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Green Jobs in Cities: Challenges and Opportunities in African and Asian Intermediary Cities

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Abstract

Cities account for approximately 70 per cent of global energy consumption and about 75 per cent of greenhouse gas emissions due to the density of economic activities and infrastructure and their often path-dependent development patterns. While this makes cities vulnerable to the impacts of climate change and causes of biodiversity loss and environmental degradation, cities can also play an important role in taking on climate change mitigation and adaptation actions. Cities adopting a green transformation process can minimise their environmental impact and maximise opportunities to improve and support the natural environment. Topics to address are energy efficiency and reduction of non-renewable energy sources to reduce their carbon footprint; actively support waste reduction and management; establish green and resilient infrastructure; encourage nature-based solutions; enhance the efficiency of new buildings; encourage low-carbon transport; and improve water cycle management. Also, these fields will lead to a greener urban economy, create more green jobs – or respectively change jobs towards becoming green – and deliver improved quality of life outcomes for residents.

The current pandemic situation and the need for a quick COVID-19 recovery has created new challenges, but also the potential for a green and just recovery "to create jobs and improve health in cities while limiting warming to 1.5°C" (C40 Cities Climate Leadership Group, 2021). Also, the OECD (2020) evaluates that "the economic stimulus packages and recovery plans that governments are now putting in place have the potential to create a recovery that is both green and inclusive."

The aim of this discussion paper is to address the challenges, opportunities and fields of actions – respectively interventions – of these economic, but also social transformations on the job market on the level of cities. The regional focus is on African and Asian cities in developing countries. A special focus is on intermediary cities with between 1 to 5 million inhabitants since they constitute the fastest-growing urban areas today (United Nations, 2018) and more importantly, they have both the capacity and expertise to guide an economic transformation while still being, at the same time, not too large to be managed effectively, as outlined above. Also, fast-growing intermediary cities face the situation of urgently expanding their urban areas and creating new infrastructure networks, which can already be part of the above-mentioned transformation process towards a green economy.

The fields of action for cities in a transformation towards a green economy, thereby creating green jobs, can be clustered into:

- land use planning
- green buildings and construction
- sustainable mobility and urban transport
- green and blue urban infrastructure services with nature-based solutions (NBSs) as a cross-cutting issue
- renewable energy and energy efficiency

These topics can serve as background to discuss options with local stakeholders to develop new initiatives. They also serve as showcases for the feasibility of green economy approaches. South-South cooperation between stakeholders is advisable in order to facilitate a replication of successful projects in partner countries.

A well-planned city will also have "opportunities for disaster risk reduction, accelerated response and recovery through land use planning, building codes and regulations, risk assessments, monitoring and early warning, and building-back-better response and reconstruction approaches" (UN-Habitat, 2020).

The employment effects of a transformation towards a green economy play an important role (UNEP, 2008). The opportunities for cities in Africa and Asia to create green jobs under their own local mandates of decision-making in urban planning and within their own service providers, and/or to support the "greening" of the private sector, will obviously create more green jobs, and respectively shift current jobs into green jobs.

The main target areas towards a green economy and green jobs in intermediary cities in Africa and Asia can be found in the fields of

- strengthening the local level, as outlined in the New Urban Agenda,
- land use planning towards a compact city concept, including addressing informal urban development and disaster risks,
- green buildings and construction materials to retrofit the existing building stock and guide new constructions, including the development of a local green construction sector,
- sustainable mobility and urban transport by developing mobility options with locally applicable technology and job creation, also on the level of unskilled workers,
- extension and retrofitting of urban infrastructures focussing on NBSs by
    - considering NBSs as a cross-cutting, interdisciplinary and inter-sectoral approach,
    - introducing water supply and sanitation systems, which guarantee a just distribution of water, resource efficiency and the long-term sustainability of water resources,
    - ensuring solid waste management, recycling and urban mining to tap the unexhausted potentials of a circular economy and job creation, also on the level of unskilled workers,
    - implementing smart cities and urban tech approaches that both enhance the quality and efficiency of urban services while creating decent jobs and support so-called digital immigrants while reducing the risk of so-called digital refugees,
- supporting investment in renewable energy infrastructures by rendering assistance within the city's mandate, while at the same time addressing energy efficiency as a cross-cutting issue for the built environment (cooling and heating) as well as transport.

Since there are already relevant and suitable local solutions in place worldwide – and at the same time, experts are available in many municipalities and the local academia – there is a huge potential to further develop international cross-continental, regional (e.g. South-East Asia) and national networks of technical experts to exchange ideas, co-produce knowledge and co-design tailor-made solutions for countries and cities – solutions that reflect different climatic, socio-economic and political environments and constitute suitable approaches. These experts should come not only from cities in Africa and Asia, but also include Latin America with some more advanced approaches that are, for example, related to recycling, mass transport systems and civic participation. Latin America has also experienced a greater degree and longer process of urbanisation that can be learnt from. The establishment of a city-focussed network can be undertaken by German development cooperation in partnership with local stakeholders such as national city associations, but also through international networks.

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Wolfgang Scholz and Michael Fink

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Abbreviations

ADB	Asian Development Bank
BEE	Bureau of Energy Efficiency
BMU	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety / Bundesministerium für Umwelt, Naturschutz, nukleare Sicherheit und Verbraucherschutz
BMZ	Federal Ministry for Economic Cooperation and Development / Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung
BRT	Bus Rapid Transport
CCB	cold ceramic brick
CCI	Centre for Community Initiatives
COVID	coronavirus disease
CO_2	carbon dioxide
EU	European Union
GDC	German development cooperation
GDP	gross domestic product
GHG	greenhouse gas
GIZ	German Agency for International Cooperation / Deutsche Gesellschaft für Internationale Zusammenarbeit
GW	gigawatts
ICLEI	Local Governments for Sustainability
IGE	inclusive green economy
ILO	International Labour Organization
IRENA	International Renewable Energy Agency
LED	light-emitting diode
LUCF	land use change and forestry
NBS	nature-based solution
NUA	New Urban Agenda
OECD	Organisation for Economic Co-operation and Development
PAGE	Partnership for Action on Green Economy
PPP	public–private partnership
QEHS	quality, environment, health and safety
SDG	Sustainable Development Goal
TUMI	Transformative Urban Mobility Initiative
TUPF	Tanzania Urban Poor Federation
UN	United Nations
UNDESA	United Nations Division for Sustainable Development
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization
US	United States
WRI	World Resource Institute
WWF	World Wildlife Fund

1 Introduction: Green jobs in cities

Cities account for approximately 70 per cent of global energy consumption and about 75 per cent of greenhouse gas (GHG) emissions due to the density of economic activities and infrastructure, and their often path-dependent development patterns. While this makes cities vulnerable to the impacts of climate change and causes of biodiversity loss and environmental degradation, cities can also play an important role in taking on climate change mitigation and adaptation actions. Cities adopting a green transformation process can minimise their environmental impact and maximise opportunities to improve and support the natural environment. Topics to address are energy efficiency and reduction of non-renewable energy sources to reduce their carbon footprint; actively support waste reduction and management; establish green and resilient infrastructure; encourage nature-based solutions; enhance the efficiency of new buildings; encourage low-carbon transport; and improve water cycle management (C40 Cities Climate Leadership Group, 2021; Hammer, Kamal-Chaoui, Robert, & Plouin, 2011; Organisation for Economic Co-operation and Development [OECD], 2011). Also, these fields will lead to a greener urban economy, create more green jobs – or respectively change jobs towards becoming green – and deliver improved quality of life outcomes for residents (see also Green Climate Fund, 2018a).

Achieving the targets of the Paris Agreement on climate change requires a global transformation of economies towards carbon-neutral production and consumption patterns. This transformation would lead to a "green economy" (United Nations Environment Programme [UNEP], 2011). However, the concept of a green economy is not only about carbon neutrality. According to the pivotal definition by UNEP (2011), a green economy is one that "results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities". Thus, a green economy is also resource efficient and socially inclusive. It thereby explicitly addresses issues such as inequality, biodiversity loss, pollution and environmental degradation. Thus, the concept is aiming at a new sustainable global economic system.

The current pandemic situation and the need for a quick COVID-19 recovery has created new challenges, but also the potential for a green and just recovery "to create jobs and improve health in cities while limiting warming to 1.5°C" (C40 Cities Climate Leadership Group, 2021). Also, the OECD (2020) evaluates that "the economic stimulus packages and recovery plans that governments are now putting in place have the potential to create a recovery that is both green and inclusive." The total amount of COVID-19 recovery funding according to the OECD is USD 3.2 trillion, including grants and loans (making up around 39 per cent of measures), tax reductions and other subsidies (19 per cent of the total), and regulatory changes (at around 14 per cent).

In the same paper, the OECD (2020) highlights that "the recovery is an opportunity to 'build back better', combining an emphasis on restoring growth and creating jobs with the achievement of environmental goals and objectives." Thus (OECD, 2020),

> the green recovery is an opportunity to undertake wider reaching and fundamental restructuring of critical sectors and activities in order to support the transition to low-emission climate-resilient and resource-efficient economies in socially inclusive ways and to enhance the resilience of their economies.

This transformation process includes fully utilising the potentials of digitalisation and urban technologies to boost economic development and create jobs (Adler & Florida, 2021).

Regarding the Global South, Barbier and Burgess (2020) highlight that "it is critical that developing countries find innovative policy mechanisms to ensure immediate socio-economic support after the COVID-19 crisis as well as continued progress towards the 17 SDGs."

This process will constitute a radical transformation of the current economic system, which results in high carbon emissions of both energy supply and production processes in many sectors. This radical transformation has obvious impacts on the labour market, where jobs in high carbon sectors such as energy production, construction, transport and partly manufacturing will face serious challenges since their companies need to adopt production modes with fewer carbon emissions or they will be phased out. However, this transformation will also have impacts on other sectors and private households through, for example, higher energy and production costs (see also Altenburg & Assmann, 2017). But it provides options to create new job opportunities in employment-intensive sectors such as renewable energies or organic agriculture (see Pegels & Altenburg, 2020).

Some scholars at the German Advisory Council on Global Change argue in the flagship report *World in Transition: A Social Contract for Sustainability* (German Advisory Council on Global Change, 2011) that the transition towards a low-carbon economy can be compared to great historical transformations such as the pre-historic Neolithic settlement and the transformation of agrarian into industrial societies (see also Leggewie & Messner, 2012). While according to Lütkenhorst, Altenburg, Pegels and Vidican (2014), these two great transformations were introduced in a more natural, evolutionary processes, the shift towards a new economic system focussing on decarbonising the economy, resource efficiency and being socially inclusive is intended to be predominantly a planned, policy-induced process.

Any policy-induced or state-led interventions on the economy, if not well-organised, accepted and supported by the majority of stakeholders, can face significant risks of unintended outcomes, collateral damages and political disputes. This applies especially to fragile economies in the Global South, which today cannot meet the demand in terms of job creation, energy and water supply, and other environmental service needs of their growing populations (see also Barbier & Burgess, 2020). European or Western approaches, targets and benchmarks towards a green economy and green jobs can, therefore, not be applied directly without adjustments and support in Africa and Asia.

Scholars, as for example Rodrik and Sabel (2019), advocate for good jobs in a green economy to be created through a "set of interventions by the public sector directly in the productive sphere", resulting in "formal-sector employment that comes with core labour protections such as safe working conditions, collective bargaining rights". He presents the programmes of the US Defence Advanced Research Projects Agency (DARPA) as a successful example of public intervention into the economy resulting in a successful transformation of the economy. While the approach is based on historical evidence in the United States (US) and can be compared by size and potential impact with the current COVID-19 recovery programmes (e.g. by the European Union (EU), the World Bank, and others), it seems not to be applicable directly to the Global South. Barbier (2015), for example, states that

> this debate has raised concerns about the various challenges facing developing countries in implementing green growth, including a large informal economy, high

> levels of poverty and inequality, weak capacity and resources for innovation and investment, and inadequate governance and institutions.

These circumstances, varying from country to country, have to be considered when attempting the large-scale transformation of the economy towards a green economy.

Nevertheless, state-led approaches from the political economy, as postulated by Rodrik and Sabel (2019), provide a solid basis for discussion with local stakeholders and decision-makers in order to find appropriate, localised ways for a necessary successful transformation and to balance between state-led and market-based approaches. This applies especially to the diverse urbanisation pattern of cities in the Global South. It seems to be advisable to instead follow Southern approaches for a successful transformation that reflects local problems, local potentials and stakeholders on the ground, especially with a South-South exchange of knowledge and solutions. These Southern approaches might differ from European or OECD approaches and might not cover all aspects of a green economy in the same manner. They also have to reflect local conditions of informality in urban development and economy, consider urban poverty, rapid urban growth and potential shortcomings in urban governance to be successful. Furthermore, the competition in the global market for export-oriented products has to be considered, especially for cases in which not all market players follow the same transformation processes (often under weak regulatory and oversight frameworks) and can take advantage of cheaper, but socially and environmentally harmful production.

The aim of this discussion paper is to address the challenges, opportunities and fields of actions – respectively interventions – of these economic, but also social transformations on the job market on the level of cities. The regional focus is on African and Asian cities in developing countries. A special focus is on intermediary cities with between 1 to 5 million inhabitants since they constitute the fastest-growing urban areas today (United Nations, 2018), and more importantly, they have both the capacity and expertise to guide an economic transformation and are still, at the same time, not too large to be managed effectively. For the conceptualisation of intermediary cities, see United Cities and Local Governments (UCLG, 2016). It is assumed that in mid-sized cities the potentials for urban governance and local decision-making to accelerate the transformation of the economy and society are greater than in mega-cities due to direct contacts among the stakeholders, leading to increased chances for successful outcomes. Also, fast-growing intermediary cities face the situation of urgently expanding their urban areas and creating new infrastructure networks, which can already be part of the above-mentioned transformation process towards a green economy. They can thus be turned from being major parts of the problem to playing a leading role in the solution. This approach is leaving the national-level or supranational discussion of green economy concepts or climate change adaption policies behind and is putting local stakeholders and decision-makers more in the centre. This is fully in line with the thinking of the New Urban Agenda (NUA), which focusses on the local government level, urban actors and the role cities can play (UN-Habitat, 2017).

This paper is organised as follows. In Section 2, we conceptualise the terms green economy and green jobs. We more closely examine specific sectors and topics on the role and importance of green economy and green jobs in intermediary cities in Asia and Africa. A focus is on the potential of local urban governments with their mandates on spatial and urban planning, with special attention being given to informal activities, green infrastructure but also building control concentrating on environmentally friendly construction – including

the energy efficiency of buildings – and life-cycle assessments of building materials. Other fields that (partially) come under the responsibility of cities are sustainable mobility, waste management and recycling, green energy production and resilient water systems. We also discuss the role cities can play in guiding local economies and public and private partnerships towards a greener production of goods and the application of nature-based solutions across the above-mentioned sectors. Digitalisation and "smart city" concepts are reviewed as important cross-cutting issues. Section 3 is devoted to assessing the potential positive and negative effects on employment with the introduction of green urban economies in cities in Africa and Asia. Particularly, it deals with employment opportunities and which new skills will be required, including education and vocational training. It also explores the risks and potential threats posed by an introduction of a green economy and aspects of post-COVID recovery in cities with respect to green jobs. Section 4 presents recommendations for actions to be taken by cities in Africa and Asia to support green economies and green jobs and to avoid negative outcomes, with a special focus on entry points for German development cooperation (GDC) to support these actions. It is followed by Section 5, which lists potential partners for GDC to implement projects on green economies in cities in Africa and Asia. The main conclusions of our paper are summarised in Section 6.

Since the discussion paper is designed as a purely desktop study, it relies on literature and information being available. Personal interviews of important stakeholders on the ground in cities in Africa and Asia were not included but would have obviously enriched the paper, especially in relation to best practice examples as well as recommendations.

2 Conceptualising a green urban economy and green jobs in cities

The development of the concept of a green economy has been on the agenda of international organisations for more than 10 years. In Section 2.1, we conceptualise the term and its development. In Section 2.2 we review economic sectors, including their carbon footprints, to identify the most relevant target sectors in Africa and Asia to become greener. Obviously, the analysis has to be repeated in individual countries and in case data are available for each city to generate tailor-made approaches. In Section 2.3 we discuss the role that intermediary cities in Africa and Asia can play and the options for concrete actions available to local sectors (Section 2.4).

2.1 Green economy and green jobs

This section deals with general definitions of the two related terms. Since the globally agreed definitions do not distinguish between green economy and green jobs in cities and outside cities, this paper assumes that the definitions also apply to green jobs in cities since most of the population, jobs and gross domestic product (GDP) are located worldwide in cities.

In 2009, the Global Jobs Pact was adopted by the International Labour Organization (ILO) in response to the global financial and economic crisis (which is now repeating itself with the pandemic) and called for cooperation on "shifting to a low-carbon, environment-friendly economy that helps accelerate the jobs recovery, reduce social gaps and support development goals and realize decent work in the process".

In the Cancún Agreements (United Nations Framework Convention on Climate Change, 2010), governments recognised that

> addressing climate change requires a paradigm shift towards building a low-carbon society that offers substantial opportunities and ensures continued high growth and sustainable development […] while ensuring a just transition of the workforce that creates decent work and quality jobs.

The United Nations Conference on Sustainable Development (UNCSD), also known as Rio 2012, Rio+20 or Earth Summit 2012, deliberated that

> we consider green economy in the context of sustainable development and poverty eradication as one of the important tools available for achieving sustainable development and that it could provide options for policymaking but should not be a rigid set of rules. […] We emphasize that it should contribute to eradicating poverty as well as sustained economic growth, enhancing social inclusion, improving human welfare and creating opportunities for employment and decent work for all, while maintaining the healthy functioning of the Earth's ecosystems. (United Nations Commission on Sustainable Development, 2012, para. 56, p. 10)

Therefore, this discussion paper is mainly grounded on the agreed comprehensive Sustainable Development Goals (SDGs) and sees the above-mentioned economic transformation towards a green economy and green jobs as an integral part of the process of achieving all SDGs, and not as a separated goal or as a purely environmental topic. In the context of the economic transformation, especially five SDGs[1] set clear targets to be achieved within the transformation process. These goals cannot be neglected by the transformation towards a green economy. As an aim of a green economy and creation of green jobs, besides the goal of decarbonisation, five additional SDGs[2] have to be considered since they have the potential to interfere with the process of moving towards a green economy if not introduced wisely.

A literature review by the United Nations Division for Sustainable Development (UNDESA, 2012) revealed that there are some attempts to define green economy and green jobs, but there is no commonly agreed definition of the concepts "green economy", and thus "green jobs" (Altenburg & Assmann, 2017). Furthermore, interrelated but differently used terminology and concepts have emerged in recent years (such as green growth, low-carbon development, sustainable economy, steady-state economy, etc.), which makes it difficult to development a common understanding between disciplines, agencies and stakeholders. As highlighted in the introduction, the most common definition is from UNEP (2011): "[A] green economy results in improved human well-being and social equity, while significantly

1 SDG 1 (End poverty in all its forms everywhere), SDG 2 (End hunger, achieve food security and improved nutrition and promote sustainable agriculture), SDG 3 (Ensure healthy lives and promote well-being for all at all ages), SDG 4 (Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all), SDG 5 (Achieve gender equality and empower all women and girls).

2 SDG 6 (Ensure availability and sustainable management of water and sanitation for all), SDG 7 (Ensure access to affordable, reliable, sustainable and modern energy for all), SDG 8 (Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all), SDG 9 (Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation), SDG 11 (Make cities and human settlements inclusive, safe, resilient and sustainable).

reducing environmental risks and ecological scarcities." Other international organisations are using definitions for green jobs that are, however, quite general, as with the ILO (2015a) citing UNEP (2008): "Green jobs are defined as jobs that reduce the environmental impact of enterprises and economic sectors, ultimately to levels that are sustainable." In its guidebook to the green economy, UNDESA displayed various attempts to define a green economy and revealed the wide range of definitions and descriptions (see Annex 1).

ILO (2015a) argues that a green job "contributes to preserving or restoring the quality of the environment while also meeting the criteria for decent work". This is also in line with the concept of Rodrik and Sabel (2019), who uses the term "good jobs". The ILO (2015a) extended the view that "it also covers activities related both to mitigation of and adaptation to climate change" and that "every job can potentially become greener".

