use of private cars. The **City of Medellin, Colombia**, has also implemented an integrated transportation system, to reduce crime rates through more timely transport and encourage the use of public spaces through planning for NMT.

Cities around the world have also been integrating the use of sensors to inform the design and maintenance of buildings, to monitor the condition of bridges and other infrastructure, to conduct air quality monitoring, to track vacancies for cars in parking lots, and to provide automated lighting in parks.

In the waste management sector, cities as diverse as **Seoul** and **Bogota** have implemented innovations to support more effective waste management. Initiatives include dedicated waste-type bags where the waste fee is charged at the time of bag purchase, smart sorting bins, sensors used to direct and monitor collection systems, and applications that provide waste collection services on an as-needed basis and provide money in exchange for recyclables. In Seoul’s case, the volume-based waste fee system contributed to a 16.6% reduction in waste generation and an increase in recycling rates from 16% to 43% between 1994 and 2001. In **Lao PDR**, the GGGI waste management program is trialing several smart devices, such as sensor tags and bins, to support waste-to-resource approaches. This initiative demonstrates how technology can be used in an LDC context.

³⁹ Rohit T. Aggarwala, Katie Hill, and Robert Muggah, “Smart City experts should be looking to emerging markets.” *World Economic Forum*, 2018, <https://www.weforum.org/agenda/2018/10/how-the-developing-world-can-kickstart-the-smart-cities-revolution/>.



03

TRANSFORMING
URBAN
INFRASTRUCTURE
AND MOBILITY

Urban Infrastructure and Mobility

3.1 Greening the Infrastructure Gap

The infrastructure built today will remain in place for the next 30 to 100 years.⁴⁰ It is estimated that USD 65 trillion needs to be spent on urban infrastructure by 2030, with ever-increasing demand in the years that follow.⁴¹ According to UN-Habitat, 75% of the building stock in developing countries in Africa and Asia will be built between 2010 and 2060.⁴² About one-third of global energy consumption is from the buildings sector. This, in part, results from the growing middle-class in emerging economies and a steadily warming climate. Energy demand for cooling is projected to continue rising over the coming decades and will surpass the energy consumption for heating by the year 2060.⁴³

Many cities face considerable infrastructure gaps with an equally important challenge in identifying sources of sustainable municipal financing. Future projected growth will ensure that this challenge persists, compounded by a lack of effective planning frameworks. Though much of the debate focusses on catching up, it is clear from a sustainability perspective that cities can no longer afford to develop through business-as-usual approaches. Instead, cities must strive to green their infrastructure gaps rather than being stuck with highly polluting infrastructure. Far from being a further impediment, looking towards innovative and green solutions will help ensure that our urban infrastructure is more resilient and sustainable.⁴⁴

Although significant major infrastructure has been developed over recent years, a lack of basic infrastructure in many parts of the world, particularly in Africa and Asia, remains a leading global challenge. Nearly 1.3 billion people worldwide do not have access to electricity, most of whom live in developing Asia and Sub-Saharan Africa.⁴⁵ In Asia, 1.5 billion people lack access to sanitation, and 300 million people lack access to safe drinking water.⁴⁶ The

damage to various types of critical infrastructure from extreme weather events and climate-related disasters has increased over recent years, resulting in significant economic losses and casualties.^{47,48}

Considering the significant anticipated growth in urban populations globally, it is critical to ensure that newly built infrastructure and buildings have low carbon footprints and are climate-adaptable and resilient. They need to avoid negative lock-in effects for many decades to come and be developed to boost economic prosperity while generating multiple social and environmental benefits. Urban infrastructure is one of the most critical sectors to reduce GHG emissions since it accounts for about a third of global energy use. It is technically feasible to construct low or nearly zero carbon buildings and infrastructure, and energy efficiency measures in buildings are often commercially attractive investments.

As energy efficiency measures tend to move costs from operational (monthly energy bills) to investment or capital costs, they are likely to create an up-front financing requirement. Governments can provide economic or tax incentives to consumers and businesses that have proven effective in accelerating the uptake of energy efficiency measures. Once energy production is predominantly renewables-based, the electrification of buildings' heating and cooling and use of heat pumps offers can reduce GHG emissions further.⁴⁹

Significant energy efficiency and mitigation potential can be realized in both new and existing buildings through energy efficiency improvements in heating and cooling, cooking, lighting, and water heating systems. Thermal insulation and the reuse of materials also create savings. Remarkably, it is possible to reduce global energy use to current levels by 2050 simply through existing technical and economically mature technologies and measures in the

⁴⁰ GGGI, G20 Background Paper, 2019, p29.

⁴¹ Nick Godfrey and Xiao Zhao, Financing the Urban Transition for Sustainable Development: Better Finance for Better Cities, New Climate Economy, 2016, <https://newclimateeconomy.report/workingpapers/workingpaper/financing-the-urban-transition/>.

⁴² UN-Habitat, *Sustainable Building Design for Tropical Climates: Principles and Applications for Eastern Africa*, (Nairobi: UNHabitat, 2014), https://unhabitat.org/sites/default/files/download-manager-files/Sustainable%20Building%20Design%20for%20Tropical%20Climates_1.pdf, p421.

