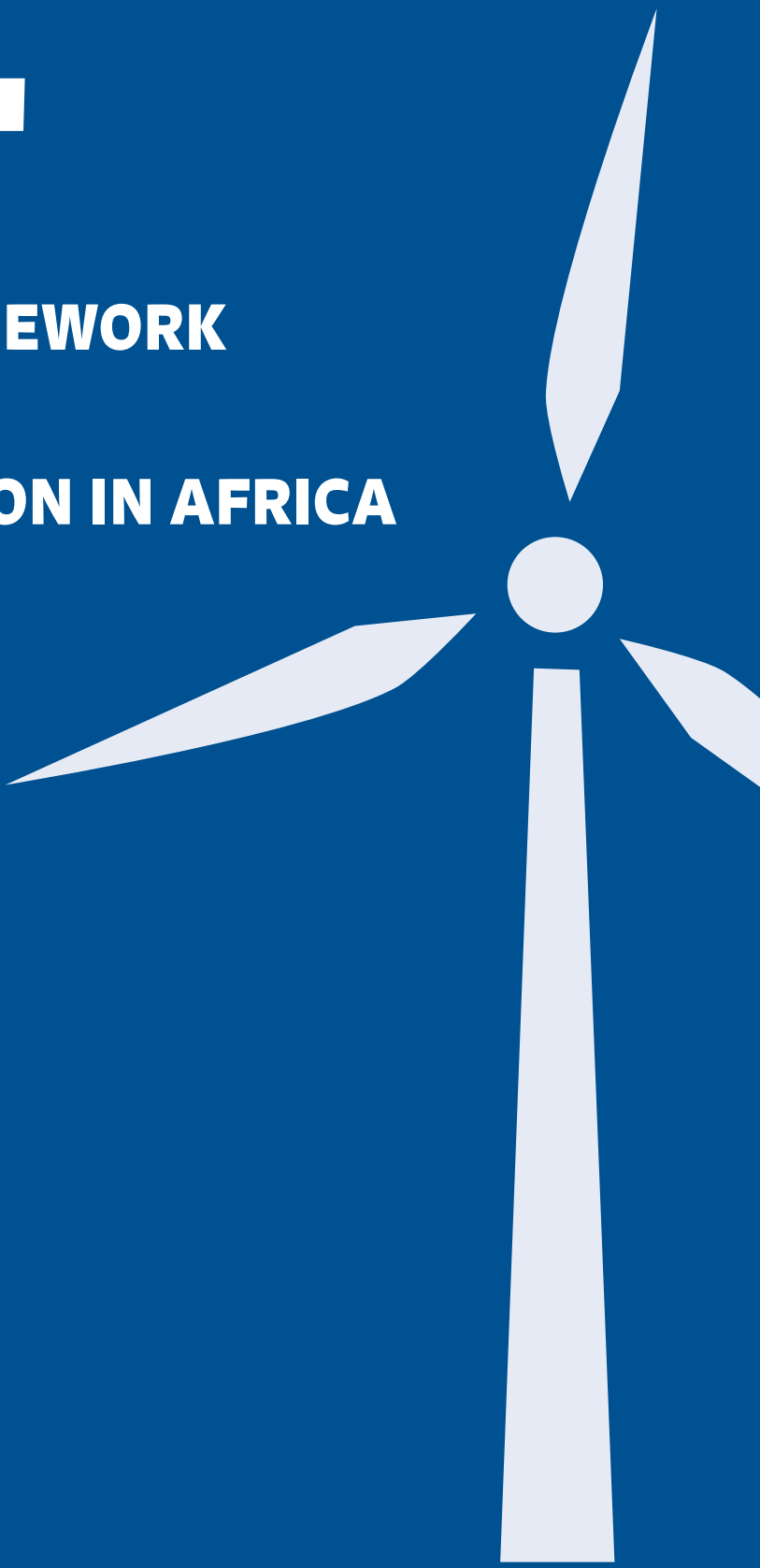
CHAPTER

4

THE POLICY FRAMEWORK FOR GREENING INDUSTRIALIZATION IN AFRICA



Chapter 3 laid out the concepts, tools and thinking underlying Africa's industrialization and the pathway to make the process green and inclusive. It showed that governments must carve a decisive pathway, working closely with private sector actors—large and small—and civil society to set the direction for long-term investment in the continent's people and natural assets.

This chapter outlines the broader policy framework within which the shift to greening industrialization is happening, the close congruence of this greening with major regional and global policy directions, and evidence of current progress at the country level.

4.1 AFRICA'S GREEN GROWTH VISION

Environmental dimensions of economic development have been on the agenda for African countries since the first United Nations (UN) Conference on Environment and Development—or the Earth Summit— held in Rio de Janeiro, Brazil, in 1992. The period after the Earth Summit saw national sustainable development strategies drawn up, ministries of the environment set up, and global conventions—such as those on Climate Change, Biodiversity and Desertification—agreed to. African countries have been active in global negotiations, most recently in designing and agreeing to the Addis Ababa Action Agenda for financing development, the Sustainable Development Goals (SDGs) adopted by the UN General Assembly in September 2015, and the Paris Agreement on climate change reached at COP21 in December 2015.

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THE AFRICAN UNION AND GREEN GROWTH

At the continental level, there is strong adherence to an inclusive, green transformation of African economies. Agenda 2063 of the African Union (AU) outlines a high-level vision of "an integrated, prosperous and peaceful Africa, driven by its own citizens and representing a dynamic force in the global arena". The first aspiration is for "a prosperous Africa, based on inclusive growth and sustainable development" and seeks a context in which "the environment and ecosystems are healthy and preserved, and with climate resilient economies and communities". Such a vision builds on Africa's

BOX 4.1 INVESTING IN RENEWABLE ENERGY FOR ALL

The Africa Renewable Energy Initiative (AREI) is a transformative, Africa-led effort to accelerate the harnessing of the continent's huge renewable energy potential. Under the mandate of the AU and endorsed by African Heads of State, the initiative is set to achieve at least 10 gigawatts (GW) of new renewable energy generation capacity by 2020 and to realize African potential to generate at least 300 GW by 2030.

The AREI is firmly anchored in the context of sustainable development, climate change and zero-carbon development strategies in Africa. It also recognizes the critical importance of energy access for enhanced well-being, economic development and the fulfilment of, particularly, Sustainable Development Goal 7 on energy access.

The premise of the AREI is that all societies, including those in Africa, must transition to low- and zero-carbon energy systems to avoid catastrophic climate change. In accord with commitments and principles under the UNFCCC, such African efforts must be supported through international public climate finance, among other sources. It will build on the renewable energy components of other initiatives, such as the Africa Clean Energy Corridor of the International Renewable Energy Agency (IRENA), the Africa–European Union (EU) Energy Partnership, Power Africa, the Programme for Infrastructure Development in Africa (PIDA), Sustainable Energy for All (SE4ALL), one of the African Development Bank's "High-Fives" on lighting up and powering Africa, and numerous bilateral, civil society and community efforts.

The AREI seeks to address the needs of small-scale farming and micro-, small- and medium-scale enterprises on the quantity and quality of access to energy, and it entails a vision of electricity access beyond households' needs. The AREI will therefore promote unprecedented efforts to reach populations currently off the grid. The AREI envisions smart, distributed energy systems that can handle a mix of renewable energy generation. With a highly diversified ownership base compared with conventional, centralized energy systems, a vast number of households, communities, cooperatives and enterprises of all sizes will become producers and consumers of electricity, allowing Africa to leapfrog to the energy systems of the future. As such the AREI stands to contribute substantially to the green growth agenda in Africa.

position at the third international conference on sustainable development held in Rio de Janeiro in June 2012, and during the climate negotiations concluded at the COP21, at which African governments demonstrated their collective ambition to build a low-carbon future by mobilizing investments to more than double the installed electricity capacity on the continent by 2030, using renewable energy resources (box 4.1).