The most important statement for this paper, which is looking for locally adapted and adjusted approaches, is also from the ILO (2015a): "The understanding of green jobs also varies from one country to another. Ultimately, countries will need to compose their own national definitions and set thresholds for practices that are considered green or non-green."

UNEP (2008) used a literature survey to estimate the employment effects of green transformation and focussed on one particular aspect of carbon reduction, namely energy-efficiency improvements. They identified the following main economic sectors as being relevant: renewable energy, buildings, food and agriculture, basic industry and recycling, transport and forestry. This list provides a suitable approach about where to look for existing green jobs, respectively where sectors have potentials to create new green jobs in cities. However, it might lead us overlook some important sectors, such as construction, infrastructure, the entire service sector, the educational sector and the wide range of informal businesses playing an important role in African and Asian cities.

Newer documents such as the UN Partnership for Action on Green Economy approach (UN PAGE, 2019) highlight social and inclusive aspects. Any attempt "aimed at transitioning to a more inclusive green economy (IGE) has to incorporate sustainable and inclusive growth, job creation, and sustainability agendas together in a virtuous circle" (UN PAGE, 2019). PAGE puts additional emphasis in particular on better ecological, economic and social outcomes for all social groups. This includes the poorest communities, and especially women and youth, but also addresses the private sector and civil society in designing and implementing the transition to an IGE (UN PAGE, 2019).

This seems to be a more appropriate approach for those cities in Africa and Asia where poverty, inequality and informality prevail and the economic and political systems are fragile. UNEP describes an IGE, as shown in Box A2 in the Annex. Another suitable approach is the one from the Green Economy Coalition (s.a.) with a vision for a fair, green economic future based on five principles (see Box A3 in the Annex).

Based on the analysis above, as a working definition for green jobs for cities in Africa and Asia, we consider four main elements: carbon efficiency, energy efficiency and resource efficiency with a circular economy approach; inclusiveness and "leave no one behind"; a focus on human well-being and social equity; being seen as a process that is adjusted to local conditions and a focus on nature-based solutions (NBSs).

2.2 Economic sectors in Africa and Asia and their carbon footprints

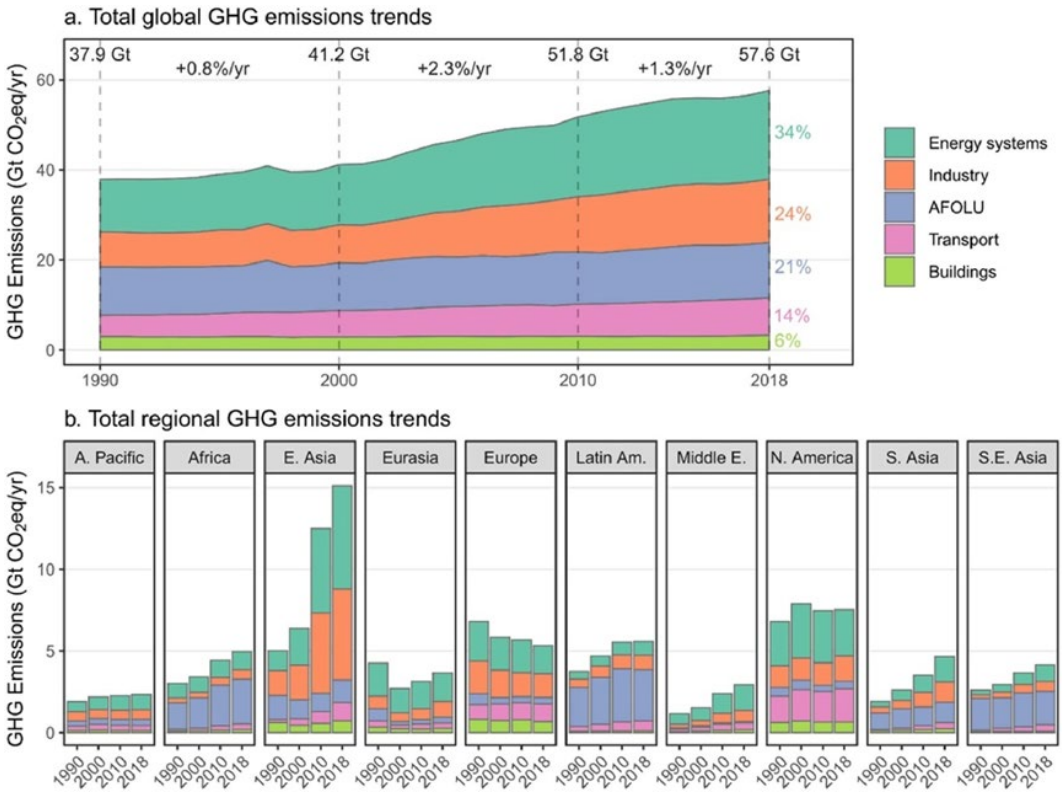
Economic sectors and their respective carbon emissions are to be reviewed in order to identify priorities for emission reductions by making them "greener" or by replacing products with "greener" products. Both processes should also create "greener" jobs. A clear picture emerges that electricity production and industrial manufacturing are the two leading sectors globally, followed by transport and agriculture. Emissions are still growing fast in all sectors.

Looking at one focus continent of this paper, clear figures for Asia are available. The share of the total workforce in agriculture is only 36 per cent, while the more urban-related sectors such as manufacturing and utilities cover 15 per cent, wholesale and retail 13 per cent, construction 8 per cent, education 5 per cent and other sectors 27 per cent. Assuming that agriculture plays only a minor role in urban areas, the figures above can be multiplied by 1.5 to get the urban data. However, still almost every second job is in the informal sector or as a family worker, and thus categorisation is difficult (ILO, 2017).

The same applies to identifying the carbon-related share of economic sectors in cities. However, some data are available. In contrast to successful carbon reduction in Europe,

> emissions from the region [Asia, the authors] have risen rapidly from 25% of the global total in 1990–1999 to 40% in 2012. Without strong climate policies, the region will generate nearly 50% of all greenhouse gas emissions by 2030, and these emissions will double in volume by 2050. […] Fossil fuels contributing over two-thirds of developing Asia's emissions, the region's low-carbon transition must start with the energy sector. (Asian Development Bank [ADB], 2016)

Figure 1: Global and regional GHG emissions by sector, 1990-2018

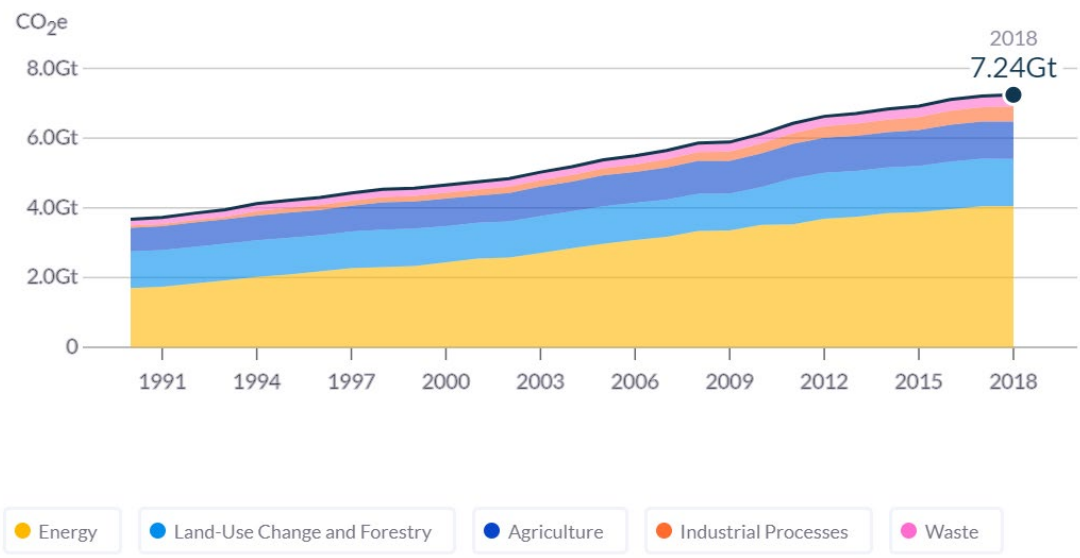


Source: Lamb et al. (2021) (CC-BY 4.0)

As can be seen from global GHG emissions figures broken down regionally and by sector (Figure 1), East Asia, South Asia, the Middle East and South-East Asia are the world regions with the fastest-growing emissions and show a rapid sectoral shift towards emissions from the energy and industry sectors (Lamb et al., 2021). Emissions from the transport sector, while starting from a lower base, show the highest growth rates of all sectors.

The ADB (2016) concluded that energy production can be shifted to less carbon-intensive modes, focussing on renewables such as wind, solar and biomass and through carbon capture and storage to achieve 50 per cent of the 2050 reduction targets, while another third can be achieved through improved energy efficiency. Also, Altenburg and Assmann (2017) see developing Asia in a crucial role since its GHG emissions, especially carbon dioxide (CO_2), are growing more rapidly than in any other region. Asia is both highly exposed to the risks of climate change, but also uniquely able to contribute to mitigating them. Therefore, energy production and energy-saving measures are the main entry points to reduce carbon emissions – followed by industrial production and transport – to serve as the main steps towards a green economy in cities.

Figure 2: Evolution of Africa's GHG emissions by sector, 1990-2018



Note: Data source: CAIT; Location: Middle East and North Africa, Sub-Saharan Africa; Sectors/Subsectors: Total including LUCF; Gases: All GHG; Calculation: Total; Show data by sectors.

Source: Adapted from Climate Watch Historical GHG Emissions (2022) (CC-BY-NC 4.0).

For Africa, the picture differs. With a rate of up to 80 per cent of informal or self-employment workers, statistics are rare. However, McKinsey (2012) estimates that the retail sector makes up 16 per cent of the labour force. Government and social services (including health care and education) employ 11 per cent of Africans, followed by manufacturing with 7 per cent of the labour force, and construction and transport each with 3 per cent. Almost 50 per cent are employed in agriculture, so we can estimate that the figures above can be doubled when looking at cities only. In Africa, the share of GHG emissions from energy production grew from about 45 per cent in 1990 to a still low 55 per cent by 2018, which already includes all indirect energy use emissions, for example from industrial production and transport. At the same time, land use change and forestry (LUCF) emissions increased from about 1 billion tons of CO_2e in 1990 to almost 1.5 billion tons of CO_2e in 2018. LUCF

emissions therefore remain significantly more important in the African context and should therefore be explicitly addressed. LUCF is related to land clearing for permanent croplands or pastures, shifting cultivation and wood harvest (industrial and fuelwood), for example for cooking in urban areas as well as urban expansion into the periphery. In contrast to Asia, direct (non-energy) emissions from industry so far play only a minor role.

Energy production and supply policies in most countries are set at the national level, but there are also options on the city level to introduce and support the transformation towards a renewable and more efficient energy system, either with direct investments or through regulations in building codes. Such local by-laws can also be efficient in case of proper enforcement when it comes to energy savings in the construction sector, including construction materials, housing and transport energy needs, as well as liquid and solid waste management, which can also be used for energy production. Promising sectors to be prioritised for intervention, and the role of cities in the transformation process, are further elaborated in the following section.

2.3 The role and potential of cities in the transformation process towards a green economy and green jobs

Cities in Africa and Asia can play an important role in achieving the SDGs as well as the climate mitigation and climate adaption goals while supporting the transformation towards an IGE, creating more green jobs. Cities have among other duties a large responsibility to promote economic development and employment generation. As cities contribute significantly to GDP, they also produce a large portion of GHG emissions. While cities in China, the US and the Gulf States are leading in CO_2 emissions per capita of up to 30 tons/year/capita, cities in South-East Asia (except Singapore with 30 tons) are far below 5 tons, and in Africa mostly below 2 tons (with the exception of Johannesburg and other South African cities with 10 tons) (City Carbon Footprints, s.a.). In response to increasing inequality and unsustainable economic development, cities can support alternative economic models to develop green jobs, provide space and specific land uses for them, and activate local stakeholders in line with SDG 8 and the NUA (UN-Habitat, 2017). This is especially the case for intermediary cities of 1 to 5 million inhabitants; since their population growth is currently the fastest, they are big enough to have the necessary expertise among staff members and can still be effectively managed in comparison to megacities.

However, the mandates of cities in setting economic policies are limited since in most countries these are a (purely) national-level responsibility. In many countries in Africa and Asia, cities have only limited mandates and resources regarding their own political decisions, and they are highly dependent on transfers from national budgets. Cities in Africa and Asia, therefore, need an appropriate framework to play their part and make use of their strengths of being close to the stakeholders and having the mandates on land use planning and building control. Therefore, the different institutional set-ups in different countries have to be analysed and considered in order to draft tailor-made solutions. There are fewer differences between Africa and Asia, which is due to the level of central decision-making and tax distribution as well as the political systems. Obviously, cities in Africa and Asia have only limited capacities to directly create jobs in the form of municipal employees. However, due to their power and competency in land use and infrastructure planning, they can apply strategic planning instruments and building codes towards a green economy.

When issuing building permits with specific green requirements, they can guide urban development and the local economy towards the transformation. They can also issue local policies and advance pilot projects on a wide range of green production and consumption patterns as well as strategically foster certain industries within national frameworks. Cities in Africa and Asia can also attract certain businesses/sectors for investments and support exchanges with universities and research institutes to create development clusters towards a green economy and green jobs.

Another important factor is the role of cities in Africa and Asia as entrepreneurs when running their own municipal services such as water supply, waste management and public transport. This depends on the national institutional set-up and does not apply to every country in Africa and Asia. Here, many cities have the powerful positions and tools to initiate, guide and support the transformation processes as a player on the market and to initiate a demand for green products and services.

Decisions taken by city leaders in Africa and Asia on where, what and how investment will be directed to support green development needs to be considered when adopting a system-based approach. A system-based approach recognises the interconnectedness of sectors and the importance of sequencing. This approach can be combined with the concept of a circular economy. It also recognises that cities will evolve to different levels of "green" at different rates and that this development is not uniform (Green Climate Fund, 2018a).

Furthermore, they are more closely linked to their citizens and the main local stakeholders in the private-sector economy and civil society than national governments, and thus can discuss and implement actions more quickly. Let us have a closer look at the role cities can play. Looking at the internationally agreed New Urban Agenda (UN-Habitat, 2017), it provides a wide range of goals, activities and tools. Although the terms "green economy" and "green jobs" do not appear in the document, the NUA displays important aspects that lead towards a green economy and green jobs. The NUA calls for sustained, inclusive and sustainable economic growth and decent work for all in paragraph 43; for livelihood opportunities in paragraph 56; a circular economy in paragraph 71; the reduction of GHG and black carbon emissions, support for sustainable consumption and production patterns, and a reduction in the costs of energy supply in paragraph 75; as well as nature-based innovation in paragraph 157. The fact that the terms "green economy" and "green jobs" do not appear in the NUA might be explained by the different terminology used in different disciplines and sectors while targeting similar goals.

In African and Asian cities, however, green policies must be compatible with initiatives to reduce poverty and combat spatial and social fragmentation. "Green growth policies therefore cannot be designed and implemented separately from broader policies aimed at global sustainability" (Hammer et al., 2011).

2.4 Fields of action for intermediary cities in Africa and Asia

Based on the analysis above, fields of action for cities with the strongest direct impact within the given mandates of cities towards a transformation to a green economy and generating green jobs while reducing the local carbon footprint can be clustered into:

- urban development and land use planning,
- green buildings and construction,
- sustainable mobility and urban transport,
- green and blue urban infrastructures, NBSs,
  - water supply systems
  - solid waste management, recycling, circular economy and urban mining
- renewable energy and energy efficiency,
- smart cities, urban tech.

Obviously, all these approaches need qualified personnel in the city administration to plan and control urban development, as well as experts to train existing staff. National governments have an essential role to play in enabling progress towards green growth in cities in terms of technical assistance, funding and knowledge-sharing (Hammer et al., 2011). Other funding sources for financing a shift to green urban development are international climate finance initiatives and the private sector. Ensuring sustainable models of finance for infrastructure development but also maintenance and operations has a big impact on whether the green jobs created are secured over a longer period.

2.4.1 Urban development and land use planning

In the context of this section, land use planning is not only understood as the traditional instrument of legally binding land use plans but also includes strategic tools and informal planning processes to guide urban development and the urban economy. These strategic tools and informal planning processes can be a powerful approach leading to more success in plan implementation than the rather inflexible legal planning tools.

With mandates to plan and organise land uses, cities can follow a model of a compact and mixed land use approach (Dempsey, 2010), which is very much in line with the ideas of the NUA (UN-Habitat, 2017). In doing so, cities are able to directly reduce per capita rates of resource use and GHG emissions in mobility due to reduced travel distances of residents and enhance the efficiency and rentability of a public transport system. In contrast, the current "unbridled expansion of urban areas has profound implications for energy consumption, greenhouse gas emissions, climate change and environmental degradation" (UN-Habitat, 2020). So, the urban fabric and its density directly influence the amount of energy consumption in transport, and compact cities with a higher plot coverage and floor space ratio as well as more mixed-use areas are less dependent on motorised transport, and thus contribute less to GHG emissions (see also UN-Habitat, 2020).

A compact city also allows for a more developed public transport system due to a higher number of potential customers per spatial unit. This can create jobs in the transport sector, which can also be part of the green jobs initiative if the transport system is run with renewable energy sources and socially inclusive (e.g. light rails, e-buses and small e-vehicles for the "last mile"). It also allows for more active mobility modes such as bicycles and walking due to

shorter distances. However, in many countries in Africa and Asia, the current planning regulations and building codes, which are often inherited from colonial times, do not allow a higher building – and thus population – density due to former colonial ideals of a small and low-density city designed with plot sizes above 400 square metres for single-family houses to prevent the spread of diseases such as malaria (Scholz, 2015). Here, the planning regulations and building codes on both the national and local levels as well as national urban policies and the mandates cities are given have to be adjusted to allow for the proper transformation into a more compact and resilient city. Obviously, the current pandemic situation must be considered when planning to increase density and should not go too far.

A compact city also reduces the pressure on the urban periphery for urban expansion, and thus reduces the amount of loss of agricultural and green land. The limitation of urban sprawl contributes to the preservation of ecosystems, especially if it considers urban–rural linkages in an appropriate way. Inside the built-up urban area, a more compact, relatively densely built city allows – while keeping the same floor space – for reserving land for the creation of green infrastructure with more parks and open spaces, wetlands and retention areas. Besides benefiting the residents, this also supports the biodiversity in the city, enhances the air quality, contributes to a cooling effect of the city and lowers the risk of flooding (also refer to NBSs, below). Therefore, compactness, density and the establishment of green and blue infrastructure with NBSs can go together perfectly. Additional green infrastructure can also create new jobs with the construction and maintenance of public and private green areas and as well as neighbourhood community gardens and urban agriculture.

> Local authorities, in their roles as landowners and planners of development, open space and environmental resources, can establish land use and land-based ecosystems policies to reduce energy demand, absorb CO_2, protect against climate impacts and provide habitats for local wildlife. (Hammer et al., 2011)

In their role as responsible actors for long-term strategic planning and facilitators as well as enablers of non-governmental action, cities can – in cooperation with key local stakeholders from civil society and the private sector – set goals for green economy policies through workshops, public hearings and online participation (see also Hammer et al., 2011).

These transformations mentioned above can be the responsibility of municipal governments if the mandate is given by the national government – as in decentralised states – and national urban policies support these. This is in line with the NUA (UN-Habitat, 2017) asking for more independent local decision-making in urban development. A well-planned city will also have "opportunities for disaster risk reduction, accelerated response and recovery through land use planning, building codes and regulations, risk assessments, monitoring and early warning, and building-back-better response and reconstruction approaches" (UN-Habitat, 2020).