⁴³ Morna Isaac and Detlef van Vuuren, "Modelling global residential sector energy demand for heating and air conditioning in the context of climate change," *Energy Policy* 37, no. 2 (2009): 507–521, <https://doi.org/10.1016/j.enpol.2008.09.051>.

⁴⁴ Christina Cheong and Donovan Storey, *Meeting Global Housing Needs with Low Carbon Materials*, Technical Report No. 4. (Seoul: GGGI, 2019), https://ggi.org/site/assets/uploads/2019/05/Report-Green-building-materials-for-low-cost-housing_circulated.pdf.

⁴⁵ UNESCAP and UN-Habitat, *The State of Asian and Pacific Cities: Urban transformations – shifting from quantity to quality*, 2015, Nairobi: UN-Habitat and UNESCAP, 204.

⁴⁶ Asian Development Bank, *A Region at Risk: The Human Dimensions of Climate Change in Asia and the Pacific*, 2017.

⁴⁷ UNISDR, *The Human Cost of Weather-Related Disasters*, 2015. https://www.unisdr.org/files/46796_cop21weatherdisastersreport2015.pdf.

⁴⁸ GGGI, G20 Background Paper, 2019, p29.

⁴⁹ GGGI, G20 Background Paper, 2019, p34.

building sector.⁵⁰ New methods and technologies used in building construction and retrofits are becoming financially attractive and now even generate net-negative costs because they provide direct performance improvements and reduce operational costs throughout building lifetimes.⁵¹

Innovations and investments into low-carbon infrastructure must also serve the world's poorest in a socially inclusive manner. Today the number of the urban poor living in slum conditions is estimated at 900 million, while the World Bank estimates that 3 billion people will require housing and basic infrastructure by 2030.⁵² Linking low-carbon solutions to housing needs is, therefore, an essential goal. GGGI has recently undertaken a study on low-carbon building materials with a focus on low-cost housing. The study looks at common gaps in the current construction value chain and proposes avenues to overcome them, especially as cities develop low-carbon infrastructure with housing as a substantial component. Despite the many economic and social benefits of energy efficiency and climate-resilient investments in buildings and infrastructure, in the long run, real investment still lags far behind what is required to limit warming to within 1.5°C or even 2°C per the Paris Agreement. Approximately USD 90 trillion in infrastructure investments is expected in the 15 years starting in 2016, according to the Global Commission on the Economy and Climate.⁵³ Infrastructure investments in low- and middle-income countries account for about two-thirds of that total, or about USD 4 trillion per year.⁵⁴

However, high costs of capital and high interest rates create significant constraints for low- and middle-income countries to access private financing for infrastructure projects. One impediment is that these long-term opportunities can require significant up-front investments. Equally important, many of these countries also lack stable policy environments and institutional capabilities to attract institutional and private investors. Mobilizing resources and raising finance—not only to bridge but also to build climate-resilient and green large infrastructure—is a major challenge for developing countries and cities. Addressing these challenges requires concerted and well-coordinated action by government, non-governmental organizations, multilateral and bilateral development banks, and multiple other stakeholders.

GGGI has made considerable progress in addressing these needs in both **Rwanda** and **Mongolia**. In **Mongolia**, residential buildings account for 40% of energy consumption in the country, more than the industrial and transport sectors combined. In supporting **Mongolia** to transition to a more sustainable built environment, GGGI began working with the Municipality of Ulaanbaatar in 2017 to improve access to finance. It carried out energy audits for three residential, multi-family buildings to determine the level and areas of heat loss. GGGI then designed a project that took into account feedback to adapt to the financing mechanism, the involvement of energy companies, and issues with household contributions. In 2019, the project secured funding for preparation from the Nationally Appropriate Mitigation Action (NAMA) Facility, which focuses on financing projects designed to reduce GHGs. The Municipality of Ulaanbaatar, together with GGGI, aims to mobilize additional finance to retrofit 375 residential building blocks.

In **Rwanda**, GGGI helped to develop the Ministerial Order that outlines the Green Building Minimum Compliance System (GBMCS) along with the revised Rwanda Building Code 2019. The GBMCS will support Rwanda's ambition to reduce GHG emissions from the building and construction sector, starting with new large-scale public buildings and major refurbishments. The GBMCS provides a baseline for mainstreaming green buildings in Rwanda and the system has helped to raise awareness on the benefits of green buildings and construction practices in Rwanda and across the African continent. These shifts are critical as Africa urbanizes and increases investment into its future built environment. In Africa, the building sector accounted for 61% of final energy use and 32% of energy-related CO₂ emissions in 2018. Rwanda is an early mover in bringing about change. It is the first country in Africa to mandate the GBMCS through its revised building codes, which is expected to trigger decarbonization and resource efficiency throughout the building construction value chain.

⁵⁰ IPCC, *Climate Change 2014: Synthesis Report*, 2014.

⁵¹ IPCC, *Climate Change 2014: Synthesis Report*, 2014.

⁵² "Housing for All by 2030," World Bank, 2016, <https://www.worldbank.org/en/news/infographic/2016/05/13/housing-for-all-by-2030>.