Agenda 2063 presents a determination to achieve structural transformation to deepen industrialization; develop modern and productive agriculture; and invest in science, technology and innovation. It recognizes sustainable management of water—including the vast ocean resources on the continent's doorstep[1]—as critical to Africa's transformation and growth (as well as management of land-based resources, which requires regional cooperation). Agenda 2063 also commits to pushing for major infrastructural investment in transport, energy and information and communications technology (ICT) through PIDA. It builds on the Action Plan for the Accelerated Industrial Development of Africa (AIDA; Chapter 3), which lays out national, regional and continental priorities.

The African Development Bank's Strategy for 2013–2022 (AfDB, 2013) aligns closely with the greening industrialization agenda, as it is underpinned by two central objectives to improve the quality of Africa's growth: inclusive growth and the transition to green growth. The first objective is based

BOX 4.2 AFRICAN GOVERNMENTS IN THE VANGUARD OF GREEN ECONOMY STRATEGIES

Country	Strategic framework for inclusive green economy
Ethiopia	Climate-Resilient Green Economy (CRGE) strategy. The vision is to achieve middle-income status by 2025 in a climate-resilient green economy. The country plans continued rapid economic growth, expanding industrialization and jobs but, by avoiding the conventional development pathway, Ethiopia aims to cut greenhouse gas emissions and shift to sustainable patterns of land, soil and water management. The CRGE makes Ethiopia a front runner in the green economy race.
Kenya	Green Economy Strategy and Implementation Plan (GESIP, 2015). The objective is to guide the transition to a green, low-carbon and climate-resilient economy. Scenario analysis shows that a green economy pathway delivers higher and more stable growth than business as usual (BAU). Building on Kenya Vision 2030 and the constitutional provisions of 2010, the GESIP promotes infrastructural investment, resilience and sustainable livelihoods. The priorities and approach were defined through an inclusive, participatory process.
Morocco	Green Morocco Plan (GMP). Launched in 2008, it has a focus on agriculture and the associated agrifood processing industry. It addresses the problem of increasing water scarcity through investment in drip irrigation technology and changes to agricultural water governance. Although the prospects for further growth in exporting agricultural produce to high-income markets in Europe has received much attention, the GMP recognizes that domestic urban growth and rising incomes are substantial new sources of growth for Moroccan agriculture.
Mozambique	Roadmap for a Green Economy in Mozambique: Accelerating sustainable economic, social, and environmental development. The vision for Mozambique is to become an inclusive middle-income country by 2030, based on protection, restoration and rational use of natural capital and its ecosystem services to guarantee development that is sustainable, inclusive and efficient within planetary limits.
Rwanda	Green Growth and Climate Resilience: National Strategy for Climate Change and Low Carbon Development 2011–2050 (2011). The vision is for Rwanda to be a developed, climate-resilient, low-carbon economy by 2050. Strategic objectives include achieving energy security and a low-carbon energy supply that supports development of green industry and services; and achieving social protection, improved health and disaster risk reduction that reduces vulnerability to climate change.
South Africa	Green Economy Accord (2011). This partnership was signed by organized labour, community constituents, businesses and government. It lays out 12 commitments to green the economy, including roll-out of solar water heaters and renewable energy; energy efficiency; biofuels; and waste recycling, reuse and recovery. Other commitments relate to clean coal initiatives, electrification of poor communities, and reduction of open fire cooking and heating. The partners also committed to promoting localization, youth employment, cooperatives and skills development.
Ghana	AKOBEN. The main responsibility for greening industrialization in Ghana at the government level lies with the Environmental Protection Agency (EPA) which implements this agenda through two units – the Ghana National Cleaner Production Centre, and the Manufacturing Industries Department. This department implements the EPA's AKOBEN Environmental Rating and Disclosure Programme that is used to assess the environmental performance of mining and manufacturing operations.

SOURCE: BASS (2015); AUTHORS' COMPILATION .

on the view that inclusive growth will unlock great, untapped potential and increase Africa's chances of reaping a demographic dividend that has been elusive so far. Green growth is seen as the means to ensure that inclusive growth is sustainable. The underlying assumption is that transitioning to green growth will protect livelihoods and improve water, energy and food security while promoting sustainable use of natural resources. Green growth is further believed to have the potential of fostering innovation, creating jobs and spurring economic development (AfDB, 2013).

SOME AFRICAN GOVERNMENTS ARE TAKING THE LEAD

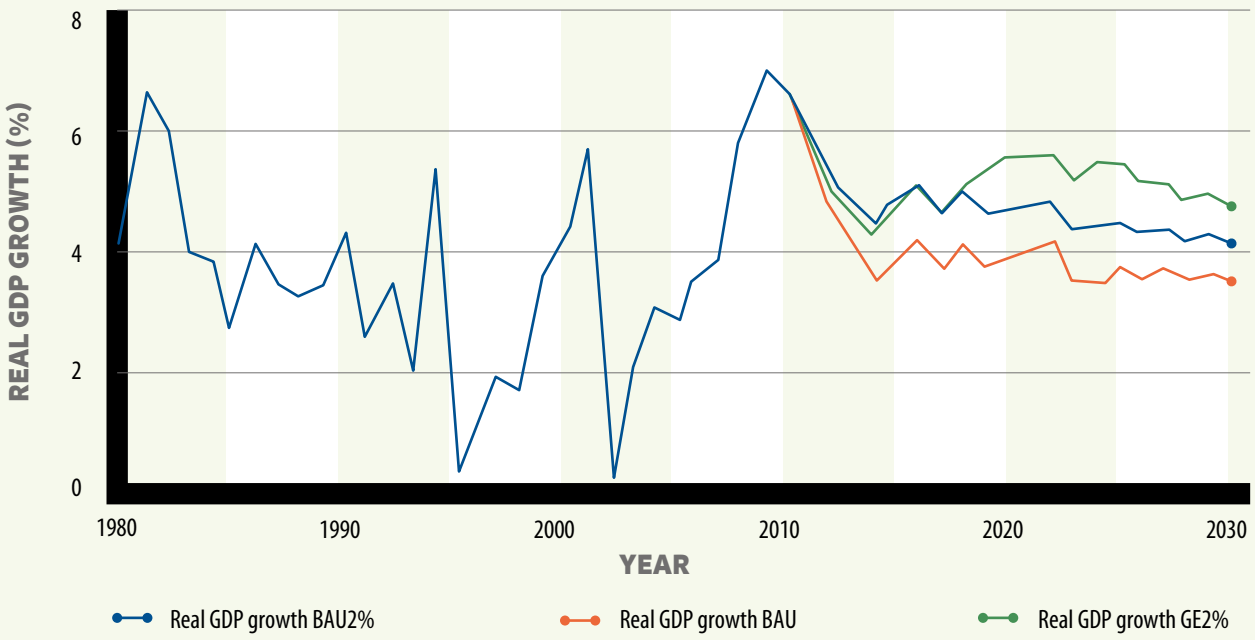
Several African governments are ahead in designing and implementing an inclusive green economy (box 4.2). Such strategies combine focusing on energy access, creating high-quality jobs with rising incomes, investing in critical environmental assets—soil, water, biodiversity and forests—and designing resilience for cities and infrastructure.

In Kenya, the Green Economy and Strategy Implementation Plan carried out a scenario exercise (figure 4.1) that shows the huge importance of shifting from a Business as Usual (BAU) economic pathway to a new green-economy track. This exercise shows that a greener economy brings significant benefits in the medium to long term, but during the initial, investment phase, growth is slightly slower under the Green Economy (GE) scenario, than in the enhanced Business as Usual Scenarios. According to the analysis, the BAU or baseline scenario assumes no fundamental changes in policy or external conditions up to 2030; The BAU2% allocates an additional 2 per cent of GDP per annum as investments to the current BAU investment path; and the GE2% scenario assumes an additional 2 per cent of GDP per annum as green investments to the baseline (GESIP, 2015).