However, some green action and sustainability policies in urban areas can have unintended impacts: Environmental and conservation projects, including green infrastructure, are adding value to the urban environment but also increase price levels in the real estate market. Marginalised groups such as informal settlers and informal traders can be pushed out by increasing housing and commercial prices and rents, and through regulatory restrictions on the use of green infrastructure for commercial activities and/or informal housing. Cities are finding a new challenge in these green and climate gentrification processes when people are excluded not only from housing and public spaces but also from safe and protected

environments. Recent assessments of urban greening initiatives show that, despite positive environmental outcomes, they have also been associated with the displacement of low-income residents and informal income-generating activities (see also UN-Habitat, 2020).

Green growth, therefore, can run the risk of addressing only two of the three pillars of sustainable development: the economy and the environment. Therefore, green policies have to include the third pillar on social equity to reduce income segregation, which can result in the relocation of urban poor from formerly unclaimed areas as they are converted into green infrastructure. Such displacement of the urban poor to make room for green infrastructure can also result in unintended benefits for real estate developers. This challenge particularly applies to rapidly growing cities in Africa and Asia. "These policies all have a social cost, and again it would not be fair to ask urban dwellers whose revenues stand below the poverty line to pay for the provision of local and global public goods like environmental protection" (Hammer et al., 2011).

Box 1: Urban planning and systematic approaches
Rapidly urbanising Mueang Songkhla in Thailand has launched four initiatives to counter environmental degradation, inefficient resource utilisation, inequitable growth, and rising risks from climate change and natural disasters. These initiatives promote tourism and enhance land management while redeveloping low-income homes, improving environmental quality and pursuing innovative financing mechanisms to raise resources.
Source: ADB (2016) (Creative Commons Attribution 3.0)

Box 2: Promoting green urban development in African cities: eThekwini, South Africa Urban Environmental Profile
The city of eThekwini, or Durban, has undergone a period of rapid urbanisation that has contributed to the degradation of the city's natural environment. Climate change is placing further strains on the city's ability to manage the urban environment. The urban environmental profile of eThekwini has been prepared as the first component of the assignment promoting green urban development in Africa: enhancing the relationship between urbanisation, environmental assets and ecosystem services, which is a project being conducted under the leadership of the World Bank. An overall objective of this project is to link the study of urban environmental issues with the advancement of more sustainable urban growth. The profile summarises the existing quality of the terrestrial and other aquatic environmental assets, identifies the key drivers that are the cause of their vulnerability, and describes the key institutional challenges and constraining factors that limit the city's ability to address environmental management challenges. Identification of the key environmental assets and key drivers of environmental degradation within the city required a more comprehensive review of reports on urban planning and infrastructure services.
Source: World Bank (2016)

2.4.2 Green buildings and construction

In the context of rapid urbanisation, the job-creation potential of green building construction is presumed to be significant (Hammer et al., 2011). Until 2060, the global building stock is projected to double in size. As a result, the construction of new energy-efficient residential and office buildings, as well as the retrofitting of the existing building stock, are by far the biggest job-creating actions worldwide (C40 Cities Climate Leadership Group, 2021). This

applies especially to the fast-growing intermediary cities in Africa and Asia. The construction sector, therefore, is one main target of the transformation process towards a green economy. Also, it comprises a huge workforce that mostly includes less-skilled, informal workers, thereby offering a huge potential to create new green jobs.

The production and use of concrete as a building material contributes already 8 per cent of total worldwide carbon emissions (Ellis, Badel, Chiang, Park, & Chiang, 2020). If we proceed to build our cities with conventional materials such as concrete, cement and aluminium, we have already "used up" about 75 per cent of the 1.5°C climate goal (WBGU, 2011). Thus, the building sector plays a fundamental role in the carbon footprint of growing cities with its construction activities for housing, but also office blocks and infrastructure. Today, the main building materials are concrete and steel, which not only create enormous carbon footprints, but they also have disadvantages in terms of thermal management of the building interior, thus creating the need for energy-intensive cooling and heating.

What is needed are local building materials with lower carbon footprints and higher insulation capacities, such as for example bricks or clay. Especially renewable building materials such as wood, bamboo, straw and typha offer high employment potentials along their value chains. Cities play an important role as the "constructors" of their own buildings and municipal infrastructure. More importantly, they can influence the private construction sector through local by-laws and the building and tender regulations regarding the materials used for construction. Cities can encourage this transformation through investments and support local climate-friendly building material production methods – simply called "green building" technologies – that stimulate demand among private and public property developers. Obviously, this would require not only a transformation of the construction industry, but it also calls for the development and market introduction/expansion of new, locally adapted construction materials that are based on local sources as well as the application of new skills. Here, the national governments have to support the transformation. South-South cooperation and knowledge transfer are important to facilitate this process.

Green building materials are composed of renewable materials, recycled elements or new materials such as bio cement, rather than non-renewable resources such as cement. Often, they consume less energy in production and/or have improved thermal characteristics, thereby lowering energy consumption during the operating life of the buildings. Using green building materials and products promotes conservation of dwindling non-renewable resources (such as sand) internationally. In addition, integrating green building materials into building projects can help reduce the environmental impacts associated with the extraction, transport, processing, fabrication, installation, reuse, recycling and disposal of these building industry source materials (Green Climate Fund, s.a.). Green building (also known as green construction or sustainable building) refers to a structure and the use of processes that are environmentally responsible and resource-efficient throughout a building's life-cycle: from siting to design, construction, operation, maintenance, renovation and demolition. The green building practice expands and complements the classical building design concerns of economy, utility, durability and comfort. Other related topics include sustainable design and green architecture. Building and construction activities worldwide consume 3 billion tons of raw materials each year, or 40 per cent of total global use (Roodman & Lenssen, 1995).

Mandatory green building codes or voluntary guidelines will generally have the biggest impact on new construction projects (Hammer et al., 2011), but also in retrofitting the existing residential and commercial building stock (C40 Cities Climate Leadership Group, 2021). This retrofitting should be supported by national funding schemes. The need to follow new standards for building also applies to the existing building stock in case of extension or change of use whenever a building permit is required, and thus will be applicable for many commercial buildings. However, especially in poorer countries in Africa and Asia, the building codes often do not include sufficient regulations (or they are not enforced) to foster energy-saving measures and enforce the application of solar energy and other renewable sources. Therefore, national and local planning legislation has to be reviewed in order to create well-working approaches. Even where legislation has been updated, sufficient capacities need to be developed to ensure full implementation.

Revised building codes could also require the use of building materials that reduce the need for cooling, for example bricks instead of concrete as well as passive building designs. Building codes can be a powerful tool to support the transformation towards a green city and economy and create stable green jobs when new technologies and products have to be implemented. This calls for experts to carefully revise and adjust the building codes in cooperation with local stakeholders, and at the same time integrate the challenges of climate change adaption and mitigation in the land use planning system and building codes. Next to that, traditional building materials and techniques also need to experience a sort of revival; right now, they are often perceived to be "backwards" in the partner countries, whereas they are often the smarter and low-emission solutions. A South-South exchange of local experts on the municipal but also the ministry level can support a change of the regulatory system and transfer knowledge and technology.

Besides regulating private-sector buildings, cities can introduce energy-saving measures for public buildings (e.g. in the cooling system, passive solar prevention by reducing the exposure of the facade to the sun through shading elements, options for daylighting, natural ventilation, the introduction of solar energy and energy-saving lightning) to create and foster a market for these products, attract companies to supply and maintain such facilities, and to act as a role model for private investors and households to follow. This also includes the retrofitting of municipal buildings and public housing, the obligatory application of green walls and roofs by planning regulations and building codes as well as installing water retention systems (e.g. green roofs or cisterns) and grey water recycling. This shift in the construction industry and facility management has to be in line with national policies, custom regulations for imports and taxation measures. When an enabling environment exists, this approach can be successful and create new and different green jobs. The new market for these products should be satisfied by local companies in order to create local jobs. This can be supported by public procurement and public-private partnerships that could facilitate green spending (Hammer et al., 2011).

Box 3: Energy efficiency in buildings

Using voluntary and mandatory standards to promote green consumption: The case of energy-efficient household appliances in India

With increasing urbanisation and growth in the number of middle-class consumers, demand for electrical household appliances has rapidly increased in India and accounts for a considerable share of the country's energy consumption. Despite the entry of large multinationals such as Hitachi, LG, Philips and Whirlpool, firms almost exclusively used to serve the market for simple technologies at low sales prices – at the expense of energy efficiency.

In 2006, the Bureau of Energy Efficiency (BEE) initiated its Standards and Labelling Programme to provide consumers with information about energy consumption and the related cost-saving potential of electric appliances. It encouraged firms to adopt voluntary energy-efficiency standards and introduce a one-to-five stars labelling scheme to categorise products with different levels of energy efficiency. In addition, manufacturers were given incentives to invest in product improvements, and the labelling scheme was aggressively promoted in the media. All relevant stakeholders – from manufacturers to electric utilities, standards bodies and government agencies – were extensively consulted during the design phase of the programme.

About three years later, the voluntary labels had already gained credibility, and consumers had increased the purchase of labelled products. For refrigerators and air-conditioners, sales of labelled products surpassed 50 per cent market share by then. At this stage, when consumers widely knew about, and relied on, the star labels to make informed purchase decisions, performance standards were made mandatory for a range of household appliances. In the meantime, the BEE had encouraged manufacturers to adopt approved testing systems and self-certify their products, and it had built up a testing infrastructure to check-test samples of household appliances drawn from the market in order to verify the information provided by the manufacturers.

The Standards and Labelling Programme has thus produced a quality label that created market transparency while helping firms to widen their product range and launch better products. At the same time, it made a substantial contribution to energy savings in India. The BEE estimated energy savings of 7 gigawatts (GW) during India's 11th Five-year Plan period (2007-2012). Starting with voluntary standards and building on partnerships with powerful firms was an appropriate strategy to prepare the market and phase-in energy-efficient alternatives; shifting to mandatory standards later helped to phase-out the undesirable inefficient technologies. Firms and consumers were given time to react, and the voluntary investments of those firms that had joined the phase of market preparation provided them with an early mover advantage when standards became mandatory.

BEE adopted similar strategies to phase in energy-efficiency standards in other fields, such as residential and commercial buildings, and light-emitting diode (LED) lamps. Strategies were designed differently depending on the characteristics of each area of energy use, but success always depended on the smart sequencing of voluntary and mandatory standards as well as extensive stakeholder involvement.

Source: Lütkenhorst et al. (2014)

Box 4: Chamazi Community-based Housing Scheme

The Chamazi Community-based Housing Scheme is a community-driven initiative aimed at providing affordable housing solutions for affected communities from Kurasini, Dar es Salaam City, whose settlements were demolished as part of the Tanzania government's port expansion project. It is a collaborative work between community members, civil society, government, donors and the private sector.

The Chamazi Housing Scheme was initiated in 2008 by the Centre for Community Initiatives (CCI) and the Tanzania Urban Poor Federation (TUPF) to provide safe, secure and affordable housing for displaced households. The CCI secured alternative land for resettlement in Chamazi, Temeke municipality, in the outskirts of Dar es Salaam city. To minimise costs, the CCI and TUPF worked with the Ministry of Lands, Housing and Human Settlements Development, the City Council and Temeke municipality to help in the surveying of the land, land acquisition, the development of the master plan of Chamazi, the designing of housings and providing engineering support. They also involved the National Building and Housing Research Agency to train community members on how to make interlocking bricks and Sisal fibres roofing tiles.

Implementation of the Chamazi Housing Scheme included a great level of involvement by the communities and other stakeholders. It also included capacity-building for community members on construction skills on how to make interlocking bricks and Sisal fibres roofing tiles. The interlocking stabilised soil bricks technology was then used for construction, and all construction materials were fabricated on site by community members. Slum Dwellers International and the CCI also organised exchange visits to India and Thailand for representatives of the national and local governments, the community and non-governmental organisations for exposure as well as to learn from similar projects.

From the outset, the project has provided affordable accommodations to low-income communities, where currently about 75 houses have been built. The project has also improved access to water and sanitation. The project constructed deep boreholes fitted with solar-powered water pumps. In addition, faecal sludge management is treated using constructed wetlands with recyclable water technology.

Community members have acquired knowledge and skills on affordable housing construction, creating opportunities for employment within and outside Chamazi. About 30 community members (both women and men) of the project have acquired skills in making interlocking bricks and Sisal fibres roofing tiles. The project has also lowered construction costs. Soil-cement interlocking bricks technology is 40 per cent cheaper than conventional building blocks. The interlocking mechanisms eliminate the need for mortar between layers and allow for a faster building rate.

Source: Authors, based on Slum Dwellers International (2010) and Transformative Cities (s.a.)

Box 5: Increasing access to solar rooftop generation in India

Enabling access to long-term, affordable financing for solar rooftop installation projects in commercial, industrial and residential housing sectors, including vulnerable communities

India's nationally determined contributions target 40 per cent electric power capacity from non-fossil fuel-based resources by 2030 – with a target of 40 GW of rooftop solar power by 2022. The programme provides long-term and affordable financing to construct 250 MW of rooftop solar capacity, reducing emissions by 5.2 million tonnes of CO_2 equivalent over 20 years. This pioneering private-sector-driven initiative will unlock private-sector investment in the rooftop solar market and pave the way towards a sustainable bankable model in India and beyond.

Source: Green Climate Fund (2018b)

Box 6: Promoting an environmentally friendly construction materials sector in Malawi
This is a public–private partnership (PPP) project implemented jointly by Lafarge Cement Malawi Limited, the German Agency for International Cooperation (GIZ) and Terrastone Limited. The aim is to make the building materials production sector more sustainable. This supports the Sustainable Building Material Act, enacted by the Government of Malawi in 2018. A bilateral approach is to be used. On the one hand, an energy-efficient and low CO_2 cement production technology shall be used for the production of high-quality cement, while conventional bricks shall be replaced by cold ceramic brick (CCB) technology using waste materials. This will reduce the environmental impact of this sector and at the same time create jobs. For the success of the project to reach the users of the materials, the existing supply relationships and distribution sites of Lafarge and Terrastone are crucial. The project will be implemented in four work packages. The first deals with adapting and piloting of the LC^3 (Limestone Calcined Clay Cement) technology, an energy-efficient and low carbon cement production technology) and CCB technology in Malawi. The second aims at awareness-raising among the building materials producers in Malawi as well as outreach to neighbouring countries. The third work package has the goal of developing the value chain, while the fourth deals with support for the development of standards and guidelines.
Source: DeveloPPP (s.a.-a)

2.4.3 Sustainable mobility and urban transport

Transport contributes a significant share (14 per cent in 2018) of global CO_2 emissions (Sustainable, Low Carbon Transport Foundation [SLOCAT], 2021, p. 28), with trends predicting a twofold increase by 2030. Growth in emissions will accelerate with increasing demands for travel and freight transport. From 2000 to 2019, the growth rate of transport-related emissions grew in Africa by 105 per cent and in Asia by 117 per cent, while in Europe only by 7 per cent (SLOCAT, 2021, p. 31). Mobility will have a distinct impact on future emissions, and there is an urgent need to encourage compact, connected urban forms linked by sustainable transit solutions, instead of sprawling, car-dominated and high-emission development. From the well-established policy options of "avoiding-shifting-improvement", for the first two options, cities can have a great influence through their own actions by:

- *avoiding* unnecessary motorised trips based on proximity and accessibility;
- *shifting* to less carbon-intensive modes – that is, from private vehicles to public transport, shared mobility, walking and cycling, water-based freight, electrified road-rail freight and cargo bikes for last-mile deliveries, among others; and
- *improving* vehicle design, energy efficiency and clean energy sources for different types of freight and passenger vehicles (SLOCAT, 2021, p. 33).

Motorisation trends vary substantially across and within regions: The use of private cars might grow fast in some countries and cities, while others are dominated by two-wheelers or a wide range of low-tech, informal public transport options. Africa had the lowest transport CO_2 levels among all regions in 2019, contributing only 5 per cent of total global transport CO_2 emissions that year. However, transport emissions in the region are growing rapidly.

Although massive investments have been made in many African and Asian cities, the road infrastructure and transport service delivery have often been unable to keep pace with this population growth. Most cities face severe problems in human and financial capacity as well as governance-related issues, which have significant negative impacts on urban

transport systems: “Weak, fragmented, and under-funded authorities have been unable to maintain existing services or to plan for expansion” (Kumar & Barrett, 2008).

The majority of urban dwellers depend on available and affordable public transport. However, over the last decades, formal public transport services have faced financial problems. Privately operated, often informal minibuses are the most popular mode of public motorised transport in many cities. Although minibus taxis are able to serve a dense transport network and are characterised by a high rate of operational flexibility, they are notorious for their poor safety records, which are a result of overcrowding and reckless driving (Kumar & Barrett, 2008).

Efficient transport is not guaranteed in most cities in sub-Saharan Africa – resulting in low productivity levels of the respective economies and societies. Emissions are expected to continue rising steadily. Some cities have introduced more sustainable transport systems such as Bus Rapid Transport (BRT), but there remains a need to scale-up their reach, coverage and functionality (REN 21, 2021b). Urban growth in developing countries, the increase in the use of private motor vehicles and correlated negative externalities are essential concerns for urban managers. The debate is often dominated by a dispute over which types of public transport should be implemented. Particularly over the last decade, the successful introduction of high-capacity BRT systems, such as the Transmilenio in Bogotá, has been gaining ground in cities in Africa and Asia.

Successful compact cities rely on functional transport linkages, mixed land uses and high-quality urban services. Land-use zoning policies that allow for higher densities and a greater mixing of residential and commercial uses can enhance transport goals by reducing trip distances, while strategic mass transit linkages can attract development and promote compact growth. Cities can, for example, plan and implement multiple transport modes around hubs that are dynamic centres for service provision. The synergy between transport with its customer flows and economic activities generates new employment opportunities. However, it can only take place if urban development plans are implemented. Besides an adjustment of the legal planning tools towards a higher efficiency level and relevance, informal processes and strategic instruments as well as incentives on the real estate market prove to be efficient instruments. Integrated urban strategies for sustainable transport can serve as incubators for green technology innovations (Hammer et al., 2011). Other tools and instruments are related to direct contact between local governments and citizens as awareness and information campaigns aim at a change in travel patterns. These campaigns have to be run in parallel with the establishment of better green mobility offers, such as the creation of bicycle lanes and/or new public transport means, and they should be monitored and evaluated in order to enhance their efficiency.

C40 Cities Climate Leadership Group (2021) sees an excellent option in maintaining and providing new mass transit infrastructure, electric vehicles, and new walking and cycling infrastructure to create a green economy and green jobs. Considering “new towns” or greenfield urban areas, proper planning and investment in transport networks, access to services, buildings, water and energy systems from the beginning will make a crucial difference in avoiding or “locking in” high-carbon infrastructure for the next generation (UNEP, 2011). On the side of German development cooperation, the Transformative Urban Mobility Initiative (TUMI, s.a.) and the Sustainable Urban Transport Project (s.a.) are at the forefront of this discussion with a broad portfolio of successfully implemented projects.

Box 7: Bus Rapid Transport

Building a zero-emissions BRT system that is safe and accessible to all

Karachi is one of the most densely populated cities in the world with a population of 14.9 million. It is ranked very low in the 2017 *Global Liveability Report*, mainly due to its traffic congestion and induced air and noise pollution. Its current public transport system fails to provide mobility for all and is characterised by long commuter trip times, the rise of private vehicle ownership and paratransit modes, thus the decline in the use of public transport. Public transport services are currently only provided by informal paratransit vehicles. Vehicles in this informal network tend to be old and poorly maintained, leading to high fuel consumption, increased emissions and higher operating costs. The vehicles are loaded beyond capacity to maximise passenger count, which leads to very cramped conditions and serious safety issues for passengers as well as the general public. This is the first dedicated low-emissions transport project presented to the Board. The project aims to establish a 30 kilometre, fully segregated BRT system operated with the "world's first" biomethane hybrid bus fleet. The project includes innovative features such as a dedicated biogas plant covering 100 per cent of the fuel demand and the last mile connectivity via bikes and e-pedicabs and includes flood proofing of the road. The project has an estimated lifespan of 20 years.