⁵³ New Climate Economy, *The Sustainable Infrastructure Imperative: Financing for better growth and development*, 2016, http://newclimateeconomy.report/2016/wp-content/uploads/sites/4/2014/08/NCE_2016Report.pdf.

⁵⁴ New Climate Economy, *The Sustainable Infrastructure Imperative*, 2016; GGGI, G20 Background Paper, 2019, p31.

3.2 Financing the Urban Green Transition

Most cities in developing countries and emerging economies continue to face critical finance gaps compounded by legal barriers to borrowing on financial markets. Tax collection remains a significant hurdle for revenue availability for infrastructure spending. Although several rapidly urbanizing economies have boomed over recent decades, many cities still fail to capture sufficient tax revenues or to effectively maintain and derive revenue from their assets. In short, this manifests itself in growing cities with clear infrastructure gaps which are ironically difficult to finance. Such impediments can be overcome through stronger partnerships between central and local government and local and international finance through blended and other financial mechanisms.⁵⁵

Innovative financing mechanisms and a suite of different financial instruments are critical to spur investments in bridging the infrastructure gap. Public finance, either from national sources or international development institutions, will play a catalytic role in attracting additional private investments. According to the Global Commission on the Economy and Climate,⁵⁶ up to 65% of infrastructure project financing is provided by public funds. At the same time, the level of funding that cities receive from state or central government is declining. For instance, total municipal revenues fell by about 12% from 2010-2016, even in OECD countries.⁵⁷ Overall, central budget allocations to cities are falling at a time when investment in future-oriented urban infrastructure is most critical. There is thus an urgent need for cities to yield more from own-source revenues, and better manage the resources they have. Additionally, it is essential that private and institutional investors make significant parts of these investments, bearing in mind that such investment will only flow to fiscally responsible and well-managed cities.⁵⁸

Municipal finance is therefore recognized as an area of great concern for urban development. The Addis Ababa Action Agenda (Article 31) explicitly refers to the need for national government and the international community

to support stronger municipal finances to, in turn, realize the goals of global development and sustainability agendas. This includes municipal governments enhancing and utilizing their Own Source Revenues (OSR), such as property taxes or business taxes, user fees such as building permit fees, utility tariffs, or leasing charges to give a few examples.⁵⁹ The majority of cities—especially smaller and emerging urban areas—remain greatly reliant upon central, national sources of finance which may be unpredictable, insufficient, or not well aligned to local planning priorities and development needs.⁶⁰ This presents a significant challenge in terms of access to adequate financial resources to both plan for, and achieve, sustainable urbanization.

In some countries, cities do not have the statutory delegation of power from the central government to be able to receive financial resources. Along with administrative decentralization, countries also need to decentralize financial management responsibilities to cities so that they can independently manage their finances. An estimated 56% of countries do not allow any kind of local government borrowing, and almost 93% of low- and lower-middle-income countries have sovereign credit ratings considered to be below international investment grade.⁶¹

Cities with limited financial resources are also unable to raise debt independently. This is due to low credit ratings for cities, which makes them ineligible to raise debt nationally or internationally. More recently, cities have been considering municipal bonds as an option, but this financial instrument is limited to larger cities with minimum required ratings to raise debt. The smaller secondary cities of Africa and Asia, where the most rapid urbanization is taking place, have limited ability to raise debt on their own. Several are, however, beginning to explore the option of collectively raising debt by pooling with other similar cities.⁶²

Still, the most rapidly growing cities in developing countries have limited financial resources per capita to address the main urban challenges they face.^{63,64} The World Bank estimates that just 4% of the 500 largest developing city governments are regarded as creditworthy

⁵⁵ GGGI, *Mind the Gap: Bridging the climate financing gap with innovative financing mechanisms*. Insight Brief. Seoul: GGGI, 2016), https://www.greengrowthknowledge.org/sites/default/files/downloads/resource/Mind_the_Gap_GGGI_Insight_Brief_1_0.pdf.

⁵⁶ New Climate Economy, *Unlocking the Inclusive Growth Story of the 21st Century: Accelerating Climate Action in Urgent Times*, (Washington, DC: NCE, 2018), <https://newclimateeconomy.report/2018/>.

⁵⁷ Loay AlMujadidi et al., "Unlocking the full potential of city revenues," *McKinsey & Company*, 12 July 2019, <https://www.mckinsey.com/industries/public-and-social-sector/our-insights/unlocking-the-full-potential-of-city-revenues>.

⁵⁸ GGGI, G20 Background Paper, 2019, p33.

⁵⁹ "Explainer: How to Finance Urban Infrastructure," C40 Cities Knowledge Hub, 2017, https://www.c40knowledgehub.org/s/article/Explainer-How-to-finance-urban-infrastructure?language=en_US.

⁶⁰ Daniel Ayalew Ali, Klaus Deininger, and Michael Wild, Using Satellite Imagery to Revolutionize Creation of Tax Maps and Local Revenue Collection, World Bank Policy Research Working Paper 8437, World Bank, 2018, <https://ideas.repec.org/p/wbk/wbrwps/8437.html>.