AFRICA IS NOT ALONE IN TARGETING GREEN GROWTH

A growing number of countries have recognized the need to promote inclusive green growth, not just as a counter to the harmful impacts of carbon emissions but also as a source of rapid economic growth, technical innovation and development benefits. Progress in addressing poverty, environment and economic growth has mainly been

FIGURE 4.1 TRENDS IN REAL GDP GROWTH IN BAU, BAU2% AND GE2% SCENARIOS FOR KENYA'S GREEN ECONOMY STRATEGY



SOURCE: GOVERNMENT OF THE REPUBLIC OF KENYA (2015).

BOX 4.3 SOME GREEN ECONOMY ADVANCES

Indonesia: Phase-out of fossil fuel subsidies, complemented by social safety nets. For more than 30 years, fossil fuel subsidies formed a large part of the Indonesian government's economic programme. Those subsidies exceeded combined government spending on education, health and social protection. Given the huge financial costs and environmental impacts, the government has begun to phase them out. To support the welfare needs of its poorest citizens, Indonesia has built a stronger social safety net, including rice subsidies, public health insurance, cash assistance for school costs, and direct and conditional cash transfers. Those programs have all helped to support the poor while fossil fuel subsidies are removed.

Mexico: Renewable energy roll-out and fuel subsidy reform. Mexico has shown that a progressive legislative stance on climate change and strong consultative processes can deliver a renewable energy roll-out and fuel subsidy reform in ways that protect the poor. Incremental shifts in energy policy, along with alternative cash transfer mechanisms, have produced environmental improvements while mitigating negative impacts on marginalized groups. Robust consultation has been at the heart of designing the green growth policy, alongside supporting the social welfare of the poorest.

China: Green growth policies. These include a comprehensive range of laws, backed up by fiscal tools and research and development (R&D). These include the Renewable Energy Law (2006); the 12th Five-Year Plan for Energy Development, Energy Saving and New Energy Vehicle Development Plan (2011–2020); feed-in tariffs for solar and wind power; fiscal incentives to support R&D in manufacturing of renewable energies; concessional lending for renewable energy projects; subsidies for green technologies, including solar photovoltaic manufacturers; fuel-economy standards for the automotive industry; and cap-and-trade programmes in five cities—Beijing, Chongqing, Shanghai, Shenzhen and Tianjin—and the two provinces of Guangdong and Hubei. The Solar Roofs program and Golden Sun program provide investors with financial incentives for solar energy projects.

SOURCE: BASS (2015).

driven separately, by different institutions at both national and global levels. The fact that these are closely linked objectives, at the level of their causes and solutions, is now recognized much more substantially in the Sustainable Development Goals. These goals provide a touchstone for joint action on poverty reduction, inclusivity and environmental sustainability, given the high degree of consensus on them between countries and stakeholders.

Green growth is being pursued at global, regional, national and subnational levels. Globally, actions include the Green Economy Initiative of the United Nations Environment Programme (UNEP), the Green Growth Papers of the Organisation for Economic Co-operation and Development (OECD), the Global Green Growth Institute (GGGI), Green Growth Knowledge Platform (GGKP) and Global Green Growth Forum (GGGF), all of which have established themselves as centres for building knowledge and sharing lessons between government and business. The Green Economy Coalition (GEC) has created space for citizen engagement with greening debates and offered a platform for excluded voices.

Regionally, Europe has flagged its intent to roll out a green economy, by creating a circular economic system. Within the EU, Germany and the Scandinavian countries have been at the forefront of building a green economy. Policy in Germany has focused on achieving an energy transition (Energiewende) through rolling out decentralized renewable energy across the country. The factors leading to success have been loud, consistent and long-term leadership by government—with the

required finance, innovation and infrastructure—alongside vocal, political demand from the population at large for the government to be ambitious in building a low-carbon economy. Households, industry and communities across the country have seen the benefit of being able to generate their own electricity, given generous feed-in tariffs and a secure energy supply.

The world now sees strong momentum for shifting economies onto a green growth pathway (box 4.3). Many strategies have been designed to be economically inclusive.

At the subnational level, a wave of green initiatives is under way in cities, states and national regions. These initiatives include the C40 initiative for cities, and the Transition Town movement. Similarly, a growing number of businesses seek to demonstrate their green credentials through a range of certification schemes, flagging the quality of their product to consumers. Although subnational governments lack the powers of the nation state, they often have considerable room for manoeuvre to test new ways of working, whether for transport, energy delivery or waste systems. City mayors often can make progress, even when inertia or special interests block the green agenda nationally.

4.2 WHY ACCELERATED GREENING MAKES SENSE FOR THE AFRICAN ECONOMY NOW

Despite having major differences in structure and context, most African economies confront four common challenges that frame their economic options and justify a strong, inclusive green growth agenda. Each challenge has implications for investment in appropriate infrastructure and for patterns of growth.

AGRICULTURE DOMINATES THE ECONOMY

Although agriculture's share of GDP has been falling in almost all African economies, it still contributes 32 per cent of continental GDP and remains the dominant sector for livelihoods and employment in most areas (AfDB, 2015). For more than two thirds of the population, it is their major source of income. Despite Africa's abundant agricultural potential, food imports have been on the rise and are an important drain on foreign exchange, although in an increasing number of economies agriculture has become a significant source of export earnings. Key continental policy initiatives have targeted growth in the agricultural sector, most particularly the African Union's 2003 Maputo Declaration on Agriculture and Food Security (see box 4.4). As shown in this box, it is easier to agree commitments than to carry them out.

Growth in food production is achievable in two ways: (1) raising agricultural yields in existing production systems, and (2) enabling entrepreneurship in new agribusiness sectors, such as those involving green technological innovation. Multiple examples show how agro-led industrialization can yield inclusive, green growth (such as the growth in aquaculture in Nigeria; Chapter 6).

BOX 4.4 AFRICAN AGRICULTURE—POLICY PLEDGES VS IMPLEMENTATION IN PRACTICE

At the AU summit in Maputo in July 2003, African leaders pledged to double spending on agriculture to reach at least 10 per cent of national budgets and to achieve at least 6 per cent annual growth in the sector. The Comprehensive African Agricultural Development Programme (CAADP), led by the New Partnership for Africa's Development (NEPAD), was drawn up to put this pledge into practice. Ten years on, however, only 10 of 54 countries had fulfilled their commitments, and growth in agriculture across the continent averaged less than one half the 6 per cent envisaged (2.6 per cent).

The AU's Agenda 2063 paints a vision of agriculture that is "modern and productive, using science, technology, innovation and indigenous knowledge. The hand hoe will be banished by 2025 and the sector will be modern, profitable and attractive to the continent's youth and women" (AU, 2013). Nigeria's example in the past three years shows the strong, positive benefits for the economy and trade balance from renewed investment in agriculture and food processing, with agricultural growth leading to a reported fall in the import bill from $11 billion in 2012 to $4.3 billion a year in 2013 (Chibuzor Emejor, 2014).

The African Development Bank launched a strategy, "Feeding Africa", in Dakar in October 2015. It seeks to make Africa food self-sufficient by 2025. With the goal of achieving rapid agricultural transformation across Africa, its 18-point plan includes better nutrition; increased research into raising agricultural productivity; affirmative action for women in Africa to de-risk financing to woman-owned businesses; and development of agro-allied industrial zones and agricultural corridors. New funding mechanisms will be developed, such as agribusiness diaspora bonds, as will ways to get greater support from private equity funds, sovereign wealth funds and pension funds to support long-term financing. Agro-input supplies to farmers will be scaled up, including African fertilizer production. Underlying emphasis will be on raising productivity, reducing production costs and expanding market outlets.