Source: Green Climate Fund (2018c)

Box 8: Strengthening the skilled workforce and promoting employment in the sharing market for electric motorcycles

On the one hand, the project ties in with the great importance of motorcycles operated as cabs in Rwanda's capital, Kigali, and on the other hand with the Rwandan government's aim to increase the share of electric-powered vehicles as part of its climate strategy. GIZ, together with the leading Rwandan service provider for e-mobility, Safi Universal Link Ltd, aims to create training opportunities in the e-mobility sector, and thus strengthen the employability of young people in this sector with the help of in-house training offers. In addition, an internship programme is being created in collaboration with the University of Rwanda and selected vocational schools. The project also uses various communication channels to boost the use of electric motorcycles among local cab drivers, promote safe driving practices and publicise the new e-motorcycle sharing service.

Source: Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ, s.a.-b)

Box 9: e-Rickshaws as public transport and emergency health services

The pilot project by the Transformative Urban Mobility Initiative deals with the implementation of a transport infrastructure system with e-rickshaws in Singra, Bangladesh. The project has a two-part objective. The first is to promote public transport, which was previously non-existent in the city, and the second is to use the vehicles as emergency medical service vehicles. To this end, 10 e-rickshaws were purchased, a workshop was provided and training sessions were held for drivers to practice using the vehicles safely. Four of the ten vehicles were produced locally, strengthening this local production. The project also addresses the COVID-19 pandemic by using the e-rickshaws as mobile testing stations and for food distribution systems and mobile information campaigns. During the spread of the pandemic, the necessary adjustments to the project demonstrated its flexibility and adaptability. The creation of basic and technical knowledge should ensure the long-term success of the project. The project ran from September 2018 to December 2019 and is a model to guide implementation in other regions that have similar challenges.

Source: TUMI (2020)

2.4.4 Green and blue infrastructure, NBSs

Depending on the institutional set-up of the country, cities either run their own public sector or can considerably influence private-sector local infrastructure service providers. This applies to water supply, wastewater collection, treatment and disposal as well as to solid waste management. In all sectors, there are huge potentials to develop a green economy and green jobs. In this section, we focus on water supply systems (blue infrastructure) as well as green infrastructure, which uses green areas to provide services such as stormwater management for runoff volume reduction, erosion prevention and aquifer recharge.

> Green Infrastructure (GI) is based on the principle that "protecting and enhancing nature and natural processes […] are consciously integrated into spatial planning and territorial development". Accordingly, the Green Infrastructure Strategy defines GI as "a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services" in both rural and urban settings. (European Commission, 2013)

Some scholars combine blue and green infrastructure under one umbrella as blue-green infrastructure, since there are considerable overlaps. The tools, strategies and approaches used for these blue and green infrastructures, however, are summarised by others as NBSs (World Wildlife Fund [WWF] & ILO, 2020). "Nature-based solutions range from simple techniques, such as using native vegetation rather than concrete to control soil erosion and reduce water runoff along road embankments, to landscape-scale watershed restoration to improve water quality and availability for entire regions" (WWF & ILO, 2020). The International Union for Conservation of Nature (s.a.) provides another definition: "Nature-based Solutions are actions addressing key societal challenges through the protection, sustainable management and restoration of both natural and modified ecosystems, benefiting both biodiversity and human well-being."

According to UNEP (2021), NBSs "include forests, wetlands, green belts and parks in and around cities as well as green infrastructure such as natural wastewater plants, green roofs, green walls, combined nonmotorized transport and ecosystem corridors and other green, blue and hybrid infrastructure". Another term related to infrastructures is "grey infrastructure", related to mainly "concrete-based" traditional infrastructures such as channels, pipes, sewers and sewage treatment works, ditches, dikes and dams.

NBS is a concept that combines technical and landscaping approaches of both green and blue infrastructure with new (technical) solutions into an integrated approach. NBSs are, by their nature, interdisciplinary and cross-sectoral integrated approaches, and thus require but also create an imperative for cross-sectoral collaboration. This creates opportunities for enhanced collaboration between actors and stakeholders on the city level but also beyond the administrative boundaries into the urban hinterland, whereas multi-level cooperation previously tended to focus on a single domain (WWF & ILO, 2020). This understanding is also supported by UN-Habitat (2020): "Nature-based solutions are closely linked to the delivery of green and blue infrastructure, as a strategically planned network of nature- and water-based features, integrated with the urban environment, that provide multiple functionalities."

Nature-related jobs are also an important potential source of employment in the green recovery (OECD, 2020). The Asian Development Bank (ADB) recognises that the

economic recovery from COVID-19 is an opportunity to both tackle the climate crisis and build resilience, including through natural and hybrid infrastructure projects and NBSs (ADB, 2019). Economic responses to the COVID-19 pandemic that focus on "building back better" can provide jobs and generate economic growth in ways that protect and restore the natural environment and address climate change (UNEP, 2021).

Major infrastructure programmes will shape the trajectory of sustainability in cities for decades. Today, three quarters of 2050's infrastructure does not yet exist (UNEP, 2021), especially in the fast-growing intermediary cities. At the same time, local governments are often key actors in raising awareness and advocating for investment in NBSs in urban contexts (McQuaid et al., 2021).

NBSs are both labour-intensive and able to use a high share of local resources (WWF & ILO, 2020). The application of NBSs in urban development, infrastructure and construction requires new skills and technologies, which will create new jobs if supported by national policies, taxation and knowledge transfer (Hammer et al., 2011). Supporting this view, the ILO sees "the greatest potential for job creation […] in natural capital investments through direct government spending both in rural and urban settings on NBSs and urban green infrastructure respectively" (WWF & ILO, 2020).

When NBSs are incorporated from the beginning into the design and management of urban areas, cities can benefit from multiple ecosystem services (UN-Habitat, 2020). Therefore, NBSs have to be integrated into the planning process at the earliest stage possible and tailored to local contexts. They also have to take into account the climate impacts that the region will experience (UNEP, 2021). Done right, green public employment programmes that integrate NBSs will create jobs for vulnerable members of society (UNEP, 2021). At the same time, NBSs build resilience and reduce disaster risks, and support climate adaptation and mitigation on the local level, as UNEP stated (2021).

However, there are some obstacles and risks to consider. Innovative NBSs may be blocked by out-dated building codes, construction standards and planning guidelines but also due to a lack of knowledge, technical capacity, political will and unawareness about investment and maintenance costs (UNEP, 2021). Another problem is related to NBSs applying standing water, which can act as a breeding ground for mosquitoes and other disease vectors. In tropical climates, a major concern is that this will contribute to public health risks such as the spread of malaria. A third obstacle can be gentrification, as green areas, lakes and other NBSs increase the value of land, thus this "needs to be balanced with the realization of how green gentrification is driving further processes of urban exclusion" (UN-Habitat, 2020). These challenges need to be carefully considered, monitored and if necessary, corrected for in planning and implementing NBS approaches.

In order to follow the sectoral approach, in which funding organisations, ministries and urban departments – as important target groups of this paper – are organised, we replicate this sectoral approach while highlighting the concept of NBS as a cross-cutting and intersectoral approach.

Water supply, flood prevention and sewage systems

NBSs, including wetland and forest restoration and floodplain reconnection, can be part of a diversified portfolio of strategies to reduce flood risk. In cities, interventions planned for

disaster risk reduction through reforestation and wetland restoration promise to create opportunities for employment on a relatively large scale and over longer time frames (WWF & ILO, 2020). These job opportunities include the informal sector, for example in recycling and upcycling systems as well as less-skilled jobs in maintenance.

An important field of activity, combined with land use planning, is water source management by cities, applying principles of green infrastructure. Well-planned and well-managed water retention areas also prevent floods and overall represent the leading application of NBSs. On the building level, rainwater harvesting can reduce run-off rates and prevent flooding in urban areas. Other options for cities are regulations to increase the use of recycled water for toilet flushing, washing cars and watering outdoor landscaping. "Water efficiency could boost overall GDP and create jobs across a range of sectors, including the construction, manufacturing, retail trade and waste sectors" (Hammer et al., 2011).

Regarding water supply systems, current problems include substantial system losses, both due to pipe leakages and illegal connections. Smart water metres and a proper control of leakages in the system using smart technologies can save water and create jobs in the maintenance sector. Other options for cities include addressing the design of water tariffs. Water tariffs should include a basic lifeline consumption threshold for households and small enterprises. This lifeline amount should be provided at very low rates that are affordable to all users. In most cases these rates will not fully reflect costs. Beyond such thresholds, however, water tariffs should increase significantly to send a price signal encouraging water savings, while at the same time ensuring full cost recovery for the water and sanitation system as a whole.

In wastewater management and sanitation, there is still a huge untapped resource for the re-use of water (e.g. irrigation), energy production (e.g. biogas) and fertiliser with the potential to create green jobs in collection, disposal and re-use (see also section below).

Solid waste management, recycling, circular economy and urban mining

In the collection and disposal of solid waste, there is a huge potential for recycling and energy production. Thus, some scholars refer to this sector as urban mining, which not only covers solid waste from households, but also from production processes as well as construction and demolition sites. In the waste sector, emission reductions are achieved by diverting and treating food waste, capturing landfill gas and improving recycling (C40 Cities Climate Leadership Group, 2021).

When solid waste is collected and separated carefully, new economic opportunities arise from recycling and selling the products. Cities can play an active role either by running recycling plants on their own or issuing designated areas near waste management and disposal sites for private-sector recycling companies. Cities can also create green jobs by encouraging and supporting the re-use and repair of goods and establish production clusters aiming at a circular economy. Models of PPP between public or private collection and private recycling can be a suitable approach as long as the control of these services and facilities remains under supervision of the public sector or under a supervised Extended Producer Responsibility scheme. Furthermore, cities can adjust the solid waste collection tariffs to support urban mining activities. Urban mining companies create green jobs but also serve as an entry point for informal workers. This is a sector where special attention

has to be given to proper regulation, but even more importantly monitoring and enforcement in terms of safe working conditions, as well as health and environmental hazards.

The solid waste sector provides many opportunities for green urban growth, with the most recent opportunities arising in the recycling sector and in energy production, including biogas production from solid and liquid waste. Waste collection costs can vary widely based on the level of automation involved in the system. Recycling can create employment or training opportunities for marginalised populations. Reuse of materials can also be important inputs for organisations with low budgets, such as schools and arts organisations (Hammer et al., 2011).

Better waste management is essential to meet the carbon reduction goals. Waste is already responsible for up to 5 per cent of global GHG emissions, and waste production from cities is set to almost double by 2020. Cutting waste generation through prevention, reduction, recycling and reuse is the fifth target of the 2030 Sustainable Development Goal 12 (Oates, Sudmant, Gouldson, & Gillard, 2018). This leads to the concept of a circular economy, where waste materials are converted into new inputs and energy cascades through the local industrial network. Reusing, repairing or recycling products from plastic, metal or paper, and composting organic waste can create considerable additional investments and jobs. The goal is to switch from a wasteful linear model of production to a circular model (Pegels & Altenburg, 2020).

Examples of circular economy initiatives – for example from Cape Town, South Africa's industrial symbiosis programme or Quezon (Philippines), among others – aim to increase efforts at reducing and recycling waste through reuse and repair (UN-Habitat, 2020). At the same time, many cities in developing countries are fostering the integration of informal-sector activities such as solid waste collectors, informal transport and street vendors into the formal economy in an effort to improve labour conditions and public space use. "In Qalyubeya Governorate (Egypt), for instance, an integrated community-based solid waste management system is improving waste collection while advancing the working conditions [of] the informal workforce" (UN-Habitat, 2020).

The circular economy is an approach to dematerialisation, combined with the management of material flows. It aims at an integration of sustainability principles in production processes, that is, closed loop processes in which waste materials serve as the input. This can be undertaken directly by municipal solid waste and sewage agencies. They can make use of material flows inside the city and re-use waste and sewage for the recycling of materials, for example for fertiliser production or through biogas plants for energy production. Informal recycling activities often already exist and are undertaken by the private sector on both formal and informal scales (sorting and processing of materials from waste such as plastics, glass, paper, etc.). These activities, however, are conducted in unsafe ways, putting workers, city inhabitants and the environment at risk. Often, regulations exist on paper but are not properly monitored and enforced. Here cities can play a major role due to their responsibility for waste and wastewater collection, and thus they have access to the "raw" materials of a circular economy (REN 21, 2021b).

Box 10: PREVENT Waste Alliance

The PREVENT Waste Alliance, together with the Steering Committee and the German Federal Ministry for Economic Cooperation and Development (BMZ), selected eight pilot projects that address solutions which contribute to a circular economy in low- and middle-income countries. These projects were also selected for their thematic relevance to mitigating the negative impacts of the COVID-19 pandemic. Specifically, the projects contribute to minimising waste, eliminating pollutants and maximising the reutilisation of resources by addressing the particular needs of low- and middle-income countries. One project in Tanzania supports the Tanzanian government in setting up mechanisms to control imports of e-waste. In Ecuador, a waste collection and Extended Producer Responsibility scheme is being supported. A project in Serbia and Bosnia-Herzegovina is helping to strengthen plastic recycling, while in Nigeria an international financing mechanism for e-waste is being developed. In Indonesia, efforts are being made to improve the waste management system in general. In India, Mexico, Vietnam and Brazil, financial instruments in particular are to contribute to inclusive and transparent circularity. In Algeria, Morocco, Jordan and Egypt, a study programme for waste management is being developed, and in Ethiopia a project is being promoted with the aim of developing a legal, technical and economic guideline for dealing with organic waste.

Source: Prevent Waste Alliance (s.a.)

Box 11: Improving employment opportunities in the municipal services sector in Algeria

This project is a special initiative in the Middle East and North Africa, commissioned by BMZ and worked on since 2018. The project aims to address two problems that are prevalent in Algeria, and thus it has its origins in the Algerian government's desire to improve the quality of waste management by outsourcing this task to external companies. In addition, about a quarter of those under 24 are unemployed and have no job prospects. Algeria provides financial support for start-ups in the small business sector, but the companies' founders lack the know-how to successfully manage municipal waste disposal. Improving this circumstance is the goal of the project. This is done through various approaches. Algerian vocational schools are being supported in teaching about waste management, which promotes the know-how of the graduates. The municipalities are being supported in controlling the quality of the awarding process for waste disposal contracts. Recent start-ups would exist, for example, in the cities of Tlemcen, El Milia and Marghina.

Source: GIZ (s.a.-a)

Box 12: Generation of (positive) energy through waste

This project, which is being carried out by GIZ, was commissioned by BMZ together with the EU. The political sponsor of the project, which started in 2015 and is expected to run until 2023, is the Jordanian Ministry of Municipal Affairs. The aim of the project, which is based in Jordan, is to create a source of income through the collection and processing of waste, which is intended to benefit disadvantaged population groups in particular. It must be said that Jordan has taken in about one million refugees from Syria. This works through a cash-for-work system for about 40 days and is being implemented in fifteen municipalities as well as two refugee camps. Educational activities on waste and the environment are also taking place. In addition, the project is establishing links between universities in Jordan and Germany to ensure the long-term success of the project. A biogas plant is being built in Za'atari Camp to dispose of sludge in an environmentally friendly manner. The resulting biogas covers a large share of the energy consumption of the treatment plant. Thus, an NBS is also being used to promote renewable energy.

Source: GIZ (2021)

2.4.5 Smart city and urban tech

"Urban tech and the concept of a smart city are promising to contribute to solve some urban problems and making cities function more efficiently" (Adler & Florida, 2021). Urban tech developments seem today to be highly concentrated in a relatively small number of cities across the world. Some years ago, leading urban tech clusters could be found mainly in cities and across North America, Europe and Asia, either in leading tech hubs such as Silicon Valley or very large global cities such as New York, London and Beijing (Adler & Florida, 2021), while the potential for intermediary African and Asian cities has been overlooked.

One precondition for urban tech and smart cities, however, is already being fulfilled in most cities, including intermediary cities in Africa and Asia: A fast mobile web, which allows clients to use new services and products. Through global networking and cloud computing, the location itself becomes less relevant, allowing for the sharing of knowledge, solutions and workloads worldwide.

While large tech firms are still mainly located in the Global North, studies have revealed that the key factors in the geography of urban tech seem to be "population, economic size, and access to universities and pools of talent" (Adler & Florida, 2021). However, a lot of tech firms are active in African countries to test out new ideas and solutions (also due to less strict regulations), hence they offer great opportunities to develop local know-how. We see in the case of urban tech developments in, for example, Nairobi, Kigali, Accra, Johannesburg and Durban as well as many cities in Asia, that locally based ideas and solutions are possible also in the Global South. Urban tech approaches can be replicated also in developing African and Asian cities, where critical components exist, including technical universities. Local decision-makers also understand the potential of urban tech and smart city applications and devices. With its tech hubs such as iHub, FabLab Nairobi and NaiLab, Nairobi is at the forefront.

In Africa, the smart city is often seen as an innovative marketing and management strategy to match the infrastructural demands of a growing middle-class, urban population. So, new smart cities, such as Konza Techno City in Kenya, are under development to create a world-class city from scratch: "[…] for many African governments, smart city visioning soon energised the collective ambition of a modern-day African society characterised by wishes for new realms of comfort" (Urbanet, s.a.). Obviously, these new urban developments will attract informal settlers (even if not wanted by the developers) due to the opportunity of income-generating activities, the availability of infrastructure and demand for household services by middle-class residents.

Some criticism from African scholars has to be considered, as from Nsikan-George at Climate Alliance, Frankfurt:

> The larger proportion of urban dwellers, yet to be integrated into the mainstream urban fabric, is disproportionately impacted by technological transformation. The […] smart city concepts are now widening social inequalities and income gaps. The urban poor in Africa, with its insufficient knowledge, capabilities and skills for digital interfaces of smart cities, is at risk for being excluded. (Urbanet, s.a.)

Therefore, smart city approaches have to integrate the informal sector and urban poor. Options are training offers, free wifi or integration in the delivery of goods market, for example food supply, fast transport of documents, etc.

Smart city or smart neighbourhood concepts typically involve technologies such as sensors, wireless networks, the Internet of Things and smart metres. Using these technologies, smart cities automate services, for example in buildings. These technologies can reduce energy consumption by automatically turning heating/cooling, lights and other appliances off when people are not around. Smart metres that communicate with smart appliances to turn them on and off reduces costs and helps balance fragile electricity grids through demand-side management. Other application options are in traffic management to reduce congestion through intelligent traffic light management or on-demand public transport options. More recently, the application of high-resolution satellite imagery is being used to support cities to better understand and plan mobility offers based on their urban infrastructure and movement patters (e.g. TUMI data project of BMZ). Additionally, benefits can arise from applying innovative technologies such as 3D printing for light, temporary (and permanent) infrastructure interventions to create, for example, segregated cycling lanes, shaded seating opportunities and more.

The largest potential, however, is in energy supply, which is mostly beyond the responsibility of local governments. Nevertheless, the local building codes, depending on the country, can allow for interventions and regulations in order to apply smart technologies in buildings. Other areas of action are public facilities such as street lightning using energy-saving LEDs, or electricity-consuming facilities such as water pumps, sewage plants and waste management installations, where energy efficiency often can be improved significantly. These initiatives are supported by "human-centred-design" measures to find out the most efficient approach, the level of public participation and also to share open data to enhance awareness and active civil support. It can also be combined with job creation in a circular economy. Here cities can play an active role in supporting the transformation and apply smart techniques and approaches as forerunners in their own facilities.

Box 13: Promoting quality, environment, health and safety (QEHS) standards for small- and medium-sized logistics suppliers

The German Investment and Development Company began this project in January 2021, and it will continue until December 2022. It cooperates with Bolloré Logistics Vietnam, a company in Ho Chi Minh City, Vietnam, offering a full range of transport and logistics solutions. This company faces the challenge of adding more trucking companies into its supply chain, but only a few of these companies meet the requirements of Bolloré Logistics Vietnam in terms of QEHS. Only if all parts of the supplier chain are designed sustainably can the supplier chain as a whole be described as sustainable. Many Vietnamese logistics companies have this problem because they do not have the resources to carry out capacity-building in this direction. However, QEHS in particular is enormously important in order to make the companies, and thus the entire Vietnamese logistics sector, sustainable. In order to achieve this, partnerships between truck companies and universities are to be developed, QEHS guidelines are to be elaborated, there will be training on proper practices and QEHS gaps are to be closed with technical assistance based on ISO standards. It is planned that fifteen companies will receive training and ten will receive technical support, whereas at least five companies will be certified on specific ISO standards on QEHS.