⁶¹ "Explainer: How to Finance Urban Infrastructure," C40 Cities Knowledge Hub, 2017.

⁶² Siemens, Citi and C40 Cities, *New Perspectives on Climate Finance for Cities*, 2016, http://www.climateaction.org/images/uploads/documents/new_perspectives_lr.pdf?

⁶³ Martin Ravallion, Shaohua Chen, and Prem Sangraula, "New Evidence on the Urbanization of Global Poverty," *Population and Development Review* 33, no.4 (December 2009): 1-48, <https://doi.org/10.1111/j.1728-4457.2007.00193.x>.

⁶⁴ UNDESA, *World Urbanization Prospects: The 2014 Revision*, 2014, <https://population.un.org/wup/Publications/Files/WUP2014-Report.pdf>.

in international markets, severely limiting their access to private finance.⁶⁵ So while the Addis Ababa Action Agenda notes the need for resource devolution and cities' access to international finance,⁶⁶ in reality, progress has been slow and demonstrably inadequate.⁶⁷

Cities must find ways to strengthen own-source revenue, increasing government capacity, improving municipal revenue collection mechanisms, and leveraging municipal assets. For most secondary cities, municipal finances are not robust enough to support the urbanization process. To help these cities become self-reliant and able to raise debt, GGGI is also working to strengthen their revenue streams and link them to national and international climate financing options with national government support. Countries are increasingly using tools such as urban asset inventories to examine their built assets and to create digital cadasters that serve as a check and balance for revenue collection.

The private sector also has an increasing role to play in the development of green cities in low- and middle-income developing countries. In many developing and middle-income countries, it is the startups and businesses that provide innovative solutions to urban challenges, such as the development of the urban sharing economy with many new employment opportunities. The private sector can also fund more of the infrastructure investment gap in cities. For instance, the private sector can either invest directly in various projects or be involved through various financial instruments. These could be through debt mechanisms mentioned earlier or through public-private partnerships (PPPs).

GGGI has enhanced its role in linking municipalities to finance, as part of its focus on green city planning and project development. Municipalities in **Myanmar, Uganda, and Cambodia** are benefiting from funds from the Green Climate Fund (GCF) to build capacities at the sub-national and national level, including strengthening policies and designing projects in areas such as waste management and sustainable transport. Such financing is critical to support

emissions reductions and help cities, especially secondary cities, to become greener, healthier, and more socially inclusive places to live.

3.3 Green Mobility

The world's 724 largest cities could reduce GHG emissions by 800 million to 1.5 billion tons of CO₂e annually by 2030, primarily through reducing personal vehicle use in favor of mass transit and supporting more walkable public areas.⁶⁸ Increasing the connectivity of public transportation, renewing the focus on NMT, and investing in safe and accessible public spaces through smart planning could be one of the biggest opportunities to reduce emissions in urban areas.⁶⁹ Improved transportation planning could also enable an important trend in the electrification of the transportation sector with electric vehicle (EV) sales reaching about 1.6 million in 2017, up from a few hundred thousand in 2014.⁷⁰ One of the New Urban Agenda's primary goals is to "promote age- and gender-responsive planning and investment for sustainable, safe, and accessible urban mobility for all and resource-efficient transport systems."⁷¹ The challenge is to get people out of vehicles, regardless of their type, and develop a sustainable, effective, and affordable NMT and public transportation system that meets the needs of urban populations and makes cities more walkable.

As one of the main contributors to global warming, the transportation sector currently consumes more than half of global liquid fossil fuels, emits nearly a quarter of the world's energy-related CO₂, and generates more than 80% of the air pollution in cities in developing countries.⁷² Without taking any action, CO₂ emissions from transportation are expected to grow between 1.5 and 2.4 times 2010 levels by 2050.⁷³ As the urgency to improve air quality in urban areas increases, EVs are emerging as an effective alternative to fossil-fuel vehicles, complementing other sustainable transportation interventions, such as modal shifts to public transportation, NMT, and intelligent transportation systems.

⁶⁵ McKinsey Center for Business and Environment and C40 Cities, *Focused acceleration: A strategic approach to climate action in cities to 2030*, 2017, <https://www.c40.org/researches/mckinsey-center-for-business-and-environment>.

⁶⁶ United Nations, *Addis Ababa Action Agenda of the Third International Conference on Financing for Development*, 2015, <https://sustainabledevelopment.un.org/frameworks/addisababaactionagenda>.

⁶⁷ United Cities and Local Governments, "Two years of implementation of the Addis Ababa Action Agenda: mixed results for local governments," 2017, <https://www.uclg.org/en/media/news/two-years-implementation-addis-ababa-action-agenda-mixed-results-local-governments>.

⁶⁸ Graham Floater et al., *Cities and the New Climate Economy: The Transformative Role of Global Urban Growth*, New Climate Economy and LSE, 2014, <http://eprints.lse.ac.uk/60775/1/NCE%20Cities%20Paper01.pdf>.

⁶⁹ "Land-use impacts on transportation: How land-use factors affect travel behavior," Victoria Transportation Policy Institute, Updated July 2017, <https://www.vtpi.org/landtravel.pdf>.