Moves to expand the green industrial sector require recognition of the strategic importance of agriculture in supply and demand factors. From the supply side, it requires critical inputs that are affected by patterns of growth—water, soil, biodiversity, infrastructure—as well as by climatic effects. From the demand side, agriculture feeds not only into local and national economies but also into regional and global markets. Each of those markets (Chapter 6) has its own characteristics; high-income markets in advanced economies, in particular, require producers to meet sustainability criteria along green supply chains (Potts et al., 2014). Given the high growth likely in Africa's urban demand for food over the next 10–20 years, African governments need to ensure that domestic producers can capture much of that growth, moving into higher value added food processing, and diverse fruit and vegetables. This growth in the food sector should generate jobs, reduce foreign exchange outflows on food imports, shift African economies from reliance on foreign foodstuffs and build positive domestic linkages between urban and rural income growth.

In building the industrial sector, expanding agri-food processing is infeasible without simultaneously building more sustainable management of the environmental assets (soils, water, biodiversity) that underlie agricultural growth. Further, because the sector is the source of livelihoods for much of the population, its future affects the inclusiveness of growth. Hence, strengthening local people's rights to land, water and other natural resources is a foundation for building an inclusive green economy, from which rural and urban people

can benefit. Secure land rights provide the basis for greater investment and higher productivity by farmers, whether smallholders or large enterprises. In many rural settings, local people rely not only on their fields but also on the wider landscape of common property resources, including woodland, lakes and wetlands, and lands for grazing. Establishing clear rights to manage and control access to these collective resources often is as important as rights to household plots because the overall farming system relies on sound management of water, soil and nutrient flows between fallow bushland and farmland.

Natural capital is the stock of natural assets that yield critical services without which people (especially the poor) and economies cannot survive. As with financial capital, drawing down too much stock can run up a debt that must be repaid, such as allowing aquifers to replenish themselves. Poorly managed natural capital can thus become an ecological, not just a social and economic, liability. Sustainable agri-food processing relies on strong natural capital assets that provide flows of water and food, climate regulation and flood defences.

AFRICAN ECONOMIES ARE RESOURCE DEPENDENT

Chapter 1 pointed to the heavy dependence of many African economies on the extractive industries and other commodities. The Africa Mining Vision (box 4.5) points to the growth potential of linkages, with the resource sectors as a source of structural transformation, industrialization and economic growth.

As with agriculture, the expansion of the natural resource sector has important green growth linkages. Extraction of many resources, particularly minerals, oil and gas, often produces heavy spillages and pollution, with major adverse consequences for the health and livelihoods of people in the locality. The resource sector also is increasingly

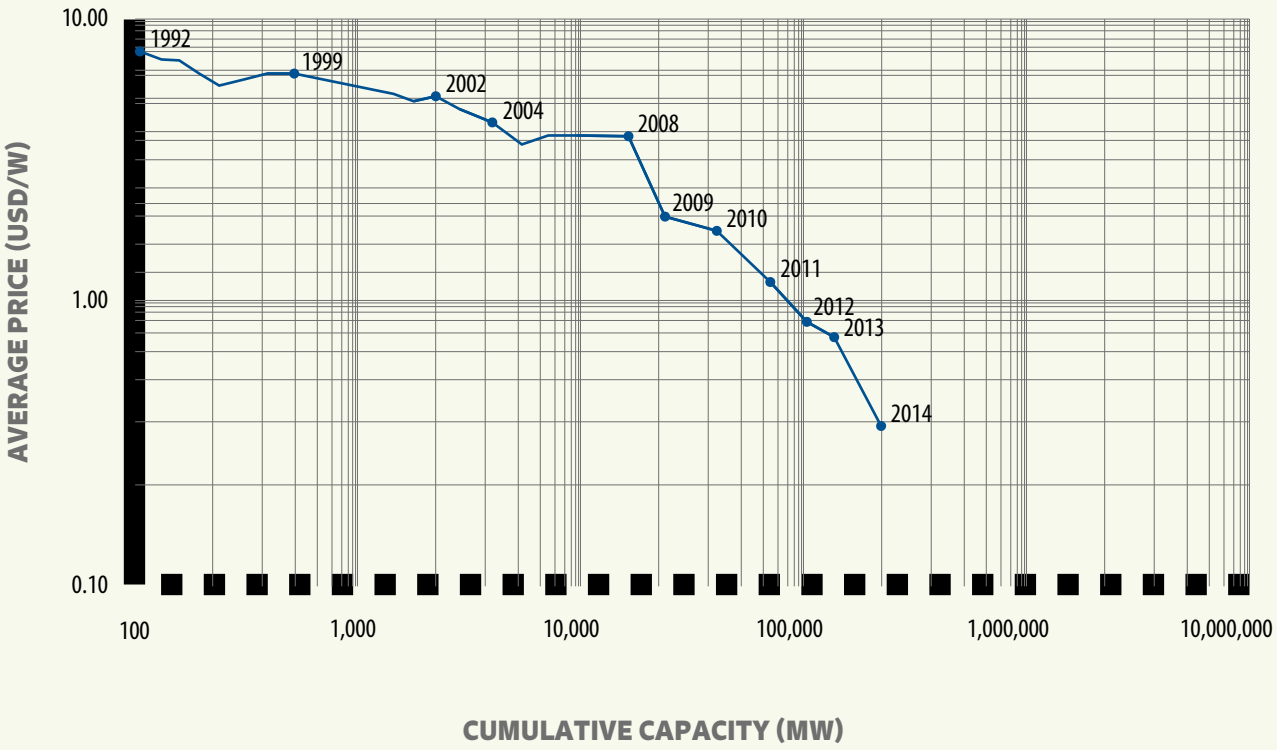
BOX 4.5 THE AFRICA MINING VISION

After decades of falling commodity prices, the Asian economic boom from 2000 onwards provided an opportunity for African countries to use their mineral wealth to support more sustainable patterns of economic growth. The Africa Mining Vision (AU, 2009) laid out the interventions needed by government to ensure that mineral wealth translates into economic growth, diversification and well-being by:

- Strengthening governance of resource rents—so that tax regimes can exact an equitable share for the public purse;
- Establishing collateral use of resource-related infrastructure—to maximize economic development within the catchment;
- Taking advantage of downstream value added—to gain benefits from transformation of resources, including industrial and energy development, jobs, training, innovation and foreign exchange; and
- Capitalizing on upstream value added—by developing local-content requirements to benefit suppliers of goods and services and to achieve longer-term investment in knowledge-intensive activity.

However, the Vision has had only limited impact, with many mineral-rich countries continuing to suffer from the "resource curse". And the recent economic slowdown in Asia has now led to a slump in prices and activity, bringing big job cuts, mine shutdowns and many investments being mothballed.

FIGURE 4.2 THE STEEP FALL IN PRICE OF SILICON PHOTOVOLTAIC MODULES AS INSTALLED GLOBAL CAPACITY HAS GROWN, 1992–2014



NOTE: MW = MEGAWATT; USD = US DOLLAR; W = WATT.
SOURCE: KING, DAVID, ET AL. 2015.

driven by the requirements of foreign markets, and those markets, as will be shown, demand a greening of supply chains and concomitant capabilities that also apply to many other sectors, offering the potential for spill-over benefits. Finally, because domestic and export-oriented resource sectors require transport, the greening of transport will be a necessary component if resource production is to expand in a sustainable manner. Early investment in low-carbon, climate-resilient infrastructure will avoid "lock-in" to systems of markets, urban density and distribution, which confer a heavy environmental burden and constrain future options.