Source: DeveloPPP (2021)

Box 14: Technology in Africa: Building innovative ecosystems

Kenya is one of the leading African countries in innovations in the IT sector with significant numbers of start-ups. Students and businessmen use the growing science and technology available to address social and business problems. Also, universities focus their research and teaching programmes in science, math and technology. Together with the business community, new start-up incubators to encourage and support entrepreneurship were established, such as iHub, FabLab Nairobi and NaiLab.

This development is also supported by the Kenyan government to establish Kenya as an information technology hub for East Africa. One example is the development of the new Konza Techno City south of Nairobi. The aim is to bring research from universities, expertise and capital from business and support from government agencies together to support job creation, research collaboration and economic development. Another example is the launch by the Kenya ICT Board to support high-tech start-ups – including seed capital funding. "If we can build the skills and innovate, it will change the entire continent," said Bitange Ndemo, permanent secretary of Kenya's Ministry of Information and Science.

Source: Adapted from Smartcitiesdive (s.a)

2.4.6 Renewable energy and energy efficiency

The generation of electricity and the provision of non-electricity energy for industry as well as the transport and heating/cooling sectors globally are the leading sources of GHG emissions. At the same time, the extraction and utilisation of fossil fuels lead to additional local environmental and social problems, and they often also have negative geopolitical implications. Electricity generation using nuclear energy suffers from its own set of supply chain, safety and long-term nuclear waste management challenges. Consequently, a major shift towards the utilisation of renewable energy is well under way globally, with significant disparities between nations and countries regarding levels of ambitions, speed and technologies used. Rapid advances in the energy transition in the electricity sub-sector, however, tend to mask the fact that considering overall primary energy usage (including non-electricity use in industry, transport and for heating/cooling), the share of renewable energy of total final energy consumption is barely advancing, mainly due to still rapidly increasing overall energy demand (see Figure 3). Electricity only constitutes 17 per cent of total final energy consumption.

Acting on renewable energy provision, or even more narrowly on renewable electricity generation, is therefore not enough. This is implicitly recognised by the importance placed on energy efficiency, transport, the construction sector, city planning and other relevant topics in the debate on green economy and green jobs, including in this paper.

Care must be taken that the technological options space is not narrowed down too early. For instance, this applies to renewable energy promotion policies, which are well-advised to encourage different technologies (onshore and offshore wind, solar photovoltaics, concentrated solar power, biomass, etc.) rather than target a single technology purely on short-term cost-efficiency grounds (Lütkenhorst et al., 2014).

While energy policy typically is defined at the national level, cities can and do play a significant role: According to REN 21's *Renewables 2021 Global Status Report*, "by the end of 2020, around 800 cities had committed to net zero emissions – up sharply from the 100 cities with such commitments at the end of 2019" (REN 21, 2021a). Overall, more than 10,500 cities have adopted targets to reduce their GHG emissions (but not to zero). In many

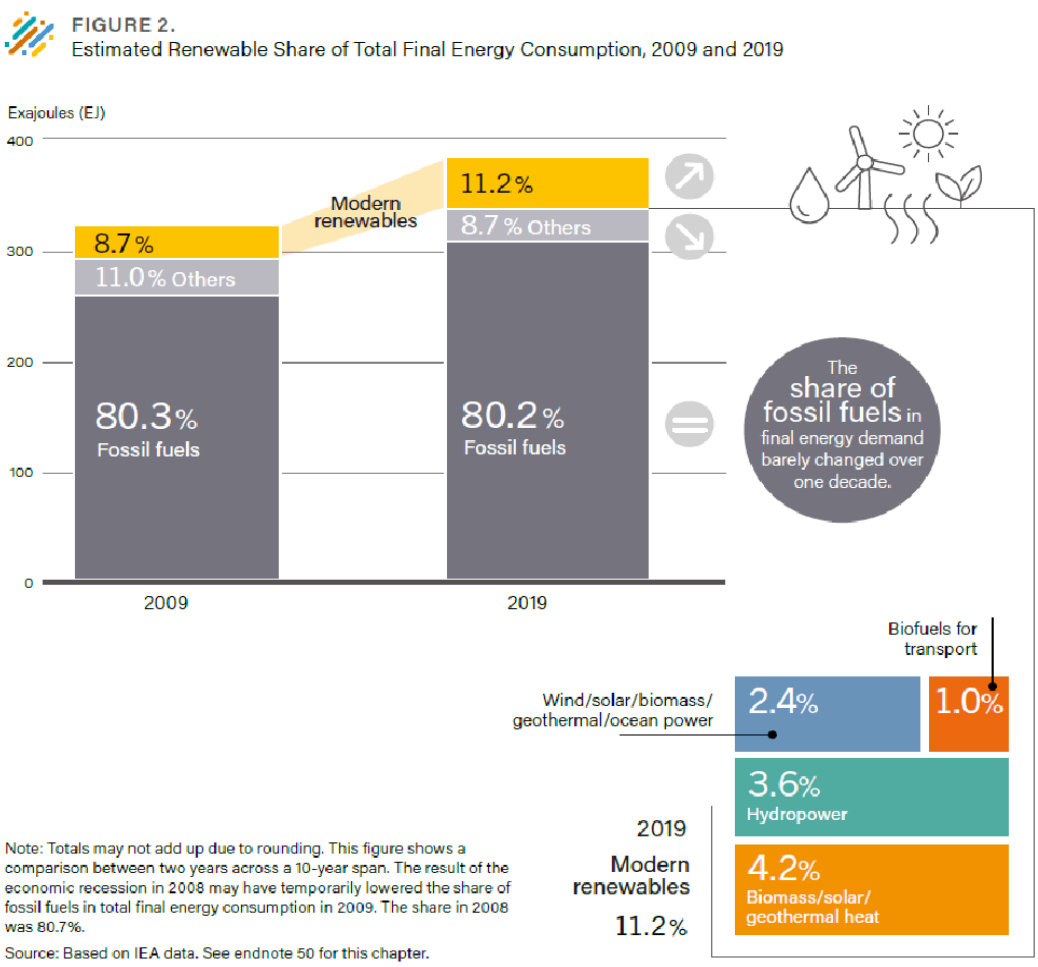
countries, the policies of cities are more advanced than national policies, and they include direct and indirect support policies, municipal codes for new buildings, incentives for retrofitting existing buildings, and restrictions on fossil fuel use in the buildings and transport sectors. A key success factor is for cities to achieve impact beyond their own investment budgets and the management of their own assets to influence the uptake of renewables by other actors (REN 21, 2021a).

REN 21 also published the *Renewables in Cities 2021 Global Status Report* (REN 21, 2021b). Based on a global overview, the report describes options in the urban policy landscape and covers aspects such as markets and infrastructure; investment and financing; and citizen participation. This 2021 report features a special focus on sub-Saharan Africa. It highlights the intense challenges of rapid urbanisation and quickly rising energy demand, the issue of energy poverty, and the importance of boosting the resilience of energy systems. Weak fiscal decentralisation, limited municipal mandates and gaps in technical, financial and human capacity are mentioned as key bottlenecks.

Removing these constraints through knowledge-building and the raising of resources – including through developing PPPs – is seen as the best intervention available to city governments and administrations. Best practice highlights include the city of Cocody in Cote d'Ivoire, with a focus on carbon sequestration through reforesting, solar lighting, solar home systems, energy-efficient cookstoves and initiatives to increase vehicle energy efficiency (REN 21, 2021b). Cape Town, South Africa, undertook an extensive analysis in its *State of Energy* report, developed tariffs and rules for distributed renewables, supported solar water heating in poor communities, reorganised parts of its administration, and is reviewing both biofuels and high-capacity e-vehicle charging for the transport sector (REN 21, 2021b). Dakar, Senegal, has placed a high importance on renewable energy not only in its Environmental Action Plan, but crucially also in its spatial planning. Kampala, Uganda, started a shift towards electric public transport by supporting local start-up companies offering electric motorcycles for use in traditional public transport modes.

Box 15: Renewable energy – solar home systems programme in Bangladesh
The solar home systems programme in Bangladesh and the formation of energy cooperatives are alternative means of expanding access for the 1.3 billion people still without affordable clean energy, opening up countless opportunities for enterprise development.
Source: ADB (2016) (Creative Commons Attribution 3.0 IGO)

Figure 3: Estimated renewable share of total final energy consumption, 2009 and 2019



Source: REN 21 (2021a)

Box 16: Solar-powered streetlights

The provision of inclusive and safe streets that are free from crime and violence, including gender-based violence, is important for a just urban development. Solar-powered streetlights can contribute to these goals by increasing the electricity supply, improving safety in urban areas and protecting the environment.

Lessons from the cities of Kampala and Jinja in Uganda have proven that solar street lighting is cheaper to build and operate than conventional streetlights. It has also generated a range of economic and social benefits, including lower crime rates, better road safety, a more vibrant night-time economy and higher property values. Tens of thousands of working hours a day – equivalent to 14,000 full-time jobs nationwide – could be added to the economy by extending trading beyond daylight hours. Based on this case study, installing and maintaining solar-powered LED streetlights across sub-Saharan Africa – rather than conventional grid-based options – could reduce upfront installation costs by at least 25 per cent, electricity consumption from street lighting by 40 per cent and maintenance costs of new roads by up to 60 per cent. Lighting new roads in sub-Saharan Africa with solar would be an opportunity to generate between 96 and 160 GW of distributed renewable energy across the sub-continent, more than doubling sub-Saharan Africa's current energy generation capacity of 92 GW.

Source: Gillard, Oates, Kasaija, Sudmant and Gouldson (2019) (CC-BY 4.0)

Box 17: Placing climate friendly infrastructure front and centre
Tshwane in South Africa is being supported by the C40 Cities Finance Facility to implement climate-resilience projects. Two specific projects are expected to be implemented over a five-year period. One of these is to strengthen cycling through the construction of a 7-17 km bicycle spine. The other deals with the construction of a combined heat and power biogas plant at one of the city's wastewater treatment works: 20 per cent of the works' energy needs will be met by it. This brings the potential for the improved operation of this technology to South Africa. The improvement of know-how should contribute to the conclusion of contracts for PPPs.
Source: C40 Cities Climate Leadership Group (s.a.-a)

3 Assessment of potential positive and negative effects of a green urban economy on employment in cities in Africa and Asia

The employment effects of a transformation towards a green economy play an important role. UNEP (2008), however, sees most future green jobs being created in OECD countries and in emerging economies such as China and Brazil. The positive employment effects in low-income developing countries will be smaller and mainly in Asian countries. The ADB (2013) expects that only up to 2 per cent of the entire Asian workforce will be employed in green jobs. However, this statement of the ADB might not include the informal sector, and it has a very narrow definition of green jobs since it deals only with sectors such as factories, buildings, transport, agriculture and electricity generation (ADB, 2013).

When trying to measure the employment effects, several different dimensions need to be considered. First and most obviously, there are jobs that are newly created in the green economy sectors, both in existing companies but also in newly established firms. Second, there are so-called spillover effects of these processes into non-green sectors, such as service providers or suppliers that support the green economy through supply chains. With a growing green economy, these indirect, not necessarily green jobs will also grow through increased demand for products and services provided by the green sector. The same applies to increasing consumer demand for greener products in the service and retail sectors. Here, it is assumed that the currents jobs in these sectors can become green jobs with training and capacity-building without a significant loss of jobs.

However, environmental or climate policies may negatively affect existing jobs in carbon-intensive sectors such as energy production and large industries, combustion engine-based car manufacturing and many other companies, including the wide range of supply companies for these sectors. "Estimating the overall impact of green industrial policies on the total number of jobs in the economy is therefore difficult and poses some methodological challenges" (Altenburg & Assmann, 2017). Furthermore, some industries may face a loss of competitiveness if forced to comply with strict regulations too quickly or their financial capabilities are not stable or highly competitive. This may lead to job losses or even to the relocation of industries to countries with lower levels of regulation (Schlegelmilch, Eichel, & Pegels, 2017). The shift of jobs across enterprises, industries and sectors therefore may entail adjustment costs for enterprises and workers. Additional government policies may become necessary to support or even trigger these transitions. Shifting employment patterns can also affect occupations, defined as a category of jobs with main tasks and duties that are characterised by a high degree of similarity, and therefore have ramifications for the development of skills and retraining as well as adjustments in the education system (ILO & UNEP, 2012).

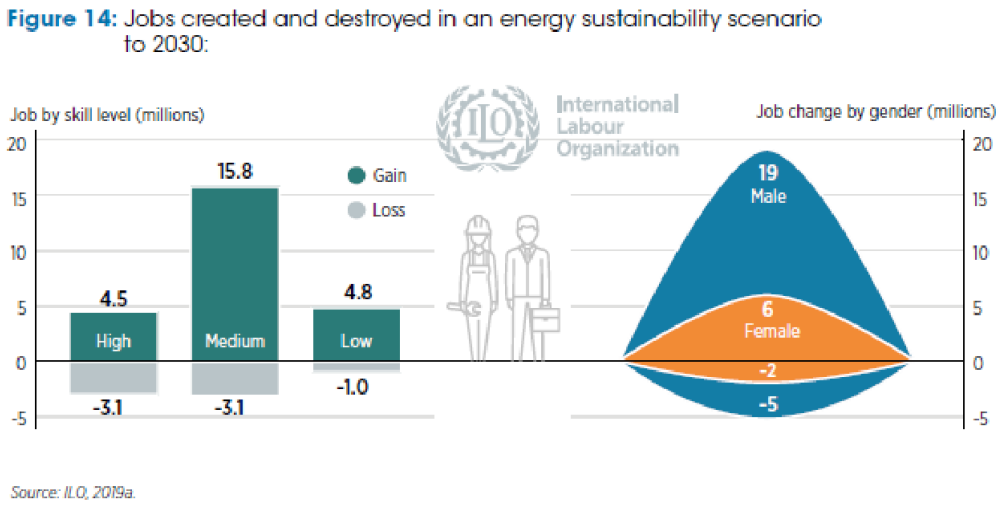
Another obstacle on the way towards a greener economy and more green jobs may occur during the transition period when the politically induced change leads to a situation in which polluting industries and their jobs are phased out while new green alternatives emerge only slowly or somewhere else (United Nations Industrial Development Organization & The Global Green Growth Institute, 2015). Unintended consequences also have to be considered, such as the example of shifting energy production from fossil fuels to renewable biofuels. It can cause higher prices for agricultural land, and thus higher food prices.

Other authors are more optimistic: "Green sectors and technologies are likely to be more labour-intensive in the short term and then to provide more jobs in total over the long term" (Fankhauser, Sehlleier, & Stern, 2008). Other options that will create directly verifiable jobs are public investments towards green production and the development of green technologies (see also Pearce, 1991; Schlegelmilch et al., 2017).

Other green jobs, such as those related to pollution control and resource efficiency management or jobs in the circular economy, "may have remained below the radar given that fewer statistics are available" (Altenburg & Assmann, 2017). The statistical evidence or projection becomes even more difficult when it comes to the unregulated and undocumented informal sector and its income-generating activities, which constitute a huge number of jobs in African and Asian cities. Verifiable evidence for lower and middle-income countries in Africa and Asia is very limited. Evidence from Europe and the US may not be transferred to developing countries due to, among other factors, the characteristics of the labour markets (Boen & Kuralbayeva, 2015). However, the prevailing informal sector in African and Asian cities has a great potential for green jobs, for example, in NBSs, solid waste management, urban agriculture and transport, since most of the income-generating activities do not require vocational training. Thus, the informal sector can respond quickly to new job opportunities in the green economy, especially for less-skilled persons.

While we are discussing the options for green jobs, we therefore have to consider the net effects from the workers' perspective. These include the total number of jobs created and lost in different segments of the economy, not only the new green jobs, which might be inaccessible due to the skills needed or relocation demands.

Figure 4: Jobs created and destroyed in an energy sustainability scenario to 2030



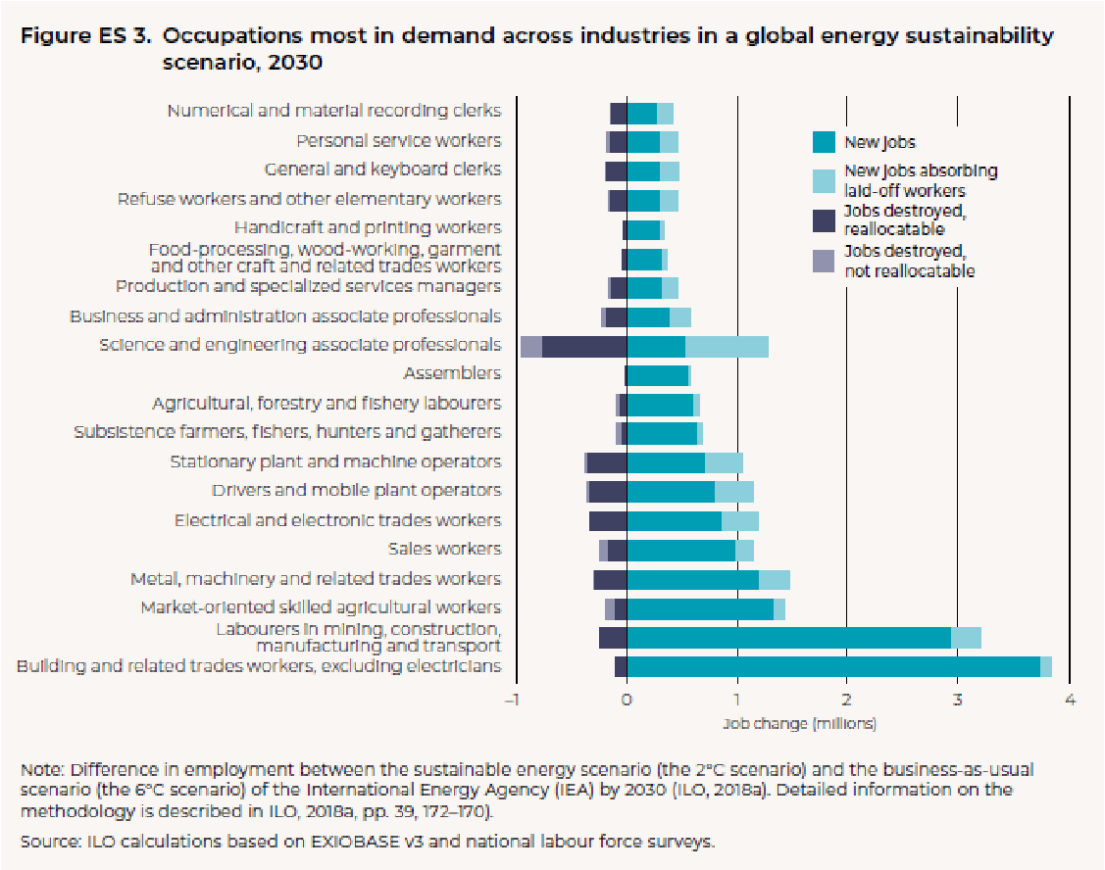
Source: International Renewable Energy Agency (IRENA, 2021)

However, Altenburg and Assmann (2017) clearly state that "given the blurred boundaries between green and non-green products and processes as well as the heterogeneity of environmental challenges across countries, it is impossible to unambiguously quantify the overall employment impacts of green transformation". They conclude: "[O]verall, it reveals how difficult it is to estimate the employment impacts of green transition and to compare development across countries, with the notable exception of renewable energy."

Keeping all these limitations in mind, the ILO in its 2019 report *Skills for a Greener Future* (ILO, 2019) developed a global energy sustainability scenario for 2030 and estimated its net employment effects compared to a "business as usual" scenario. It calculates not only the new jobs created and the jobs destroyed in obsolete energy sub-sectors, but it also estimates the potentials for new jobs to be reallocated to existing energy-sector workers. Globally, it predicts a loss of 7 million existing jobs and the creation of 25 million new jobs, resulting in a net gain of 18 million jobs, mostly at medium-skill levels.

The ILO proceeded to break down these figures by occupation, as shown in Figure 5.