⁷⁰ Bloomberg New Energy Finance, *Electric Vehicle Outlook 2018*, 2018, <https://about.bnef.com/electric-vehicle-outlook/#toc-download>.

⁷¹ United Nations, *The New Urban Agenda*, 2017, p1.

⁷² H. Dalkmann, and K. Sakamoto, "Transport: Investing in energy and resource efficiency." *Towards A Green Economy: Pathways to Sustainable Development and Poverty Eradication*: 375-411, 2011.

⁷³ International Transport Forum and OECD, *Transport Outlook: Seamless growth for green transport*, May 2012, <https://www.oecd.org/greengrowth/greening-transport/Transport%20Outlook%202012.pdf>.

When deployed in combination with increased renewable energy electricity generation, EVs can substantially help reduce GHG emissions.⁷⁴ The environmental and economic benefits of various types of EVs have been widely reported. According to Climate Action Tracker, about half of all passenger vehicles would need to be electrified by 2050 to achieve the target of limiting global warming to below 2°C.⁷⁵ Deeper decarbonization through the further electrification of not only passenger vehicles but also freight vehicles would be needed to meet the 1.5°C target.⁷⁶

Increased adoption of EVs is largely a result of two factors. The first is a political commitment to reducing fossil-fuel vehicles. France and the United Kingdom, for example, declared that sales of fossil-fuel vehicles would be banned starting in 2030 and 2040, respectively. Even in some developing countries where public transportation is not available or popular, governments have signaled their political commitment by providing fiscal incentives for the purchase of EVs.

Bus Rapid Transit (BRT) is increasingly recognized as among the most effective solutions to provide mobility services on a cost-effective basis in urban areas, as it provides a high-quality, metro-like transit service at a fraction of the cost of other options. The electrification of high-capacity BRT buses can also be technically and financially viable, as demonstrated in a recent GGGI study for **Jordan**.⁷⁷ The adoption of electric buses is expected to grow significantly with the recognition of their contribution to improving air quality in urban areas. For instance, the Seoul Metropolitan Government of the **Republic of Korea** announced in November 2018 that it would introduce 3,000 electric buses by 2025.

Ideally, electrification will support public transportation options with clear benefits of cleaner air and lower emissions. However, in many cities in the developing world, where public transportation is not well-established, motorcycles and three-wheelers are used intensively for mobility. With electric mobility rapidly becoming the most attractive form of transportation, electric two-wheelers from scooters to bicycles to motorbikes are leading the way. In India, 630,000 electric three-wheelers were sold

in 2018-2019, outselling fossil-fuel models by more than 100,000. In **Cambodia**, GGGI is helping authorities to make the transportation sector greener by identifying policy and financial incentives to shift from gasoline motorcycles, which currently dominate Cambodia's national vehicle market, to electric motorcycles. To support a holistic approach accounting for the full benefits to partners in this transition, GGGI is assessing the economic, environmental, and social aspects of e-motorcycles and working with both government and the private sector to stimulate the market through regulatory reform.

Transitioning away from fossil-fuel-powered vehicles to EVs is expected to contribute to reducing GHG emissions in congested urban areas, together with significant co-benefits such as improvement in air quality, reduction of noise, and positive impacts on public health. In **Lao PDR**, GGGI is also supporting electrification of motorcycles, which accounted for 76% of the total vehicle stock in 2017, and is therefore expected to have significant air quality benefits. The prices of low-end electric motorcycles with a lead-acid battery in Lao PDR are already on par with those of gasoline motorcycles.⁷⁸

The environmental and economic benefits of various types of EVs have been widely reported. The average fuel efficiency of battery EVs has been found to be 2.6 times greater than that of comparable internal combustion engine vehicles.⁷⁹ Both plug-in hybrid and hybrid EVs result in 28% to 67% less GHG emissions than similar conventional vehicles.⁸⁰ In the **United States**, plug-in hybrid EVs with a fuel economy of 3 miles/kWh and 25 miles/gallon significantly reduced CO₂ emissions by an average by 42% per mile driven.⁸¹ In **Seoul**, it has been found that replacing liquefied petroleum gas (LPG)-powered taxis with EV taxis would be economically feasible due to abated CO₂ and air pollutant emissions and savings in operating costs.⁸² Repair costs for EVs are also up to 90% lower during the lifetime of the car than conventional vehicles.^{83,84} Governments are increasingly signaling their political commitment by providing fiscal incentives for the purchase of EVs. In **Jordan**, for example, the Ministry of Finance introduced import tariff exemptions for fully electric passenger cars, which resulted in a rapid increase in the uptake of EVs between 2016 and 2018.

⁷⁴ GGGI, G20 Background Paper, 2019, p25.

⁷⁵ Michael Schneider, "The road ahead for electric vehicles," ICG Reflection, no. 54, 2017.

⁷⁶ GGGI, G20 Background Paper, 2019, p25.

⁷⁷ GGGI, G20 Background Paper, 2019, p28.

⁷⁸ GGGI, G20 Background Paper, 2019, p26.

⁷⁹ Stefan Unnasch and Louis Browning, *Fuel Cycle Energy Conversion Efficiency Analysis*, (Sacramento: California Energy Commission and Air Resources Board, 2000).