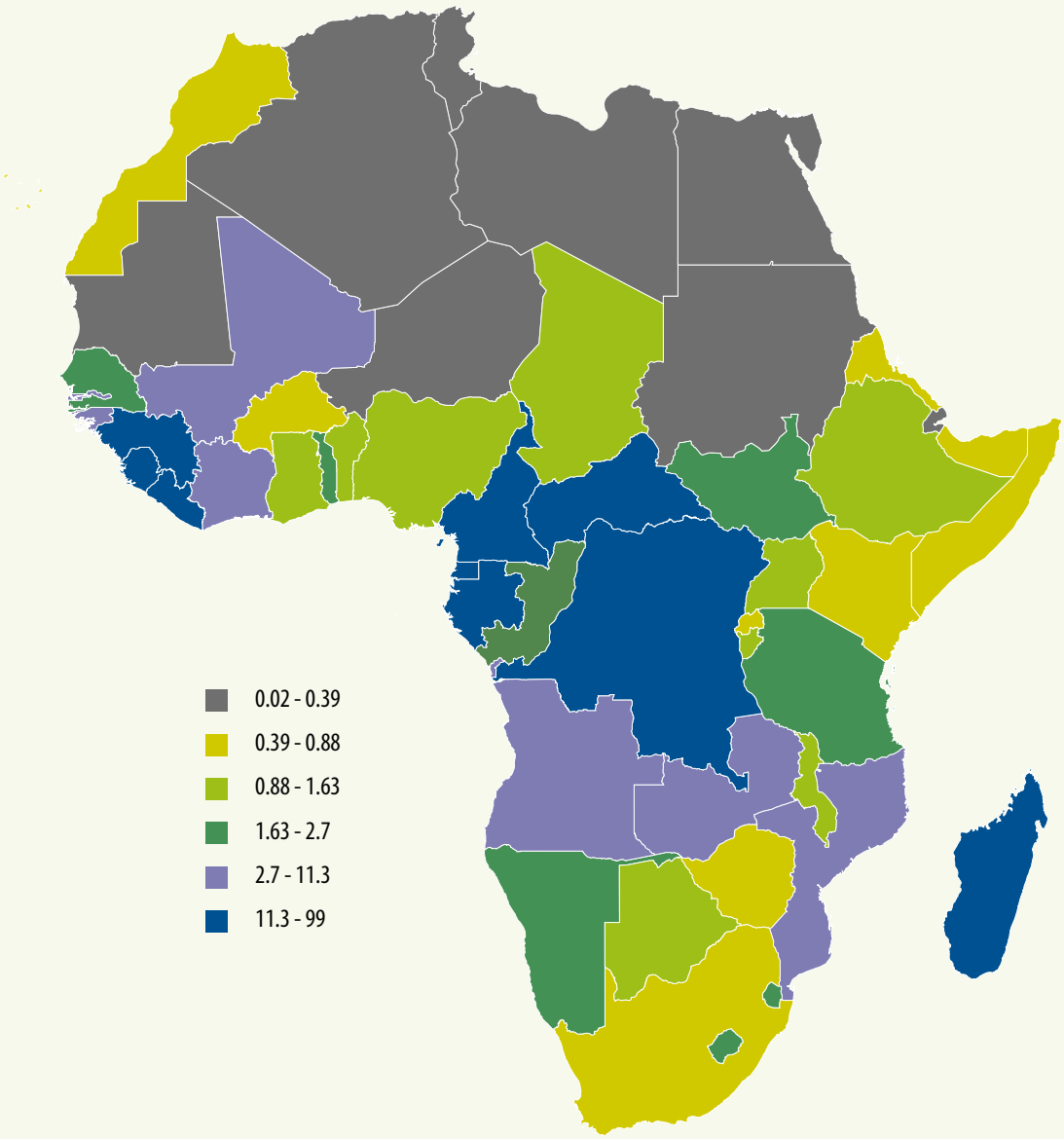
READY ENERGY IS SCARCE AMID AN ABUNDANCE OF RENEWABLE ENERGY RESOURCES

Africa is blessed with bountiful energy potential—much of it renewable—but needs investment to unlock supplies that meet people's hunger for electric power. A great deal of policy on energy generation in advanced economies has focused on the need to reduce carbon emissions, and that focus has promoted major investments in developing and deploying renewable energy.

From the perspective of low- and middle-income economies, such as those in Africa, the renewable energy agenda offers important further economic advantages. In most African economies, imports of carbon-based energy are a major drain on foreign exchange, and the volatility in prices

generates potential disruptions in fuel supply and distribution systems (as in Malawi; Chapter 6). The facilities to produce renewable energy are generally smaller than those for carbon-based generation, and they offer the combined advantage of decentralized production and off-grid access that supports greater social inclusion and security in supply. Off-grid renewables reach low-density populations across much of Africa, providing access to electricity in regions that were otherwise unlikely to gain access to grid supplies in the near future. The roll-out time for renewables is quick, requiring much less basic infrastructure than does energy generation based on fossil fuels and hydropower (Rwanda; Chapter 6). Renewable energy production also tends to be more employment intensive than traditional forms of energy generation (ILO, 2016). Finally, although renewable energy has traditionally been more expensive than carbon-based energy, the steep fall in prices

FIGURE 4.3 RENEWABLE INTERNAL FRESHWATER RESOURCES PER PERSON (1,000 CUBIC METRES)



SOURCE: WORLD BANK (2015).

of photovoltaic panels (shown in figure 4.2) is making renewable energy cost competitive with high carbon sources in many countries. However, the take-up of renewable energy has been hindered in some countries by a policy regime that favours traditional, large electricity generating systems. Government action to address such hurdles is central to supporting investment in decentralized, smaller, renewable systems.

While the deployment of solar power has seen enormous growth in Africa, they are by no means the only significant source of renewable energy for the continent. Morocco has established an enormous concentrated solar power scheme, and Kenya has made major investments in geothermal power and also has the largest wind-powered array of turbines on the continent (Chapter 6). For decades, hydropower has been a major source of the baseload electricity supply for many African countries, and further large schemes are under construction. The combination of low rainfall, sediment from soil erosion, and fiercer competition for water, however, is causing major problems for hydropower generation in several African countries (box 4.6). Further investment is needed to incorporate climate uncertainty and better land management into the future design of big dams.

WATER CONSTRAINS AFRICAN GROWTH

The greening of industry and the wider economy often has been conflated with meeting carbon-reduction targets and lowering energy imports. Looking to 2050, though, water scarcity is the unacknowledged crisis confronting social, economic and political development in many economies. Water is the source of life and feeds directly into everyone's basic needs—rural and urban, producers and consumers—in all sectors of the economy. Even without the disruption to supply that will inevitably result from climate change, current levels of water abstraction in many regions are more than twice as high as those that offer long-term security of the supply.

Availability and volatility of the water supply in Africa vary hugely (figure 4.3). In North Africa, for example, the low rainfall and drying climate are leading to an absolute water shortage and, although extensive underground fossil water reserves exist, too great a reliance on such sources will place people and production at jeopardy in the near future. Much of Central, East and West Africa, by contrast, has substantial bodies of water—from rainfall, groundwater and rivers—that could be used for domestic and production purposes. The missing component is adequate infrastructure to capture and make more effective use of the resource and to ensure that it is channelled into high-value activities. Throughout Africa, little attention is paid to pricing water, which leads to misallocation and waste, and few, if any, controls limit the use of groundwater. Hence, Africa's water supply requires vast increases in investment and much more careful management if it is to meet the demands of a growing economy and population (Chapter 5).