Figure 5: Occupations most in demand across industries in a global energy sustainability scenario, 2030



Source: ILO (2019)

Staying with the example of the energy sector, where "green jobs" in renewables can be easily distinguished statistically and for which precise numbers are available, IRENA (2021) shows major employment effects for China with 4,732,000 jobs, Brazil with 1,202,000 jobs, India with 726,000 jobs and all of Africa with 324,000 jobs in 2020. The

figures also show Africa significantly lagging behind Asia in terms of value added in production chains and the operation/maintenance of renewable energy installations. Under IRENA's renewable energy scenario, the total number of jobs just in this sector is expected to grow from 12 million in 2020 to 38 million by 2030 and 43 million in 2050. More than half of this increase will happen in solar photovoltaics as the leading technology type, with a projected increase from 4 million jobs today to 20 million by 2050. While the need for supportive policies and significant investment to create decent jobs is recognised, the relevant bottleneck already today consists of the expansion of skills, which has to be addressed through the training of trainers, vocational training and training in digital innovations (IRENA, 2021).

The ILO "Guidelines for a just transition towards environmentally sustainable economies and societies for all" (ILO, 2015b) provide an important policy framework to ensure that "green jobs" are also "good jobs", as also highlighted by Rodrik and Sabel (2019). One main challenge consists of the temporal, spatial, educational and sectoral misalignments between the jobs created and the available skillsets. There is a need for intervention to close the gaps.

Another example is a calculation from Lebanon. The ILO and the UN Development Programme (UNDP) assessed in 2011 the green employment potential in Lebanon for five sectors we discussed before: energy, construction, waste management, agriculture and forestry. "In the energy industry, the report estimates that around 4,000 jobs would be created by 2020 through the introduction of concentrated solar power, wind energy, photo-voltaic solar and by expansions of hydraulic power and solar water heater markets" (Altenburg & Assmann, 2017).

A more recent example of a country-level estimate of projected green jobs was presented by the ILO (2019) for India. This study estimates a total of 54 million green jobs to be created between 2020 and 2030, with water management, waste management, green construction and green transport providing high numbers of jobs also at lower skill levels (see Figure 6). The validity of such macro-economic estimates, however, seems limited, as they highly depend on the quality of the input data and assumptions. Therefore, such estimates (which, for example, the ILO provided for a number of countries) are not necessarily a sound basis for decision-making in the development cooperation context.

Due to the huge amount of informal economic activities, it is not possible to comprehensively estimate the full potential for green jobs in most sectors in the transformation process towards a green economy, especially for countries in Africa and Asia. Even more difficult is the net effects calculation for new jobs versus lost jobs on the job market. This applies especially to the informal sector, which offers a huge share of income-generating activities. Nevertheless, the informal sector provides opportunities to create green jobs, since not all green jobs – for example for NBSs, solid waste management, urban agriculture and transport – require a long comprehensive education and training period. Thus, the informal sector can respond quickly to new job opportunities in a green economy. The opportunities for cities in Africa and Asia to create green jobs under their own local mandates of decision-making in urban planning and through their own service providers and/or opportunities to support a greener economy, as shown in Section 2, will obviously create more green jobs and respectively shift current jobs into green jobs. These interventions will most likely not reduce the number of existing jobs but shift them into greener activities. The risks mentioned before concerning green infrastructure development and the eviction of informal businesses have to be taken into account.

Figure 6: Projected green jobs in India – cumulative employment in thousands ('000), 2018-2030

SI NO.	SECTOR	SUBSECTOR	UP TO 2020	UP TO 2030	2021–30
1	Renewable energy	Solar PV	180.0	900.0	720.0
2		Solar thermal	14.5	35.0	20.5
3		Wind	60.0	180.0	120.0
4		Small hydro	10.0	30.0	20.0
5		Biomass/cogeneration/CHP	25.0	100.0	75.0
6		Energy storage	50.0	300.0	250.0
7		Biofuels/biogas/pellets/ briquettes	55.0	275.0	220.0
8		Clean cook stoves	75.0	2968.6	2893.6
	Subtotal renewable energy		**469.5**	**4788.6**	**4319.1**
9	Green construction	Green buildings/campuses	2200.0	11000.0	8800.0
10	Green transportation		750.0	7500.0	6750.0
11	Carbon sinks		240.0	2100.0	1860.0
12	Water management		3000.0	19000.0	16000.0
13	Solid waste management		4000.0	19800.0	15800.0
14	E-waste management		170.0	582.0	412.0
Total			**10829.5**	**64770.6**	**53941.1**

Source: ILO (2019)

4 Recommendations: Entry points for German development cooperation for cities in Africa and Asia to support a green economy and green jobs

We recommend considering the three approaches (PAGE, UNEP IGE and Green Economy Coalition, see Section 2.1 and full text in the Annex) as the basis for future programme and project development of GDC in the areas of green economy and in supporting the establishment of green jobs. As outlined before, the concept of a green economy is not only about carbon neutrality. A green economy has also to result "in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities" (UNEP, 2011). A green economy can only be successful if it is, at the same time,

socially inclusive and explicitly addresses issues such as inequality, as stated in the SDGs and other international commitments.

The current pandemic situation and the need for a quick economic COVID-19 recovery have created new challenges, but they also bear the potential for an economic as well as social recovery that can be both green and just. The OECD (2020) highlights that "the recovery is an opportunity to 'build back better', combining an emphasis on restoring growth and creating jobs with the achievement of environmental goals and objectives". The huge post-COVID recovery programmes, as outlined in Section 1, provide a unique window of opportunity for a just economic transformation that takes all of the SDGs into consideration. Thus, the transformation of the economy towards a green economy with green jobs has to follow the just principle – as outlined by UNEP (2011) and the ILO (2015a) – and reflect the risks highlighted by Barbier and Burgess (2020), Altenburg and Assmann (2017) and others to "leave no one behind".

In the context of the economic transformation, especially SDGs 1, 2, 3, 4 and 5 set clear targets to be achieved within the transformation process. These goals cannot be neglected or overruled by the transformation towards a green economy. As the aspiration of the green economy goes beyond the goal of decarbonisation and encompasses other ecological, economic and especially social development dimensions, SDGs 6, 7, 8, 9 and 11 also have to be considered, since they have the potential to interfere with the process of moving towards a green economy if not considered carefully.

The "vision for a fair, green economic future" from the Green Economy Coalition (see Annex) could be furthermore used as a basis to elaborate a checklist for project approval and evaluation together with existing evaluation criteria. As mentioned before, it is important to consider that European/Western approaches, targets and benchmarks towards a green economy and green jobs cannot be applied directly in cities in Africa and Asia. This is underlined by IGE and PAGE, but also by scholars such as Hammer et al. (2011), Altenburg (2013) and others.

Thus, it is recommended to develop locally based solutions reflecting local problems in cities, and also to identify the potentials in the cities together with local stakeholders on the ground. For this, it is important to develop South-South cooperation among stakeholders from different cities for knowledge exchange. Southern-based approaches might differ from European or OECD approaches and might not cover all aspects of a green economy in the same way. But they can better reflect local conditions of informality in urban development and economy as well as consider urban poverty, rapid urban growth, local climatic conditions and related risks in addition to potential shortcomings in urban governance. These circumstances are extended by Altenburg (2013), who focusses on "weak institutional capabilities, corruption-prone administrations, pervasive market failures, and neo patrimonial rule where checks and balances are needed to disentangle and evaluate different policy functions".

Identification of success factors and target areas

The examples displayed in Sections 2 and 3 allow for identifying some success factors for projects. Obviously, they cannot apply to all new projects and cannot serve as a binding and complete list. However, the cases allow for drawing some common conclusions. These success factor identified in most initiatives are mainly related to:

- applying a holistic, inter-sectoral and interdisciplinary approach, and working together across administrative sectors, especially when it comes to innovative approaches and/or NBSs,
- the involvement of the most relevant local stakeholders, including the local business community, local politicians and civil society,
- support from the national government, which is needed in the fields relating to financial, legal and regulatory support,
- the need for a clear, feasible business model from the beginning and a promising market for any new products or services,
- PPPs that enable long-term success and financial feasibility,
- a mixture of voluntary and mandatory regulations, which serve to gain support from various stakeholders,
- the application of appropriate technologies and locally produced inputs, which supports the projects running beyond the designated project period,
- projects that are technology neutral and allow the application of locally adjusted approaches,
- the tapping of unexhausted local potentials, as for example from local academic institutions, to provide options for innovation,
- immediate job opportunities, which are important for gaining support from the residents, and especially from those who might face job losses in the transformation process,
- direct visible benefits for the urban population, which support the political backing in civil society.

These success factors can serve as an adjustable checklist for project development and evaluation.

In order to develop projects successfully and spend funds efficiently, the main target areas towards a green economy and green jobs in intermediary cities in Africa and Asia can be found, as outlined before, in the fields of

- strengthening the local level, as outlined in the NUA,
- land use planning towards a compact city concept, including addressing informal urban development and disaster risks,
- green buildings and construction materials to retrofit the existing building stock and guide new constructions, including the development of a local green construction sector,
- sustainable mobility and urban transport by developing mobility options with locally applicable technology and job creation, also on the level of unskilled workers,

- extension and retrofitting of urban infrastructures focussing on NBSs by
  - considering NBSs as a cross-cutting, interdisciplinary and inter-sectoral approach,
  - introducing water supply and sanitation systems, which guarantee a just distribution of water, resource efficiency and the long-term sustainability of water resources,
  - ensuring solid waste management, recycling – including repair and reuse/sharing systems – and urban mining to tap the unexhausted potentials of a circular economy and job creation, also on the level of unskilled workers,
  - implementing smart cities and urban tech approaches that both enhance the quality and efficiency of urban services while creating decent jobs and support so-called digital immigrants while reducing the risk of so-called digital refugees,
- supporting investment in renewable energy infrastructures by rendering assistance within the city's mandate, while at the same time addressing energy efficiency as a cross-cutting issue for the built environment (cooling and heating) as well as transport.

Important to mention is the role cities can play, as outlined in Section 2.3, and the focus of tailor-made projects on carbon emission reductions (see Section 2.2). The mandates of cities, and thus their options for interventions and action, differ from country to country based on the constitutional set-up of the country and the power relations between national, regional and local governments, as well as their respective share of the tax base and other resources. It ranges from quite independent cities with mandates for local taxes and local by-laws, as for example in the US, to a role as a simple service provider on the local level, purely implementing national policies and goals, with very limited mandates for local decision-making and a lack of local capacities as well as resources to be spent. Thus, legal and fiscal power relations have to be analysed first for each country before developing projects. It is important to identify cities with strong leadership and the political willingness of the mayor, the city council and more importantly the business community and civil society to use innovative approaches towards a green economy.

The main sources of carbon emissions differ from country to country. Thus, an initial analysis of the countries' and cities' carbon footprints is advisable to develop tailor-made and focussed projects. Therefore, programmes targeting different countries at the same time are most likely difficult to establish. However, many countries, due to their common (e.g. colonial or post-socialist) history, share similar institutional set-ups and economic structures, and they could be clustered for similar approaches and programmes. A second criterion for clustering is a similar level of socio-economic development, which determines potential interventions without risking the livelihoods of the urban poor.

Although the mandates and influence of cities in being able to directly change energy production modes are limited, the construction sector, urban transport and waste management are the areas where cities can directly or indirectly influence the urban economy and the job market. Also, these sectors employ a huge workforce, mostly including less-skilled and informal workers. Furthermore, with the mandate on land use planning, cities can directly influence the density towards a more compact city, thereby reducing mobility-related carbon emissions. Examples of interventions were given in Section 2.4 with good practice examples. Since the legislation and mandates of cities differ, cities in Africa and Asia can mainly focus on:

- land use planning to determine the distribution of urban land uses, urban functions and densities,
- the wide field of building regulations and building codes, which can play a role in the levels of resource consumption and resource savings in construction, maintenance and the operation of buildings towards a green economy and green jobs,
- urban transport, including public transport, bicycle lanes and mixed mode solutions,
- NBSs with green and blue infrastructure projects for water supply, green open spaces and air quality as well as retention space against floods, and
- local waste management, including recycling towards a local circular economy and tapping options for local-based energy production, for example biogas.

In cases where the constitutional and legal mandates of cities allow it (respectively can be expanded), cities can actively support the development of industry clusters by designing and implementing so-called eco-industry parks. Here, due to their production processes, companies can work together by following the principle of circular economy and recycling materials and cascading the use of energy inside the eco-industry parks. Cities can support this with tailor-made energy and waste management strategies, and by assisting with access to suitable land and infrastructure, as well as fast-tracking permitting procedures.

Since there are already relevant and suitable local solutions in place worldwide – and at the same time, experts are available in many municipalities and the local academia – we suggest establishing international cross-continental, regional (e.g. South-East Asia) and national networks of technical experts in the above-mentioned fields to exchange ideas, co-produce knowledge and co-design tailor-made solutions for the countries and cities that reflect the climatic, socio-economic and political environments of each.

These experts should come not only from cities in Africa and Asia but also include Latin America. Latin American experts can put forward more advanced approaches that are, for example, related to recycling, mass transport systems and civic participation. Latin America also has greater and more long-term experiences with urbanisation that others can learn from. The establishment of focussed networks can be undertaken by GDC in partnership with local stakeholders such as national city associations, but also through international networks such as Local Governments for Sustainability (ICLEI), C40 and Cities Alliance. Existing initiatives, for example the network of Waste Wise Cities from UN-Habitat, can serve as starting points to establish such networks. They are outlined in Section 5 below.

In each target country of GDC where projects towards a green economy and green jobs are planned, we suggest organising local stakeholder workshops to identify first the needs and capacity gaps as well as institutional and legal obstacles for each of the above-mentioned fields. Here, experts from the city administration, local civil society organisations, the business community, international associations and Technical and Vocational Education and Training experts but also local academia – often neglected knowledge sources in development cooperation – can discuss approaches and identify obstacles in skills development, the development of curricula in vocational schools and the reforms of educational/vocational policies on the national level. In a second step, we suggest inviting experts from other countries in the Global South where successful approaches have already been implemented

for knowledge transfer and peer-to-peer discussions. Based on this, further capacity-building needs can be identified and interventions developed on the specific city level for local stakeholders.

On the national level, projects focussing on policy recommendations (including revising and adjusting national policies), especially on the role and mandates of cities, as well as building codes can be planned and implemented. Thus, cities are seen as key players, but their role has to be strengthened on the national level. Obviously, the topics and project details will differ from country to country and even city to city. South-South exchanges will not only disseminate knowledge and sustainable tested solutions to support their application on the ground. They will also attract outside stakeholders such as the private sector and the donor community, and internally underline the role of cities in the transformation process, which today is mainly left to the national governmental level. For all these workshops and activities, the active involvement of the local business community as a main actor, as well as civil society organisations, should be obligatory to understand their needs and capacities and to have them on board from the beginning.

In order to exhaust fully the potentials that cities in Africa and Asia already have and the active role they can play, there is a need to analyse and review the local urban planning regulations and building codes to enable cities to play a more active role. For this, international planning associations, for example the International Society of City and Regional Planners (ISOCARP), can play a facilitation role due to their extensive networks in most countries. This also applies to regional or continent-based organisations such as the African Planning Association and the Commonwealth Association of Planners. Similarly, higher education institutions are already linked through, for example, the Asian Planning Schools Association and the African Association of Planning Schools. Here, we find local experts from practice and academia who are aware of the shortcomings in urban planning legislation and institutional set-ups that hinder cities in fulfilling their mandates. They can provide entry points for revising national legislation and sharing best practice cases to be applied in other cities.

In terms of waste management and recycling, cities can play a more active role as entrepreneurs or facilitators of the private sector. Partnerships with local companies through PPPs can fully tap the market potential of waste management and recycling. Examples such as the network of Waste Wise Cities from UN-Habitat provide a sound basis for the exchange of knowledge and the development of innovative solutions (UN-Habitat, s.a.).

In public transport, we have examples such as BRTs to help efficiently develop a greener transport sector and introduce greener means of transport such as electricity-based tricycles. These innovations can be undertaken through a South-South knowledge exchange on the city level between the mayor and technical staff, facilitated by GDC. Here, we can tap the knowledge available in the Global South and learn from success stories on public transport, waste management and recycling. Depending on the local context, not only a knowledge transfer is needed, but also a deeper look at the institutional and legal framework to facilitate PPPs and leverage incentives from the national level to support the transformation process with financial means and policies.

In the area of renewable energy generation and distribution, cities' mandates often are limited, and overall development is highly dependent on national policies, capacities and

incentives. Cities, however, still can and should play a crucial role in supporting private-sector investment in renewable energy infrastructure. They can allocate land (both through land use planning and by granting or renting property actually owned by the city) and assist with often highly complicated and time-consuming permitting procedures. Cities can set pro-renewables procurement policies for own consumption, including for their subsidiaries (city-owned companies, public transport operators, etc.). Awareness campaigns can influence the procurement and investment decisions of inhabitants and private-sector companies. Given a supportive regulatory framework, private prosumer and community energy approaches can be rolled out or piloted where adoption is in the earlier stages and where enabling conditions have yet to be developed.

Box 18: Qualification of RAC technicians – one of the world's most climate-relevant professions

More than 100 million refrigerators and over 120 million air conditioners are sold every year, and the demand is rising. Their climate impact is considerable: Many devices use refrigerants with high GHG potential that can leak into the atmosphere. Each cooling device emits up to 2 tons of CO_2-equivalents per year if it is not installed, maintained and repaired properly. Devices that use natural refrigerants are more climate-friendly but require special safety precautions. That creates a high need for well-trained refrigeration and air conditioning (RAC) technicians – one of the world's most climate-relevant professions. The programme Proklima therefore supports partner countries worldwide with the qualification of RAC technicians (19 partner countries in December 2021). Proklima is implemented by GIZ on behalf of BMZ within the scope of the Multilateral Fund for the Implementation of the Montreal Protocol. More than 7,000 technicians participated in trainings by Proklima in 2019 alone, for example more than 4,700 in India, 1,800 in Brazil and almost 140 in Kenya. Some of the participants are trainers who now train other technicians.

Source: GIZ Proklima (2020)

Finally, building codes can set requirements concerning renewable energy generation, for example by setting standards for the deployment of solar rooftops. Considering the intermediary cities in the focus of this discussion paper, almost 40 cities in Asia and about 15 in sub-Saharan Africa in the 1 to 5 million inhabitants range had set renewables targets by 2020 (REN 21, 2021b). These might offer entry points for further research into more case-specific approaches. The same report also offers a wealth of further recommendations on specific actions available to cities.

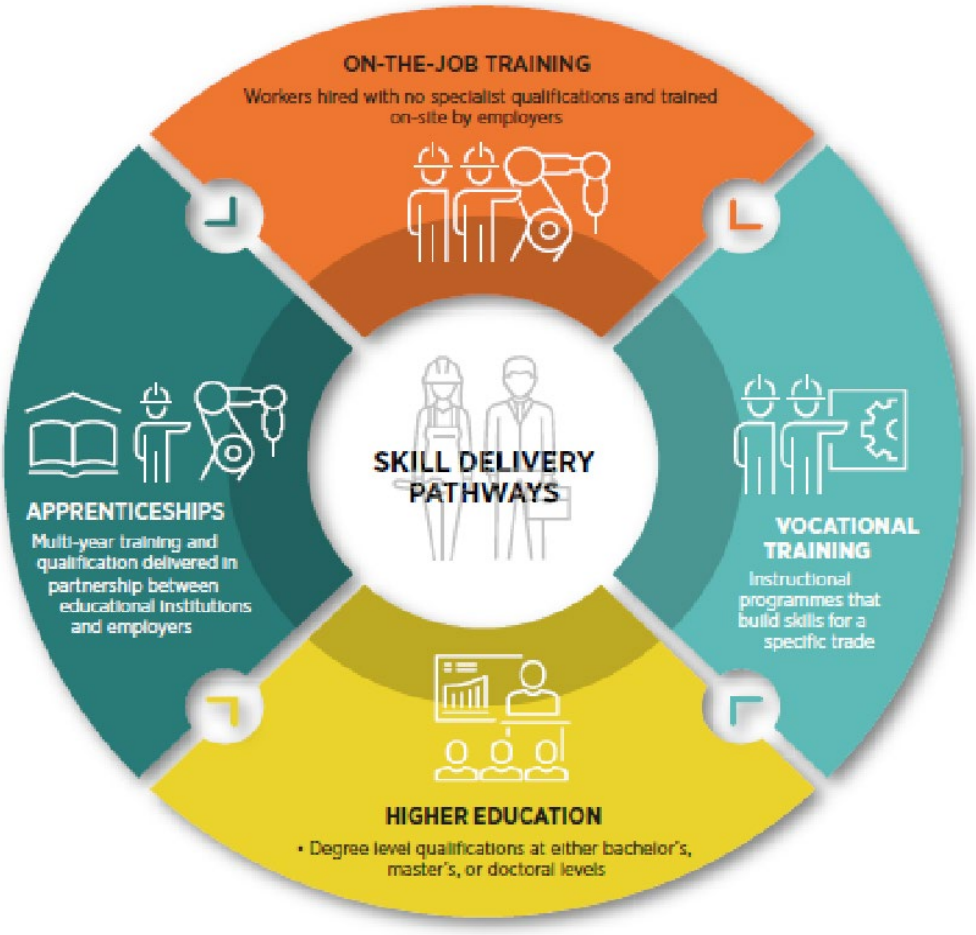
In the field of energy efficiency, the first step is to recognise the cross-cutting nature of this field and the close interrelationships with other sectors and interventions described above. Depending on the current local situation and apparent trends, energy consumption patterns should be carefully analysed first before defining interventions, thereby creating a fact-based and sector-wide approach. In many cases, the greatest and most economically energy-efficiency gains will be able to be made in the building sector (especially cooling and heating, but also other aspects such as lighting, water pumping, etc.) and in the transport sector. Again, even in the many cases where policies are mainly set at the national level, intermediary cities can embed requirements in their building codes, set examples in their own areas of investment and operation (e.g. public transport, street lighting), and assist with innovative approaches coming from both the private sector (including supporting local start-ups) and civil society.