⁸⁰ Electric Power Research Institute, "Environmental assessment of plug-in hybrid electric vehicles," *Nationwide Greenhouse Gas Emissions 1*, 2007.

⁸¹ Peter Lilienthal and Howard Brown, *Tackling Climate Change in the U.S. – Potential carbon emissions reductions from plugin hybrid electric vehicles by 2030*, (American Solar Energy Society, 2007).

⁸² Kang, Seong-Cheol, and Hoyoung Lee (in press). "Economic Appraisal of Implementing Electric Vehicle Taxis in Seoul." *Research in Transportation Economics*.

⁸³ Tony Seba, *Clean Disruption of Energy and Transportation*, (California: Clean Planet Ventures, 2014).

⁸⁴ GGGI, G20 Background Paper, 2019, p25.

Despite the strong potential for EVs, there are several barriers to implementation and policies and infrastructure to support EVs are needed. In many cases, governments lack the necessary energy infrastructure, technical expertise, leadership, risk appetite, strategies, policies, and regulations to navigate this new technology. Therefore, even as EVs become more affordable and popular in developed economies, governments in developing countries will need substantial support in facilitating market development for commercialized EV charging services. Without access to charging services, uptake of EVs is less likely, making the business case for the electrification of private transportation less attractive. The government will also require technical analysis and evidence-based recommendations as they attempt to modernize and green their national transportation systems. Secondly, despite their impressive promise of significantly reducing air pollution and potentially carbon emissions, the materials supply chain and waste footprint of EVs needs to be understood better. Ideally, these new systems should be deployed with a circular economy approach from the outset, rather than during a later clean-up phase. To support a sustainable EV future, countries and cities require support to have effective collection, storage, and recycling systems to handle new forms of electronic and toxic waste in place.

3.4 Towards an Urban Circular Economy

Cities struggle to access raw materials to meet the demand for urban infrastructure and manage the environmental consequences of inefficient use of resources. A stronger emphasis on mainstreaming resource efficiency and the development of more circular economies is needed. The extraction of construction materials grew by a factor of almost 34 during the 20th century (European Environment Agency 2015). The OECD reports that materials use will increase from 79 gigatons in 2011 to about 167 gigatons in 2060. More than half of GHG emissions, expected to be about 50 Gt CO₂e by 2060, are related in some way to materials management.⁸⁵ As natural resources are finite, there is a sense of urgency to focus on resource efficiency, especially in response to rapid and increasing urbanization.

Cities derive clear benefits from transitioning to circular economies with resource efficiency at the foundation such as eliminating waste and pollution, keeping products and materials in use, and regenerating natural systems.⁸⁶ GGGI has supported several countries with circular economies in solid waste, sanitation, and, more recently, in green industry. GGGI's work on waste has been defined by several key principles, including evaluating and valorizing waste chains, shifting away from landfill-dependent systems, supporting local solutions and responsibility, engaging all stakeholders in change, providing a role for the private sector, and utilizing and encouraging adoption and investment in smart systems and infrastructure.⁸⁷

Cities worldwide, at all levels of development, face both a resource and waste crisis. Waste management is principally a local government responsibility but local governments rarely have the funding or capacity to develop the systems and infrastructure required. The rate of waste generation will more than double over the next twenty years in lower-income countries alone. Research shows that unsustainably managed waste through unregulated dumps or open burning has more severe impacts on the health and quality of life of residents in developing countries, especially the urban poor. These practices have serious health, safety, and environmental consequences and they also create a massive financial and resource burden on local governments.

For GGGI, the link between climate change and waste is becoming increasingly evident. The overarching links between solid waste management and climate change will be addressed through three entry points, derived from the GHG protocol: direct GHG emissions, indirect GHG emissions, and measurable impacts on ecosystems including those supporting nature-based adaptation solutions. As countries also consider carbon trading under the Paris Agreement rulebook, decreased emissions from the waste sector could, in some countries, substantially contribute to future activities in this area.

⁸⁵ OECD, *Global Material Resource Outlook to 2060*, 2019, <https://www.oecd.org/environment/waste/highlights-global-material-resources-outlook-to-2060.pdf>.

⁸⁶ "What is a circular economy?" Ellen MacArthur Foundation, <https://www.ellenmacarthurfoundation.org/circular-economy/concept>.

⁸⁷ Donovan Storey, "Circular Economies as an Answer to the Waste Crisis: Lessons Learnt," Urbanet, April 21, 2020, <https://www.urbanet.info/circular-economy-waste/>.

Box 5. Towards Circular Economies: Solid Waste Management

GGGI has been working with several local governments to improve their management of solid waste.