Addressing water scarcity for greening industrialization requires complex and demanding policy responses. Because water provides the basis for life and survival, the scarcity, pollution and poor quality of water can generate strong political responses sub-nationally (sectors, locations and users) and between neighbouring countries. Water-scarce economies often show conflicting needs, as final consumers and agricultural producers compete for the same scarce resource. In Africa, agriculture gets the lion's share of water, for irrigation, with industry and domestic consumers sharing the remaining 15–20 per cent (UNESCO, 2009 p.99). Some irrigated crops are highly water intensive for both crop production and processing, such as cotton, which requires 4,000 cubic metres per ton of crop harvested and 9,980 per

ton of finished textile, and fruits, vegetables and nuts, with almonds requiring 8,000 cubic metres for raw nuts, and 16,000 cubic metres per ton of shelled and peeled product (Mekonnen and Hoekstra, 2010). Countries facing water scarcity have important questions to resolve about how best to maximize the value from a limited water supply and about investing in much better water management. Morocco and its Green Plan aims to achieve savings of 20-50% water savings through a shift from furrow to drip irrigation, and improved public irrigation canal networks (EIB, 2015).

Coupled with changing rainfall patterns, competition for water has led in recent years to a water crisis in the Zambezi River Basin where, among other impacts, Victoria Falls has seen lower water volumes (box 4.6). The problems of water spanning national boundaries provide an additional layer of complexity.

BOX 4.6 DAMS AND IMPACTS OF COMPETITION FOR SCARCE WATER

In Zambia in recent months, ZESCO (the national electricity utility) has been increasing its rationing of electricity throughout the country as a result of insufficient water in the reservoirs at Lake Kariba and Itezhi Tezhi because of below average rainfall in the 2014/15 rainy season. At the end of December 2015, Kariba reservoir was about 14 per cent full, compared with 51 per cent a year earlier, and hydropower generation was at a minimum. Power cuts now average 10–14 hours a day, affecting industries, commerce and domestic customers. If the dry spell continues, it is likely to force a shutdown of hydropower plants (Business Report, South Africa 11 January 2016).

Low rainfall amounts and overuse of water by Zambia and Zimbabwe—the countries that share Lake Kariba—have caused water levels in the lake to drop, and electricity generation in Zambia has fallen by more than one half in a country that is 95 per cent dependent on hydropower for its electricity. This has led to public outcry and anger against the national utility, necessitating a fuller investigation of the cause (EIZ, 2015). Without a transboundary water management institution taking an effective lead, ZESCO assessed matters and concluded that both the low drought-related inflows (2014/15) and over-abstraction by the power plants at the Kariba Complex were the main factors. Tourism has been affected, with a fall in the amount of water going over the typically spectacular Victoria Falls. Mining companies in Zambia—Africa's second-biggest producer of copper—have had to reduce electricity use and buy expensive imported diesel fuel at a time of job losses and mothballing of mining operations.

Other hydropower investments around the Zambezi Basin, such as Batoka, are also failing to meet expected returns on investment, a trend likely to worsen as El Niño, exacerbated by climate change, continues to grip Southern and Eastern Africa.

In North Africa, a major loss of hydropower capacity has been caused by sedimentation of the reservoir because of soil erosion in the catchment area. In Morocco, many dams have lost 10–40 per cent of their capacity since construction, and some are now filled with silt. Similarly, in the Rift Valley, the Koka Reservoir in Ethiopia is threatened by siltation. Dredging is possible, but it is extremely expensive. In the future, hydropower investments must be more carefully designed and planned. Beyond sedimentation, hydropower—representing a good baseload supply of low-carbon energy—is also vulnerable to increasing rainfall volatility.

Improved transboundary water governance to manage dams and river basins is the solution to competing priorities between nation states so that they can agree on a process for managing scarcity. At the national level, priorities for the use of scarce water require careful thought for the long-term consequences of such trade-offs.

4.3 ENTRY POINTS TO EMBED GREENING IN INDUSTRIALIZATION

The greening of industrialization can become reality in Africa via four major entry points: changing price incentives; regulating environmental standards; greening public infrastructure; and reducing the resource intensity of industrial growth, a process called "decoupling".

CHANGING PRICE INCENTIVES—SHIFTING FROM FOSSIL FUEL SUBSIDIES

Energy is a critical environmental input to the industrialization process. It provides the motive power for machinery, enables delivery of multiple inputs into production, is required in the processing of industrial outputs and is critical to the distribution and use of industrial goods and services. Industry uses a variety of energy sources, and its choices are largely determined by price. The greening agenda, which focuses on mitigating global warming and climate change, requires a sharp cut in the use of fossil-fuel energy sources in the absence of efficient capture and sequestration of all greenhouse gas emissions.

Energy pricing should, in principle, cover three sets of costs. The first set is the *capital cost* of providing the energy-generating capacity, which includes the cost of infrastructure, the cost of equipment and the cost of construction. The second set includes those costs involved in running the capital equipment—the *recurrent costs* of production. Finally, the third set, and the most difficult one to measure, are the *environmental externalities* generated in energy production and use. These costs include a welter of tangible and intangible spillovers, ranging from carbon dioxide emissions (which generate global climate change) to various pollutant emissions (which blight many urban lives).

The greening agenda, ... , requires a sharp cut in the use of fossil-fuel energy sources in the absence of efficient capture and sequestration of all greenhouse gas emissions.

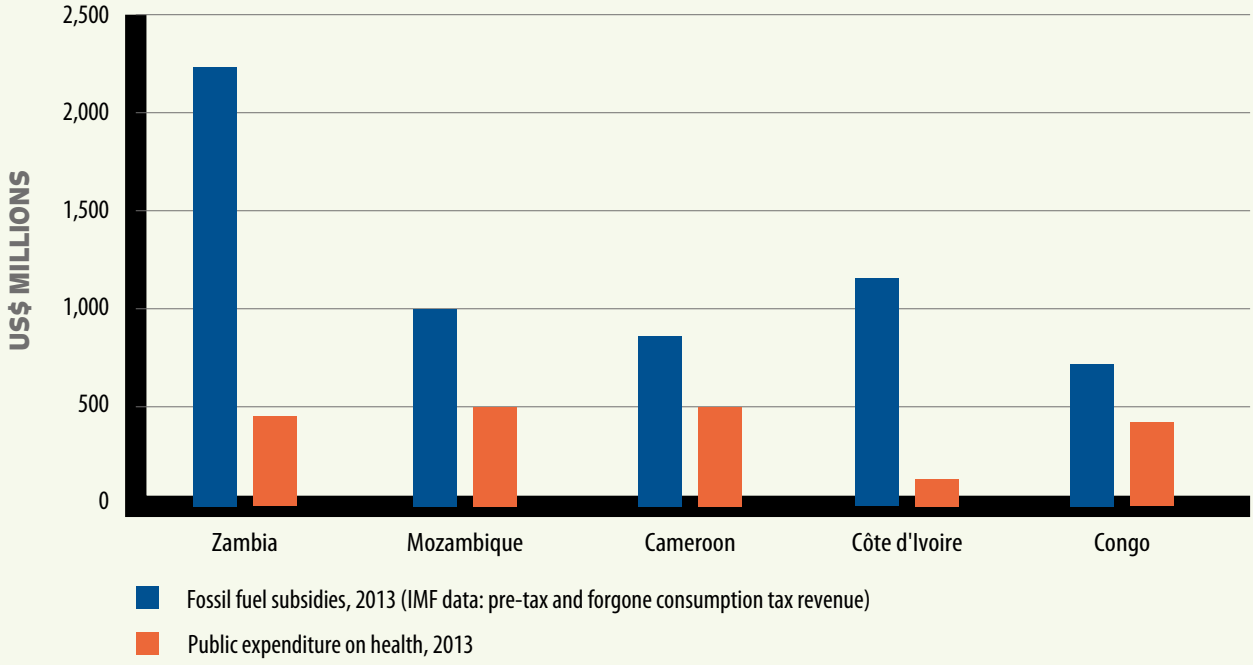
The pricing problem arises because most countries gear energy pricing primarily to meet the recurrent costs of production. Many of the capital costs are subsidized by a range of mechanisms, and in most countries the full depreciation cost is not factored into energy prices. Equally, very few countries have built externalities into the pricing of energy, although with growing awareness of the dangers of climate change and the health costs of pollution, this is beginning to change. The political shock in the United States (US) and Europe from carmaker Volkswagen's falsified emissions data has brought much greater awareness of the health costs associated with diesel vehicle emissions. It highlighted the need to take action to limit people's exposure to particulates—by regulation, price rises to shift away from use of diesel-powered vehicles, and by ensuring that energy prices include funds to repair the estimated social and environmental damage caused.