Points to consider and potential obstacles

One main challenge for programme and project planning towards a green economy for GDC and cities will remain in the temporal, spatial, educational and sectoral misalignments between jobs created and the available skillsets. There is a need to intervene to close the gaps. Thus, strong policy coherence at the planning, design and implementation stages is required to enable a successful green transition. However, skills gaps and shortages are almost inevitable whenever any new product or service appears, and a large-scale green transition is no exception. Without the engagement of all social partners, it can have negative consequences for the relevance of policies on skills for green jobs. Thus, a combination of top-down coordinated policy-making and bottom-up local initiatives on the city level could provide effective and sustainable support to the green transition. "Sectoral plans for skills for green jobs, supported by government taxes and incentives, are most common in those sectors directly affected by climate change and environmental depletion, such as energy, transport, construction and waste management" (IRENA & ILO, 2021).

Figure 7 shows a range of skill-delivery pathways addressing different levels of qualification and delivery modes. The exact choice of instruments has to depend on local conditions and often, several of the delivery modes will be productively used in parallel.

Figure 7: Skill-delivery pathways



Source: IRENA (2021)

The ILO's 2015 report *Anticipating Skill Needs for Green Jobs – A Practical Guide* provides hands-on guidance on how to determine skill needs for the transition to a green economy for a specific country and sector. While the methodologies explained mostly build on national statistics, there is nothing to stop cities from adopting this approach and independently undertaking such an analysis for their own area (ILO, 2015a).

There is a need for collaboration across and within different tiers of government in terms of vertical and horizontal coordination and collaboration, just as there is a need for cooperation with the business community and local civil society to avoid failure. Hammer et al. (2011, p. 82) therefore ask for a

> multi-level governance framework [that] can help to address many of the challenges to effective policy design and implementation. Second, in many countries, cities are seen as a subsidiary form of government and lack the legal or financial tools or authority to empower them on this issue.

5 International initiatives to join forces in supporting "green jobs in cities"

UN PAGE was launched in 2013 as a response to the call at Rio+20 to support those countries wishing to embark on greener and more inclusive growth trajectories. PAGE provides integrated and holistic support to countries for eradicating poverty, increasing jobs and social equity, strengthening livelihoods and environmental stewardship, and sustaining growth (UN PAGE, s.a.).

PAGE brings together five UN agencies – the UN Environment Programme (UNEP), the ILO, UNDP, the UN Industrial Development Organization (UNIDO) and the United Nations Institute for Training and Research (UNITAR) – to provide integrated and holistic support to countries, thereby ensuring coherence and avoiding the duplication of efforts.

The PAGE project, which is already being supported by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), could be an entry point for GDC due to its well-established stakeholder network towards a green economy on the international level. What is missing in PAGE is the involvement of the local level. The additional and innovative contribution of GDC could be to create a PAGE+ or PAGE city programme to support cities in the transformation process. Obviously, this is also a political question, firstly among BMZ and BMU, and secondly among the well-established PAGE networks.

However, the holistic approach of PAGE can provide a promising starting point. GDC could therefore set up a new network based on cities and local organisations covering the same holistic approach as PAGE does on the international and national levels. Since there are already relevant local solutions in place – and at the same time, experts are available in many municipalities and the local academia – we suggest establishing local, national and regional networks to exchange ideas, co-produce knowledge and co-design tailor-made solutions.

New partners, including academia and the research community (e.g. the international part of the programme "Research for Sustainability" (FONA) of the Federal Ministry of Education and Research, BMBF), could fill some gaps that the consultancy community has

not been able to address. These new partners could tap to the full extent especially the knowledge and experience of local academia, which is less involved in national governmental structures and policy-making.

A second important factor are the networks of actors on the city level. While C40 comprises the largest cities around the globe and therefore does not directly represent intermediary cities, its excellent knowledge hub (C40 Cities Climate Leadership Group, s.a.-b) can provide a suitable entry point for knowledge exchange and experts' peer-to-peer co-development of green economy approaches, also for intermediary cities in Africa and Asia. Thus, C40 is an important partner for GDC on technical expertise.

However, ICLEI is the most suitable partner since it covers more than 2,500 local governmental units, including many intermediary cities in Africa and Asia. ICLEI is strongly committed to transforming urban environments worldwide and to building connections across levels of government, sectors and stakeholder groups, thereby sparking city-to-city connections. ICLEI already runs programmes that are in line with this discussion paper and the transformation towards a green economy in the above-mentioned sectors, as for example:

- 100% Renewables Cities and Regions Network (ICLEI – Local Governments for Sustainability [ICLEI], s.a.-a) with its Renewables Cities and Regions Roadmap (supported also by BMU), which can be expanded more to cities in Africa and Asia with support of GDC.

- Circular economy with the Circle City Scan Tool, which can be applied in intermediary cities in Africa and Asia as well (ICLEI, s.a.-b). The case study of Bogor City, Indonesia, within the project "Supporting circular jobs for COVID-19 recovery" can serve as an ideal starting point to build on, and also for replication (ICLEI, s.a.-c).

- In the construction sector, ICLEI is active with its Building Efficiency Accelerator (BEA) programme (ICLEI, s.a.-d) to successfully transform local markets and improve building efficiency. The project runs in collaboration with the WRI and the private sector. BEA is active already in intermediary cities and can be expanded with the support of GDC to the target countries of BMZ (Building Efficiency Accelerator, s.a.-a).

- In capacity-building and knowledge exchange, ICLEI is partnering with GBCI (Green Business Certification Inc.) to operate LEED (Leadership in Energy and Environmental Design) and the WRI's City Climate Planner programme (ICLEI, s.a.-e) to train urban professionals to support local climate action planning, including GHG emission inventories, climate action and low-emission development planning, and climate adaptation planning.

- ICLEI has also been active for more than a decade in mobility to reduce dependence on fossil fuel-based automobiles and create vibrant cities where communities and organisations can access goods, services, people and information (ICLEI, s.a.-f).

The fields of action above clearly demonstrate that the activities and fields of expertise of ICLEI cover the topics for a transformation towards a green economy and green jobs. ICLEI is thus an ideal partner for the collaboration with cities in Africa and Asia. This network should be enriched by partnering with the national and regional networks of cities.

The third potential partner could be UN-Habitat due to its strong connections to cities in the Global South and existing thematic networks such as Waste Wise Cities. Here, UN-Habitat can serve as a partner for GDC via its thematic networks.

Our recommendation is to set up a programme that shares the holistic approach of PAGE by bringing organisations with – to a certain extent – contradicting agendas together (e.g. UNEP, ILO and UNIDO) and utilises ICLEI as the core partner to approach the city level through its established network. As cooperation partners, C40 as a knowledge hub and UN-Habitat with its thematic networks can contribute knowledge and expertise.

6 Conclusions

This discussion paper addressed challenges, opportunities, fields of actions and the necessary interventions for the economic, but also social transformations to create green jobs on the level of cities. The regional focus was on African and Asian cities in developing countries. Cities in Africa and Asia can play an important role in achieving the SDGs as well as climate mitigation and adaption goals while supporting the transformation towards an IGE, creating more green jobs.

A special focus is on intermediary cities with between 1 to 5 million inhabitants since they constitute the fastest-growing urban areas today (United Nations, 2018) and, more importantly, they have both the capacity and expertise to guide an economic transformation and are not too large to be managed effectively.

The development of the concept of a green economy has been on the agenda of international organisations for more than 10 years. A green economy is both resource efficient and socially inclusive and addresses issues such as inequality, biodiversity loss, pollution and environmental degradation. Thus, the concept is aiming at a radical transformation of the current economic system, which currently results in high carbon emissions of both energy supply and production processes in many sectors.

The current pandemic situation and the need for a quick COVID-19 recovery stress the importance of the potential for a green and just recovery "to create jobs and improve health in cities while limiting warming to 1.5°C" (C40 Cities Climate Leadership Group, 2021). Also, the OECD (2020) evaluates that "the economic stimulus packages and recovery plans that governments are now putting in place have the potential to create a recovery that is both green and inclusive." The OECD (2020) highlights that "the recovery is an opportunity to 'build back better', combining an emphasis on restoring growth and creating jobs with the achievement of environmental goals and objectives".

Any policy-induced or state-led interventions on the economy – if not well-organised, accepted and supported by the majority of stakeholders, can face significant risks of unintended outcomes, collateral damages and political disputes. This applies especially to fragile economies in the Global South, which for example cannot meet the demand in terms of job creation, energy and water supply, and other environmental service needs of their growing populations. In African and Asian cities, green policies must be compatible with initiatives to reduce poverty and combat spatial and social fragmentation.

Thus, it seems to be advisable to follow Southern approaches for a successful transformation that reflects local problems, local potentials and stakeholders on the ground, especially with a South-South exchange of knowledge and solutions. These Southern approaches might differ from European or OECD approaches and might not cover all aspects of a green economy in the same manner. They also have to reflect local conditions of informality in urban development and economy, consider urban poverty, rapid urban growth and the potential shortcomings in urban governance to be successful.

The paper is mainly grounded on the agreed comprehensive SDGs and sees the above-mentioned economic transformation towards a green economy and green jobs as an integral part of the process for achieving all SDGs, and not as a separated goal or as a purely environmental topic. In the context of the economic transformation, especially SDGs 1, 2, 3, 4 and 5 set clear targets to be achieved within the transformation process. These goals cannot be neglected by the transformation towards a green economy. As the aspiration of the green economy goes beyond the goal of decarbonisation and encompasses other ecological, economic and especially social development dimensions, SDGs 6, 7, 8, 9 and 11 have to be considered since they have the potential to interfere with the process of moving towards a green economy if not handled wisely.

In line with the ILO (2015a), green jobs vary from one country to another, and countries will need to compose their own national definitions and set thresholds for practices that are considered green or non-green.

UNEP (2008) identified the transformation of the following main sectors as being relevant: renewable energy, buildings, food and agriculture, basic industry and recycling, transport and forestry.

This list provides a suitable starting point about where to look for existing green jobs, respectively where sectors have potentials to create new green jobs in cities. However, we also have to consider the wide range of informal businesses playing an important role in African and Asian cities.

In many countries in the Global South, cities have only limited mandates and resources regarding their own political decisions, and they highly depend on transfers from national budgets. Cities therefore need an appropriate framework to play their part and make use of their strengths of being close to the stakeholders and having the mandates on land use planning and building control. Obviously, cities have only limited capacities to directly create jobs in the form of municipal employees. However, due to their power and competency in land use and infrastructure planning, they can apply strategic planning instruments and building codes. By issuing building permits with specific requirements, they can guide urban development and the local economy towards the transformation. They can also issue local policies and advance pilot projects on a wide range of green production and consumption patterns as well as strategically foster certain industries within national frameworks.

Cities are more closely linked to their citizens and the main local stakeholders in the private-sector economy and civil society groups than national governments, and thus can discuss and implement actions more quickly.

The fields of action for cities in a transformation towards a green economy, thereby generating green jobs, can be clustered into:

- land use planning
- green buildings and construction
- sustainable mobility and urban transport
- green and blue urban infrastructures, NBSs
  - water supply systems
  - solid waste management, recycling, circular economy and urban mining
- renewable energy and energy efficiency

These topics were thoroughly elaborated in Section 2.4, including good practice cases from the Global South. They can serve as background to discuss options with local stakeholder to develop new initiatives. They also serve as showcases for the feasibility of green economy approaches. South-South cooperation between stakeholders is advisable in order to facilitate a replication of successful projects in partner countries.

The employment effects of a transformation towards a green economy play an important role. UNEP (2008), however, sees most future green jobs being created in OECD countries and in emerging economies such as China and Brazil. The positive employment effects in low-income developing countries will be smaller and mainly in Asian countries. The ADB (2013) expects that only up to 2 per cent of the entire Asian workforce will be employed in green jobs. The validity of such macro-economic estimates, however, seems limited, as they highly depend on the quality of input data and assumptions. Therefore, such estimates (which, for example, the ILO provided for a number of countries) are not necessarily a sound basis for decision-making in the development cooperation context.

The statistical evidence or the projection becomes even more difficult when it comes to the unregulated and undocumented informal sector and its income-generating activities, which constitute a huge number of jobs in African and Asian cities. Verifiable evidence for lower- and middle-income countries in Africa and Asia is very limited. Due to the huge amount of informal economic activities, it is not possible to comprehensively estimate the full potential for green jobs in most sectors in the transformation process towards a green economy, especially for countries in Africa and Asia. Even more difficult is the net effects calculation for the number of new jobs while taking employment losses in obsolete sectors into account. However, the opportunities for cities in Africa and Asia to create green jobs under their own local mandates of decision-making in urban planning and through their own service providers – and/or to support the "greening" of the private sector – will obviously create more green jobs and respectively shift current jobs into green jobs. The risks mentioned before concerning green infrastructure development and the eviction of informal businesses have to be taken into account. One main challenge consists of the temporal, spatial, educational and sectoral misalignments between jobs created and the available skillsets.

For the future portfolio development of GDC, we recommend considering the three approaches of PAGE, UNEP IGE and the Green Economy Coalition (see Section 2.1 and the full text in the Annex) as the basis in the areas of a green economy and supporting the establishment of green jobs. As outlined before, a green economy can only be successful if

it is, at the same time, socially inclusive and explicitly addresses issues such as inequality, as stated in the SDGs and other international commitments.

As outlined in Section 2.4, the main target areas towards a green economy and green jobs in intermediary cities in Africa and Asia can be found in the fields of

- strengthening the local level, as outlined in the NUA,
- land use planning towards a compact city concept, including addressing informal urban development and disaster risks,
- green buildings and construction materials to retrofit the existing building stock and guide new constructions, including the development of a local green construction sector,
- sustainable mobility and urban transport by developing mobility options with locally applicable technology and job creation, also on the level of unskilled workers,
- extension and retrofitting of urban infrastructures focussing on NBSs by
    - considering NBSs as a cross-cutting interdisciplinary and inter-sectoral approach,
    - introducing water supply systems, which guarantee a just distribution of water, resource efficiency and the long-term sustainability of water resources,
    - ensuring solid waste management, recycling – including repair and reuse/sharing systems – and urban mining to tap the unexhausted potentials of a circular economy and job creation, also on the level of unskilled workers,
    - implementing smart cities and urban tech approaches that both enhance the quality and efficiency of urban services while creating decent jobs and support so-called digital immigrants while reducing the risk of so-called digital refugees,
- supporting investment in renewable energy infrastructures by rendering assistance within the city's mandate, while at the same time addressing energy efficiency as a cross-cutting issue for the built environment (cooling and heating) as well as transport.

Since there are already relevant and suitable local solutions in place worldwide – and at the same time, experts are available in many municipalities and the local academia – we suggest establishing international cross-continental, regional (e.g. South-East Asia) and national networks of technical experts in the above-mentioned fields to exchange ideas, co-produce knowledge and co-design tailor-made solutions for countries and cities that reflect the different climatic, socio-economic and political environments of each.

These experts should come not only from cities in Africa and Asia, but also include Latin America with some more advanced approaches that are, for example, related to recycling, mass transport systems and civic participation. Latin America has also experienced a greater degree and longer process of urbanisation that can be learnt from. The establishment of a city-focussed network can be undertaken by GDC in partnership with local stakeholders such as national city associations, but also through international networks.

For future programmes and projects on the level of cities moving towards a green economy and green jobs, we recommend following the holistic approach of the existing PAGE

project, which works with organisations such as UNEP and the ILO while partnering with ICLEI to benefit from its direct link to cities. We also recommend tapping the knowledge base of C40 and the existing thematic networks of UN-Habitat.

The biggest obstacles, however, are four-fold: first, the prevailing population growth rates, which create poverty by overtaking economic growth; second, the share of informality in decision-making in the economy, which is outside the scope of a state-led transformation of the economy; third, the risks of carbon-emission-related pricing of goods and services, which overstress the majority of the poor urban population; and fourth, that newly created green jobs might not compensate for job losses.

References

ADB (Asian Development Bank). (2013). *Low-carbon green growth in Asia: Policies and practices*. Hong Kong: Author.

ADB. (2016). *Asian development outlook 2016 update. Meeting the low-carbon growth challenge*. Mandaluyong City, Philippines: Author.

ADB. (2019). *Strategy 2030 operational plan for priority 3: Tackling climate change, building climate and disaster resilience, and enhancing environmental sustainability 2019-2024.* Manila: Author.

Adler, P., & Florida, R. (2021). The rise of urban tech: How innovations for cities come from cities. *Regional Studies*, *55*(10-11), 1787-1800.

African Development Bank. (2020). *Drivers of greenhouse gas emissions in Africa: Focus on agriculture, forestry and other land use*. Retrieved from https://blogs.afdb.org/climate-change-africa/drivers-greenhouse-gas-emissions-africa-focus-agriculture-forestry-and-other

Altenburg, T. (2013). Can industrial policy work under neopatrimonial rule? In A. Szirmai, W. Naudé, & L. Alcorta (Eds.), *Pathways to industrialization in the twenty-first century* (pp. 345-372). Oxford: Oxford University Press.

Altenburg, T., & Assmann, C. (2017). *Green industrial policy. Concept, policies, country experiences*. Geneva & Bonn: UN Environment & German Development Institute / Deutsches Institut für Entwicklungspolitik (DIE).

Barbier, E. (2015). *Is green growth relevant for poor economies?* Retrieved from https://ferdi.fr/dl/df-9YpSggBpToy9PGHg3pZp3CKS/ferdi-p144-is-green-growth-relevant-for-poor-economies.pdf

Barbier, E., & Burgess, J. (2020). Sustainability and development after COVID-19. *World Development, 135*. https://doi.org/10.1016/j.worlddev.2020.105082

Boen, A., & Kuralbayeva, K. (2015). *Looking for green jobs: The impact of green growth on employment.* London: London School of Economics and Political Science.

Building Efficiency Accelerator. (s.a.). BEA cities. Retrieved from https://buildingefficiencyaccelerator.org/bea-cities/

City Carbon Footprints. (s.a.). *Global gridded model of carbon footprints (GGMCF)*. Retrieved from https://www.citycarbonfootprints.info/

Climate Watch Historical GHG Emissions. (2022). Washington, DC: World Resources Institute. Retrieved from https://www.climatewatchdata.org/ghg-emissions

C40 Cities Climate Leadership Group. (2021). *Research reports April 2021: The case for a green and just recovery.* Retrieved from https://www.c40knowledgehub.org/s/article/The-Case-for-a-Green-and-Just-Recovery?language=en_US

C40 Cities Climate Leadership Group. (s.a.-a). *Tshwane – placing climate friendly infrastructure front and centre*. Retrieved from https://www.c40cff.org/projects/tshwane-placing-climate-friendly-infrastructure-front-and-centre

C40 Cities Climate Leadership Group. (s.a.-b). Homepage. Retrieved from https://www.c40knowledgehub.org/

Dempsey, N. (2010). Revisiting the compact city? *Built Environment, 36*(1), 4-8.