The Government of **Lao PDR** is working to change its waste management system in the capital city of Vientiane by shifting away from the conventional “collect and dump” approach to a “waste-to-resource” approach. Through a comprehensive situational assessment⁸⁸ of Vientiane’s waste sector, GGGI identified three potential intervention areas that could help transition to a more efficient solid waste management system for the city: decentralizing collection services by organizing micro-enterprises, decentralizing composting facilities, and deploying waste banks. This has led to three projects to date. The first is deploying pushcarts and small trucks in Vientiane to collect waste, which will be able to go to areas in the city where people do not usually have access to collection services. The second is introducing organic waste recovery from businesses, such as restaurants, hotels and vegetable markets and the third is increasing recycling in Vientiane. These initiatives will see around 20,000 people gain new access to adequate waste collection services while 30t/day of organic waste generated in the city will be recovered. Stakeholders also expect the project to create new jobs and improve employment opportunities for informal waste pickers.

In **Uganda**, the national and local government has engaged stakeholders to support the implementation of the National Urban Solid Waste Management Policy (NUSWMP)—one of the few national visions for managing solid waste in Africa. In support of the City of Kampala, to support this process GGGI has undertaken a policy assessment⁸⁹ and value chain analysis⁹⁰ to better understand critical intervention areas that would provide a positive and catalytic impact. These will lead to the development of interventions that improve waste management from the household to landfill.

Urban island communities have limited land available for dumping waste, with numerous implications for waste management in terms of climate resilience and ecosystem-based adaptation. In **Fiji** and **Kiribati**, GGGI has identified potential interventions in the solid waste management sector.⁹¹ The two most important interventions for both island countries and most of the Pacific is to minimize the amount of waste going to open dumps or landfills which negatively affect coastal systems and near-shore fisheries. Secondly, diversion of waste to decentralized transfer stations can generate employment and better use waste as a resource.⁹²

In **Peru**, GGGI has been supporting the Lima Municipality in implementing a circular economy solution to tackle especially the problem of organic waste in the city center by promoting waste management sustainable practices that directly benefit citizens. This includes helping the municipality explore options to increase the organic waste that is diverted from the waste management system through household composting and create valuable products from the organic waste ready for disposal, such as through waste-to-resource (energy, compost) solutions.

In **Cambodia**, GGGI has been building on its earlier work helping seven secondary cities to draft a ‘Sustainable City Strategic Plan’ under the leadership of the National Council for Sustainable Development and the Ministry of Interior. Most cities identified solid waste and wastewater management as high priorities, including Battambang, where GGGI now works on the ground with a focus on plastic and organic waste recycling. Battambang’s push to deliver green cities solutions followed a detailed GGGI analysis of the city’s waste value chain, including generation, storage, collection, transport, recycling, and disposal. GGGI developed a set of recommendations based on the findings of the analysis to improve waste separation and collection, develop innovative opportunities to scale up the local waste recycling business, and create better jobs for waste pickers. The municipality is now turning its attention to Battambang’s markets, planning plastic source separation activities at two markets, and source separation of organic waste for composting at the wholesale fruit and vegetable market.

⁸⁸ GGGI, *Solid Waste Management in Vientiane, Lao P.D.R.: Situation assessment and opportunities for waste-to-resource*, 2018, https://gggi.org/site/assets/uploads/2018/09/Solid-Waste-Management-in-Vientiane-Lao-P.D.R_Publication-3.pdf.

⁸⁹ GGGI, *Kampala Municipal Solid Waste Value Chain Mapping*, Seoul, 2018, <https://gggi.org/report/kampala-municipal-solid-waste-value-chain-mapping/>.

⁹⁰ GGGI, *Value Chain Analysis Report and Investment Options Study on Municipal Solid Waste Management in Kampala*, Seoul, 2018, <https://gggi.org/report/value-chain-analysis-report-and-investment-options-on-mswm-in-kampala/>.

⁹¹ GGGI, *Synthesis Report: Impacts of Urbanization and Solid Waste Management on Ecosystem based Adaptation in Fiji, Kiribati and Vanuatu*, 2018.

⁹² GGGI, *Synthesis Report: Impacts of Urbanization and Solid Waste Management on Ecosystem based Adaptation in Fiji, Kiribati and Vanuatu*, 2018.

Provision of sanitation is a vital development intervention, which can improve health, well-being, and economic productivity as reflected in SDG 6.2. Despite its importance, achieving real gains in sanitation coverage has been slow and lagging compared to gains in water supply. Development actors often develop new technologies or pilot initiatives. However, not enough are scaling up and increasing the effectiveness of investments in sanitation, which is critical for the sustainability of services. GGGI brings its expertise in green investments and incorporates solutions for other challenges that exist at a local level – solid waste management, transforming both streams into renewable energy or organic fertilizers.

Box 6. Sanitation

While access to water supply has increased, access to sanitation on the other hand has been lagging and did not meet the Millennium Development Goal (MDG) targets. With the 2030 SDGs in sight, investments in sanitation are not currently enough to reach SDG 6.2 and 1.4. Extending sanitation coverage to unserved or underserved areas has been slow despite being critical to public health. Over 30% of the world's population, or 2.3 billion people, remain without access to safe and improved sanitation. These challenges are greatest in Sub-Saharan Africa, and in South and Southeast Asia, where access to basic sanitation services is low. High levels of pathogens in drinking water and inadequate sanitation are the cause of some 1.4 million deaths per year from diarrhea, intestinal parasites, and other water-borne diseases. The lack of sanitation poses a considerable and rising risk with the effects of climate change.⁹³ In the effort to address sanitation challenges and ensure affordable and financially sustainable services, appropriate levels of septage treatment along with reuse of fecal sludge are priorities. It is also vital to embed sanitation in overall water resource management and urban planning and design.