The International Monetary Fund (IMF) has laid out the heavy cost to government budgets of fossil-fuel subsidies. It estimated the total cost of fossil fuel subsidies globally to be the equivalent of $5.3 trillion (6.5 per cent of global GDP). The IMF notes that fossil fuel subsidies damage the environment, causing premature deaths through local air pollution, exacerbating congestion and other adverse side effects of vehicle use, and increasing atmospheric greenhouse gas concentrations (IMF, 2015). Fossil fuel subsidies also impose steep fiscal costs, which must be financed by a combination of higher public debt, higher tax burdens, and crowding out of potentially productive public spending (on, for example, health, education and infrastructure), all of which can slow economic growth. Fossil fuel subsidies discourage needed investments in energy efficiency, renewables and energy infrastructure and increase the vulnerability of countries to volatile international energy prices. Finally, fossil fuel subsidies are a highly inefficient way to help low-income households because rich households typically capture most of those benefits.

By comparison, the International Energy Agency (IEA) (2014b) estimates that subsidies to low-carbon and renewable energy amounted to $121 billion globally—a tiny sum compared with fossil fuel subsidies. The urgent need to reduce greenhouse gas emissions emphasizes the clear need to level the playing field and ensure that fossil fuel production and consumption bear the true cost of use so that governments no longer favour exploration, production and consumption of high-carbon fuels.

In Central, East, Southern and West Africa, estimates of fossil fuel subsidies—including subsidies related to electricity—for 30 countries were $32 billion for 2013 (Bridle, Kitson and Wooders, 2014). Countries providing subsidies for fossil fuels worth more than $1 billion in 2015 include Angola, Côte d'Ivoire, Mozambique, Nigeria, South Africa,

FIGURE 4.4 PUBLIC HEALTH EXPENDITURE AND FOSSIL-FUEL SUBSIDIES IN FIVE AFRICAN COUNTRIES, 2013



SOURCE: WHITLEY AND VAN DER BURGH (2015).

Tanzania, Zambia and Zimbabwe. Several North African countries exhibit much greater levels of fossil fuel subsidies, measured as a percentage of GDP. Fossil fuel subsidies in Egypt are reported to be among the highest in the world, as a share of GDP, reaching 10.2 per cent in 2012, or $16.9 billion (IEA, 2014a). Although the motivation on the social side may have been to provide the population with access to affordable energy, the benefits accrue primarily to the well-off (Bridle, Kitson, and Wooders, 2014).

Comparing the amount of government spending on fossil fuel subsidies with that on health is a somber exercise (figure 4.4). The enormous differences show how fuel subsidies tend to become locked into government spending—because of their political sensitivity—and are rarely reviewed relative to other expenditure. In the past three years, however, governments in Angola, Nigeria and Uganda have made efforts to cut fuel subsidies, often phasing in such changes and providing targeted assistance to poorer sections of the population.

REGULATING ENVIRONMENTAL STANDARDS

Government regulation is intended to tackle the social and environmental damage generated by productive activity. Because public authorities have a responsibility to represent fairly the interests of current and future citizens, they must find ways to correct market failures, ensure a fair balance between the interests of different groups and achieve a level playing field with rules that apply to all. In greening industrialization, the principal regulatory measures open to governments include the following:

- Setting standards for products, such as energy efficiency for electrical goods and fuel efficiency for cars and lorries;

Government regulation is intended to tackle the social and environmental damage generated by productive activity.

- Setting standards for air and water quality, which oblige enterprises to address the pollution they generate and to clean up the air and water they use before releasing it back to the atmosphere and rivers; and
- Establishing regulations for handling chemicals, waste, oil spills and other hazardous materials.

Regulation has the particular merit of setting a clear standard for an environmental good or service against which performance can be measured, but its effectiveness depends on credible enforcement. Enterprises must know that they will face sanctions if they breach the limits. An effective system for monitoring and enforcement is thus critical. Where regulation is weak, the law fails, often because of limited numbers and quality of staff and equipment and the potential for bribery, as businesses pay enforcement agencies to ignore breaches. Achieving regulation of the informal sector is especially difficult given the very large number of small enterprises and the absence of documented business ownership.

Limits to regulation have led governments to turn to other measures, such as creating incentives for private sector investment in energy supply by offering assured tariffs for renewable energy; investing in R&D; and encouraging universities to set up centres for joint technology development with local enterprises, to "incubate" new businesses. Governments can also use their own funds to promote greener products through green public procurement. In construction, for example,

governments can set targets for energy conservation, forcing building firms to achieve higher standards for energy efficiency.

GREENING PUBLIC INFRASTRUCTURE

The "greening" of public infrastructure means taking a more holistic approach to its design and finance and integrating climate resilience into its construction and standards. There are big plans to expand public infrastructure across the continent. In addition to PIDA, some of the regional economic communities have infrastructure plans and strategies to support industrialization (for example, SADC's Regional Infrastructure Development Master Plan, 2012), and many countries (such as Ethiopia and South Africa) have ambitious infrastructure development plans. The combined investment of these plans amounts to more than $500 billion—to address the existing infrastructure deficit and to ensure the scale of infrastructure to support industrial growth. All these plans have the added advantage of creating jobs while stimulating growth; for example, South Africa's Expanded Public Works Programme (2014–2019) was designed with as many as 6 million jobs by 2019 (South African Government, 2015).

The greening of Africa's infrastructure offers an immediate and longer-term opportunity to leapfrog because the infrastructure deficit is so great that, ... , Africa can avoid the expensive and difficult business of retrofitting current assets.

The greening of Africa's infrastructure offers an immediate and longer-term opportunity to leapfrog because the infrastructure deficit is so great that, in starting from a low base, Africa can avoid the expensive and difficult business of retrofitting current assets. Instead, the continent can build to leading-edge standards based on the latest information and practices, which consider the expected impacts of climate change not only on resource availability but on infrastructure assets. In planning for a different future, the two primary considerations for investing in green infrastructure are *environmental decoupling* — reducing the resource intensity of growth — and building *climate-change resilience*.

On the first point, Africa is reaching its environmental boundaries and faces a crucial need to reduce the effects of its development pathways (Chapter 5). Because of the lumpy investment that infrastructure projects represent and the lock-in effects they induce once the asset is built, long-lived infrastructure projects must be part of the continent's decoupling strategy over the long term and thereby support sustainable economic growth and access to services. Strategic environmental assessments and environmental impact assessments will be key in making the right choices in greening Africa's infrastructure.

On the second point, although infrastructure is crucial in fostering development, it is also highly vulnerable to the destructive impacts of climate events and natural disasters. Planning for and building climate-resilient infrastructure are essential to avoid "stranded assets" and to minimize climate damage to Africa's infrastructure (and the people using it). Roads and bridges in Africa's flood-prone regions are routinely washed away, having to be rebuilt at a steep cost. Dams and their facilities on the continent are facing closure given the El Niño, a threat that is compounded by the growing impacts of climate change, which are felt most keenly in Southern and Eastern Africa. Some

of these big, expensive investments already are becoming stranded, losing most of their value as climate impacts bite. Africa's infrastructure investments must integrate climate change risks and opportunities with their design, management and operation, essentially, "climate proofing" (AfDB, 2015).