DeveloPPP. (2021). *Vietnam: Promoting quality, environment, health and safety (QEHS) standards for small- and medium-sized logistics suppliers.* Unpublished project report of KfW and DEG.

DeveloPPP. (s.a.). *Promoting an environmental-friendly construction material sector in Malawi.* Unpublished project report of Lafarge Cement Malawi Limited, DeveloPPP.de Programme of GIZ and Terrastone Limited.

Ellis, L. D., Badel, A. F., Chiang, M. L., Park, R. J.-Y., & Chiang, Y.-M. (2020). Toward electrochemical synthesis of cement – an electrolyzer-based process for decarbonating CaCO3 while producing useful gas streams. *Proceedings of the National Academy of Sciences, 117*(23), 12584-12591.

European Commission. (2013). *Green infrastructure (GI): Enhancing Europe's natural capital.* Retrieved from http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52013DC0249

Fankhauser, S., Sehlleier, F., & Stern, N. (2008). Climate change, innovation and jobs. *Climate Policy, 8*(4), 421-429.

German Advisory Council on Global Change. (2011). *World in transition: A social contract for sustainability*. Berlin: Author.

Gillard, R., Oates, L., Kasaija, P., Sudmant, A., & Gouldson, A. (2019). *Sustainable urban infrastructure for all: Lessons on solar- powered street lights from Kampala and Jinja, Uganda.* London & Washington, DC: Coalition for Urban Transitions.

GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit). (2021). *Beschäftigung schaffen mit Abfall*. Retrieved from https://www.giz.de/de/weltweit/75211.html

GIZ. (s.a.-a). *Bessere jobs in der Abfallwirtschaft.* Retrieved from https://www.giz.de/de/weltweit/73009.html

GIZ. (s.a.-b). *Ruanda: Fachkräftestärkung und Beschäftigungsförderung im Sharing-Markt für elektrobetriebene Motorräder.* Unpublished project report. Bonn.

GIZ Proklima. (2020). *Event recording: Qualification, certification and registration of RAC technicians*. Retrieved from https://www.green-cooling-initiative.org/news-media/publications/publication-detail/2020/07/24/event-recording-qualification-certification-and-registration-of-rac-technicians

Green Climate Fund. (2018a). *FP086: Green cities facility*. Retrieved from https://www.greenclimate.fund/project/fp086#documents

Green Climate Fund. (2018b). *FP081: Line of credit for solar rooftop segment for commercial, industrial and residential housing sectors*. Retrieved from https://www.greenclimate.fund/project/fp081

Green Climate Fund. (2018c). *FP085: Green BRT Karachi*. Retrieved from https://www.greenclimate.fund/project/fp085

Green Climate Fund. (s.a.). *Buildings, cities, industries, and appliances.* Retrieved from https://www.greenclimate.fund/results/buildings-cities-industries-appliances

Green Economy Coalition. (s.a.). *The world's largest alliance for green and fair economies*. Retrieved from https://www.greeneconomycoalition.org/the-coalition

Hammer, S., Kamal-Chaoui, L., Robert, A., & Plouin, M. (2011). *Cities and green growth: A conceptual framework*. Paris: OECD.

ICLEI (ICLEI – Local Governments for Sustainability). (s.a.-a). 100% renewables cities and regions network. Retrieved from https://iclei.org/100RE/

ICLEI. (s.a.-b). Circle city scan tool. Retrieved from https://iclei.org/Circle_City_Scan_Tool/

ICLEI. (s.a.-c). Supporting circular jobs for COVID-19 recovery in Bogor City. Retrieved from https://iclei.org/news/supporting-circular-jobs-for-covid-19-recovery-in-bogor-city/

ICLEI. (s.a.-d). Building efficiency accelerator. Retrieved from https://iclei.org/BEA/

ICLEI. (s.a.-e). City climate planner. Retrieved from https://iclei.org/en/City_Climate_Planner.html

ICLEI. (s.a.-f). Ecomobility alliance. Retrieved from https://iclei.org/EcoMobility_Alliance/

ILO (International Labour Organization). (2015a). *Anticipating skill needs for green jobs. A practical guide.* Geneva: Author.

ILO. (2015b). *Guidelines for a just transition towards environmentally sustainable economies and societies for all.* Geneva: Author.

ILO. (2017). *Asia-Pacific employment and social outlook 2018.* Geneva: Author.

ILO. (2019). *Skills for a greener future*. Geneva: Author.

ILO & UNEP (United Nations Environment Programme). (2012). *Working towards sustainable development: Opportunities for decent work and social inclusion in a green economy.* Geneva: Author.

International Union for Conservation of Nature. (s.a.). *Ensuring effective nature-based solutions*. Retrieved from https://www.iucn.org/resources/issues-briefs/ensuring-effective-nature-based-solutions

IRENA (International Renewable Energy Agency) & ILO. (2021). *Renewable energy and jobs: Annual review 2021*. Abu Dhabi & Geneva: Authors.

Kumar, A., & Barrett, F. (2008). *Stuck in traffic: Urban transport in Africa. Africa infrastructure country diagnostic*. Retrieved from http://siteresources.worldbank.org/EXTURBANTRANSPORT/Resources/341448-1269891107889/urban_tr_afr.pdf

Lamb, W. F., Wiedmann, T., Pongratz, J., Andrew, R., Crippa, M., Olivier, J. G. J., …Minx, J. (2021). A review of trends and drivers of greenhouse gas emissions by sector from 1990 to 2018. *Environmental Research Letters 16 073005*. https://doi.org/10.1088/1748-9326/abee4e

Leggewie, C., & Messner, D. (2012). The low-carbon transformation: A social science perspective. *Journal of Renewable and Sustainable Energy 4*(4). http://dx.doi.org/10.1063/1.4730138

Lütkenhorst, W., Altenburg, T., Pegels, A., & Vidican, G. (2014). *Green industrial policy: Managing transformation under uncertainty* (Discussion Paper 28/2014). Bonn: German Development Institute / Deutsches Institut für Entwicklungspolitik (DIE).

McKinsey Global Institute. (2012). *Africa at work: Job creation and inclusive growth*. New York, NY: Author.

McQuaid, S., Rhodes, M. L., Andersson, T., Croci, E., Feichtinger-Hofer, M., Grosjean, M., …Schante, J. (2021). *From nature-based solutions to the nature-based economy – delivering the green deal for Europe. Draft White Paper for consultation.* Nature-based Economy Working Group of EC Task Force III on Nature Based Solutions. Retrieved from https://networknature.eu/Nature-Based-Economy-White-Paper-Consultation

Oates, L., Sudmant, A., Gouldson, A., & Gillard, R. (2018). *Reduced waste and improved livelihoods for all: Lessons on waste management from Ahmedabad, India*. London & Washington, DC: Coalition for Urban Transitions.

OECD (Organisation for Economic Co-operation and Development). (2020). *OECD policy responses to coronavirus (COVID-19): Making the green recovery work for jobs, income and growth*. Retrieved from https://www.oecd.org/coronavirus/policy-responses/making-the-green-recovery-work-for-jobs-income-and-growth-a505f3e7/

Pearce, D. (1991). The role of carbon taxes in adjusting to global warming. *The Economic Journal*, *101*(407), 938-948.

Pegels, A., & Altenburg, T. (2020). Latecomer development in a "greening" world: Introduction to the Special Issue. *World Development, 135*.

Prevent Waste Alliance. (s.a.). Worldwide pilot projects. Retrieved from https://prevent-waste.net/en/pilotprojects/

REN 21. (2021a). *Renewables 2021 global status report*. Paris: Author.

REN 21. (2021b). *Renewables in cities 2021 global status report*. Paris: Author.

Rodrik, D., & Sabel, C. (2019). *Building a good jobs economy*. Retrieved from https://drodrik.scholar.harvard.edu/publications/building-good-jobs-economy

Roodman, D. M., & Lenssen, N. (1995). *A building revolution: How ecology and health concerns are transforming construction*. Washington, DC: Worldwatch Institute.

Schlegelmilch, K., Eichel, H., & Pegels, A. (2017). Pricing environmental resources and pollutants and the competitiveness of national industries. In T. Altenburg & C. Assmann (Eds.) (2017), *Green industrial policy. Concept, policies, country experiences* (pp. 102-119). Geneva & Bonn: UN Environment & German Development Institute / Deutsches Institut für Entwicklungspolitik (DIE).

Scholz, W. (2015). Colonial planning concept and post-colonial realities: The influence of British planning culture in Tanzania, South Africa and Ghana. In C. N. Silva (Ed.), *Urban planning in sub-Saharan Africa: Colonial and post-colonial planning cultures* (pp. 68-93). Oxfordshire: Routledge.

SLOCAT (Sustainable, Low Carbon Transport Foundation). (2021). Transport and climate change global status report 2nd edition. Retrieved from https://tcc-gsr.com/wp-content/uploads/2021/06/Slocat-Global-Status-Report-2nd-edition_high-res.pdf

Slum Dwellers International. (2010). *New houses in Chamazi*. Retrieved from https://sdinet.org/2010/06/new-houses-in-chamazi/

Smartcitiesdive. (s.a.). *Technology in Africa: Building innovative ecosystems*. Retrieved from https://www.smartcitiesdive.com/ex/sustainablecitiescollective/technology-africa-building-innovation-ecosystems/120386/

Sustainable Urban Transport Project. (s.a.). Homepage. Retrieved from https://sutp.org

Transformative Cities. (s.a.). *Dar es Salaam, Tanzania*. Retrieved from https://transformativecities.org/wp-content/uploads/2020/11/2018-HOUSING-Dar-es-Salaam-FORM-AoU.pdf

TUMI (Transformative Urban Mobility Initiative). (2020). *e-Rickshaws as public transport & emergency health services: Final report.* Bonn: Author.

TUMI. (s.a.). Homepage. Retrieved from https://www.transformative-mobility.org/

UCLG (United Cities and Local Governments). (2016). *UCLG frame document for intermediary cities: Planning and management of sustainable urban development*. Retrieved from https://www.uclg.org/sites/default/files/uclg_frame_document_ic.pdf

UN-Habitat. (2017). *New urban agenda.* Nairobi: Author.

UN-Habitat. (2020). *World cities report 2020.* Nairobi: Author.

UN-Habitat. (s.a.). *Waste wise cities*. Retrieved from https://unhabitat.org/waste-wise-cities

UN PAGE. (2019). *PAGE strategy 2021-2030 and Delivery Plan 2021-2025 (Phase 1).* Retrieved from https://www.un-page.org/about/governance-strategy/clone-governance-strategy

UN PAGE. (s.a.). Who we are. Retrieved from https://www.un-page.org/about/who-we-are

UNDESA (United Nations Division for Sustainable Development). (2012). *A guidebook to the green economy: Issue 1: Green economy, green growth, and low-carbon development – history, definitions and a guide to recent publications.* New York, NY: Author.

UNEP (United Nations Environment Programme). (2008). *Green jobs: Towards decent work in a sustainable, low-carbon world.* Nairobi: Author.

UNEP. (2011). *Towards a green economy: Pathways to sustainable development and poverty eradication – a synthesis for policy makers.* Retrieved from https://www.unep.org/greeneconomy

UNEP. (2021). *Smart, sustainable and resilient cities: The power of nature-based solutions*. Retrieved from https://www.unep.org/resources/report/smart-sustainable-and-resilient-cities-power-nature-based-solutions

UNEP. (s.a.). *Why does green economy matter?* Retrieved from https://www.unep.org/explore-topics/green-economy/why-does-green-economy-matter

United Nations. (2018). *2018 Revision of world urbanization prospects. Department of Economic and Social Affairs.* New York, NY: Author.

United Nations Commission on Sustainable Development. (2012). Resolution adopted by the General Assembly on 27 July 2012 – 66/288. The future we want. Retrieved from https://www.un.org/ga/search/view_doc.asp?symbol=A/RES/66/288&Lang=E

United Nations Framework Convention on Climate Change. (2010). *Report of the Conference of the Parties on its sixteenth session, held in Cancun from 29 November to 10 December 2010*. Bonn: Author.

United Nations Industrial Development Organization & The Global Green Growth Institute. (2015). *Global green growth. Clean energy industry investments and expanding job opportunities. Volume I: Overall findings.* Vienna & Seoul: Authors.

Urbanet. (s.a.). *Smart city: Is Africa ready? Echoes from African urban slums*. Retrieved from https://www.urbanet.info/smart-city-is-africa-ready-echoes-from-african-urban-slums/

WBGU (German Advisory Council on Global Change). (2011). *World in transition: A social contract for sustainability*. Retrieved from https://www.wbgu.de/fileadmin/user_upload/wbgu/publikationen/hauptgutachten/hg2011/pdf/wbgu_jg2011_kurz_en.pdf

World Bank. (2016). *Promoting green urban development in African cities: eThekwini, South Africa urban environmental profile*. Retrieved from https://openknowledge.worldbank.org/handle/10986/24037

WWF (World Wildlife Fund) & ILO. (2020). *Nature hires: How nature-based solutions can power a green jobs recovery.* Retrieved from https://wwf.panda.org/wwf_news/?943816/Nature-based-solutions-jobs-report

Annex 1

Box A1: Literature review on definitions of green economy

1. One that results in improved human wellbeing and social equity, while significantly reducing environmental risks and ecological scarcities. It is low carbon, resource efficient, and socially inclusive. In a green economy, growth in income and employment should be driven by public and private investments that reduce carbon emissions and pollution, enhance energy and resource efficiency, and prevent the loss of biodiversity and ecosystem services (UNEP, 2011).
2. A system of economic activities related to the production, distribution and consumption of goods and services that result in improved human wellbeing over the long term, while not exposing future generations to significant environmental risks or ecological scarcities. (UNEP, 2009).
3. An economy that results in improved human wellbeing and reduced inequalities, while not exposing future generations to significant environmental risks and ecological scarcities. It seeks to bring long-term societal benefits to short-term activities aimed at mitigating environmental risks. A green economy is an enabling component of the overarching goal of sustainable development (UNCTAD, 2011).
4. Green economy is "a resilient economy that provides a better quality of life for all within the ecological limits of the planet" (Green Economy Coalition, 2011).
5. "Green economy" is described as an economy in which economic growth and environmental responsibility work together in a mutually reinforcing fashion while supporting progress on social development (International Chamber of Commerce, 2011).
6. The green economy is not a state but a process of Transformation and a constant dynamic progression. The green economy does away with the systemic distortions and dysfunctionalities of the current mainstream economy and results in human wellbeing and equitable access to opportunity for all people, while safeguarding environmental and economic integrity in order to remain within the planet's finite carrying capacity. The Economy cannot be Green without being Equitable (Danish 92 Group, 2012).
7. The green economy involves largely new economic activities and must provide an important entry point for broad-based black economic empowerment, addressing the needs of women and youth entrepreneurs and offering opportunities for enterprises in the social economy (Government of South Africa, 2011).
8. Green economy can be seen as a lens for focussing on and seizing opportunities to advance economic and environmental goals simultaneously (Rio+20 Objectives and Themes of the Conference - UNCSD, 2011).

Quotation source: UNDESA (2012, Annex 1)

Box A2: Inclusive green economy (IGE)

An IGE has evolved from earlier work on green economy. In its simplest expression, such an economy is low-carbon, efficient and clean in production, but also inclusive in consumption and outcomes and based on sharing, circularity, collaboration, solidarity, resilience, opportunity and interdependence.

It is focussed on expanding options and choices for national economies, using targeted and appropriate fiscal and social protection policies, and backed up by strong institutions that are specifically geared to safeguarding social and ecological floors. And it recognises that there are many and diverse pathways to environmental sustainability.

An IGE must provide not only for jobs and income, but for our health, our environment and our future. This is our common challenge: creating the conditions for enhanced prosperity and growing social equity, within the contours of a finite and fragile planet.

An IGE is an alternative to today's dominant economic model, which generates widespread environmental and health risks, encourages wasteful consumption and production, drives ecological and resource scarcities and results in inequality.

Source: UNEP (s.a.)

Box A3: Vision for a fair, green economic future

Our vision of a green economy is one that provides prosperity for all within the ecological limits of the planet. It follows five key principles, each of which draws on important precedents in international policy, and which together can guide economic reform in diverse contexts.

1. The Wellbeing Principle

A green economy enables all people to create and enjoy prosperity.

- The green economy is people-centred. Its purpose is to create genuine, shared prosperity.
- It focusses on growing wealth that will support wellbeing. This wealth is not merely financial, but includes the full range of human, social, physical and natural capitals.
- It prioritises investment and access to the sustainable natural systems, infrastructure, knowledge and education needed for all people to prosper.
- It offers opportunities for green and decent livelihoods, enterprises and jobs.
- It is built on collective action for public goods, yet is based on individual choices.

2. The Justice Principle

The green economy promotes equity within and between generations.

- The green economy is inclusive and non-discriminatory. It shares decision-making, benefits and costs fairly; avoids elite capture; and especially supports women's empowerment.
- It promotes the equitable distribution of opportunity and outcome, reducing disparities between people, while also giving sufficient space for wildlife and wilderness.
- It takes a long-term perspective on the economy, creating wealth and resilience that serve the interests of future citizens, while also acting urgently to tackle today's multi-dimensional poverty and injustice.
- It is based on solidarity and social justice, strengthening trust and social ties, and supporting human rights, the rights of workers, indigenous peoples and minorities, and the right to sustainable development.
- It promotes empowerment of micro, small and medium-sized enterprises, social enterprises and sustainable livelihoods.
- It seeks a fast and fair transition and covers its costs – leaving no one behind, enabling vulnerable groups to be agents of transition, and innovating in social protection and reskilling.

3. The Planetary Boundaries Principle

- The green economy safeguards, restores and invests in nature.
- An IGE recognises and nurtures nature's diverse values – functional values of providing goods and services that underpin the economy, nature's cultural values that underpin societies and nature's ecological values that underpin all of life itself.
- It acknowledges the limited substitutability of natural capital with other capitals, employing the precautionary principle to avoid loss of critical natural capital and breaching ecological limits.
- It invests in protecting, growing and restoring biodiversity, soil, water, air and natural systems.
- It is innovative in managing natural systems, informed by their properties such as circularity, and aligns with local community livelihoods based on biodiversity and natural systems.

4. The Efficiency and Sufficiency Principle

The green economy is geared to support sustainable consumption and production.

- An IGE is low-carbon, resource-conserving, diverse and circular. It embraces new models of economic development that address the challenge of creating prosperity within planetary boundaries.

Box A3: Vision for a fair, green economic future

- It recognises there must be a significant global shift to limit the consumption of natural resources to physically sustainable levels if we are to remain within planetary boundaries.
- It recognises a "social floor" of basic goods and services consumption that is essential to meet people's wellbeing and dignity, as well as unacceptable "peaks" of consumption.
- It aligns prices, subsidies and incentives with true costs to society, through mechanisms where the "polluter pays" and/or where benefits accrue to those who deliver inclusive green outcomes.

5. The Good Governance Principle

The green economy is guided by integrated, accountable and resilient institutions.

- An IGE is evidence-based – its norms and institutions are interdisciplinary, deploying both sound science and economics along with local knowledge for adaptive strategy.
- It is supported by institutions that are integrated, collaborative and coherent – horizontally across sectors and vertically across governance levels – and with adequate capacity to meet their respective roles in effective, efficient and accountable ways.
- It requires public participation, prior informed consent, transparency, social dialogue, democratic accountability and freedom from vested interests in all institutions – public, private and civil society – so that enlightened leadership is complemented by societal demand.
- It promotes devolved decision-making for local economies and management of natural systems while maintaining strong common, centralised standards, procedures and compliance systems.
- It builds a financial system with the purpose of delivering wellbeing and sustainability, set up in ways that safely serve the interests of society.

Source: Green Economy Coalition (s.a.)