Addressing these challenges requires increased investments in sustainable sanitation service delivery and infrastructure. Investment in decentralized approaches such as on-site systems, which typically include septic tanks or pit latrines, or smaller community systems, is more cost-effective than networked systems and also has the co-benefit of creating jobs in the circular economy.

With the Bill and Melinda Gates Foundation's support, GGGI is working with the Governments of **Nepal** and **Senegal** to mainstream City Wide Inclusive Sanitation through four outputs in each country: i) to imbed sanitation into the National Climate change agenda and planning; ii) to develop and implement a policy at the national level that can help attract financing, notably climate financing, to the sanitation sector; iii) to incorporate sanitation into the green municipal planning in target municipalities; and iv) to develop innovative business models for sustainable sanitation service models in select cities of Nepal and Senegal. Business models will be designed to be economically viable, socially acceptable and, technically and institutionally appropriate with a focus on the sanitation value chain, which includes collection, emptying, transport, treatment, and reuse/disposal.

In **Lao PDR**, GGGI is assisting the government in developing a comprehensive approach towards decentralized sanitation. In the secondary city of Pakse, GGGI is demonstrating this approach by developing a city level sanitation strategy, implementing decentralized wastewater treatment systems in 4 zones of the city, developing a city level faecal sludge treatment plant and organizing the associated improvements in faecal sludge management systems. GGGI is also assisting Government of Lao PDR to develop and adopt a National Urban Sanitation Policy to help scale up this sustainable approach in other cities.

Industrialization is an important means to develop a country's economy and improve living standards. Several GGGI Member countries are making the transition from agricultural economies to industrialized economies, as with LDCs, or are looking to transition from highly polluting industrial models to cleaner pathways. Countries are now also revising their commitments under the Paris Agreement through their NDCs. These NDCs highlight the areas of focus, identifying priority sectors, and providing an opportunity to prioritize mitigation measures for its GHG emissions.

Twenty-five out of 77, or 32% of NDCs from the African, Caribbean, and Pacific countries, mentioned the need for more sustainability in industries. Improving the social and environmental outcomes of industrialization is not only a means to meet global commitments, but drives sustainable development. Industrial processes will increasingly be a focus area for GGGI Member countries. Accordingly, GGGI outlines sustainable industrialization as a future core programmatic area in its Strategy 2030.

⁹³ WHO, *The resilience of water supply and sanitation in the face of climate change*, 2011, https://www.who.int/water_sanitation_health/publications/9789241598422_cdrom/en/.

GGGI is supporting green industrialization in Member countries, given its increasing importance. GGGI's emerging impact in supporting transitions to green industry has been in three areas:

- o Green certifications and standards;
- o Material circularity and waste management including waste to energy or input initiatives; and
- o Decarbonizing energy demands, for example through rooftop solar.

Box 7. Supporting Green Industry

As Least Developed Countries (LDCs) and Lower Middle-Income Countries (LMICs) undergo a structural transformation from being primarily agricultural economies towards manufacturing and services sector-led economies, the number of urban Special Economic Zones (SEZs) is also steadily increasing. According to United Nations Conference on Trade and Development (UNCTAD) estimates, there are approximately 4,800 SEZs globally.⁹⁴

Both the 2030 Agenda and the Addis Ababa Action Agenda focus on the relevance of inclusive and sustainable industrial development as the basis for sustainable economic growth. In previous planning cycles, industrial growth was associated with larger cities but, for example in **Thailand, Viet Nam, Indonesia, and Ethiopia**, industrial estates and parks are increasingly being used to spur regional growth and employment. However, there are concerns over managing the environmental, social, and community impacts of regional industrialization, specifically the resource footprints of industrial zones themselves with several being developed as small-scale cities.

Greening industry provides an opportunity to plan and develop future urban manufacturing centers that embed circular economy principles and practices into their operations. Practices such as the re-use of wastewater, solid waste, and materials recycling can support industry to be resource-efficient and low-carbon in operations. Greening industry is a multi-sectoral strategy for achieving green growth in the manufacturing and related productive sectors, and it aims to reduce the resources needed to produce goods through more energy and material-efficient production and consumption processes. This involves addressing the life cycle impacts of products affecting supply chain companies and small- and medium-sized enterprises. Greening industry also promotes decent green jobs and the health and safety of workers. It can also create a platform for empowering women to take part in the green economy transition.

The United Nations Industrial Development Organization (UNIDO), The World Bank Group, and the German Agency for International Cooperation (GIZ) have jointly developed an international framework for Eco-Industrial Parks.⁹⁵ This is directed towards park operators and facility managers and aims to provide a global matrix for assessing industrial park performance in the following areas: environmental management, industrial symbiosis, resource efficiency, energy savings, inclusive development, and economic competitiveness. GGGI is working with national governments in **Indonesia, Viet Nam, Uganda, and Ethiopia** on policy development to create enabling environments for green industrial parks.



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