Adapting infrastructure in this way helps to reduce the physical damage to assets and interruptions in services while yielding benefits such as greater energy security, biodiversity and water conservation, and reduced greenhouse gases. Moreover, climate proofing through expanded public works programmes can stimulate job creation, promote green jobs and skills, and transfer this knowledge to other sectors.

Africa's high and accelerating rates of urbanization accentuate the need to ramp up the greening of urban infrastructure through environmental decoupling and climate proofing (Chapter 5). Cities around the world have been central actors in stimulating green infrastructure. In Africa, city governments are key to designing the hardware of city infrastructure, the building standards for private investors and the broader software of urban systems. Africa's municipal authorities have growing knowledge of what they can achieve by rethinking how they design buildings; public spaces; and energy, water, transport and waste systems. The city of Durban, South Africa, shows what can be done by careful planning for resilience to climate impacts in ways that generate jobs and security for the urban poor. Starting in 2004, Durban's Municipal Climate Protection Programme has prioritized the need to tackle the challenge of climate risk within the context of poverty, escalating urbanization and deteriorating environmental conditions, and has become a national and international leader in the field of climate change adaptation planning and implementations (Roberts, 2008). It has done this by integrating concern for climate change across the urban, peri-urban and rural areas within the local government boundaries, and enhancing the contributions of natural capital and ecosystem services to adaptation, mitigation and disaster risk reduction. The environmental sector has been able to show the city government that greening the city can generate good jobs, and thereby build firm political support for climate action. Durban's government has developed more capacity than some better resourced cities, but it also has other pressing development priorities that can make the necessary commitment to adaptation and mitigation difficult (Roberts and O'Donoghue, 2013).

Given expected huge urban growth, cities hold the key to generating greater ecological sustainability and represent another leapfrogging opportunity for Africa. As the continent shifts to having 55 per cent of its people in urban areas by 2050 (Chapter 5), city planning will need to meet this challenge through greening its public and ecological infrastructure with ambitious energy and water use reduction targets, best-practice urban planning, and innovative technologies. Jobs, enhanced skills and social inclusion are major co-benefits of this process.

DECOUPLING INDUSTRIAL GROWTH FROM ENVIRONMENTAL IMPACTS

CONCEPTS AND DATA

A primary objective for green growth is to reduce the use of environmental inputs, particularly energy and water, and minimize harmful pollution discharges by decoupling. Decoupling takes two forms (figure 4.5). *Absolute decoupling*, which is desirable but rare, implies a constant or absolute reduction in inputs despite growth in output. *Relative decoupling*, which is more common, implies positive growth in inputs or pollutant discharge but slower than the growth in output.

Ideally, the assessment of decoupling requires baseline data on resource use, preferably by country and industry. The decoupling of energy and materials use from industrial output requires a timeline of how they have changed. For any given country, the intensity of resource use, whether energy or water, is a function of population, land mass, infrastructure, technology development, economic development and industry mix. Thus, practical analysis of the intensity of energy and water use is generally expressed as a series of ratios: energy or water use per capita, or as a share of GDP or manufacturing value added (MVA). These ratios can be used to assess the trajectory of resource intensity in the economy over time and among countries or regions.

Efficiency is a concept separate from intensity and is a measure of the ratio of inputs to output for an activity or process. An efficiency gain is achieved either by a reduction in inputs for the same level of output, an increase in output for the same inputs, or a reduction in pollution for the same level of output. Ideally, efficiency gains should also capture qualitative changes in inputs or outputs, but they rarely do so. Industrial greening should be reflected over time as an upward trend in the efficiency with which materials and energy are used at the industrial or plant level.

Although the essential elements of the decoupling objective are clear and help to inform policy choices, data constraints hinder capacity to measure decoupling in its various dimensions. One problem is that many of the data on output are a gross measure of value added in the economy (for example, MVA). Second, the patchy data on gross output and value added often are at very high levels of aggregation, usually at the two-digit ISIC (industry) or SITC (trade) levels. Hence, the chemicals sector in one country at this level of aggregation may hide very large differences in the composition of activity and output within the sector and over time, making a comparison of that sector across economies and between two periods very hard.

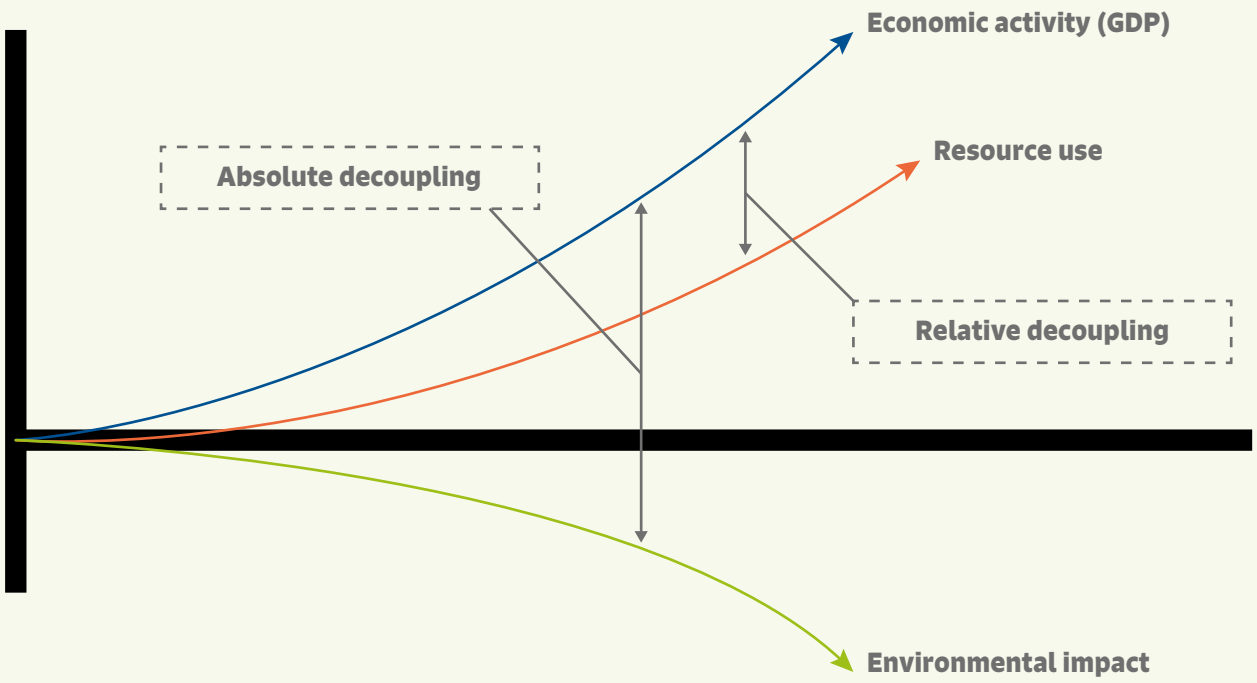
A third and related problem is that many countries that report "progress" in decoupling may in fact merely have shifted the resource-intensive stages of their value chains abroad. Ideally, therefore, the decoupling measure should focus on resource use per unit of consumption rather than per unit of recorded production in an economy. Such measures are unavailable on an economy- or sector-wide basis, however. Fourth, although these data limitations apply to all economies, in Africa data are particularly inconsistent (Jerven, 2013), so measuring the progress of decoupling is harder still.

Finally, whereas data for energy use and carbon emissions exist, little or no data are available for water use and pollution. The production and cleaning processes in the iron and steel, textiles, leather, pulp and paper, and chemical sectors, among others, pose a severe threat to human health and water resources in several African countries. Some data are available at the plant or enterprise level,[2] but little quantitative evidence exists at the economy-wide level.

DECOUPLING FROM ENERGY USE: HOW DOES AFRICA COMPARE?

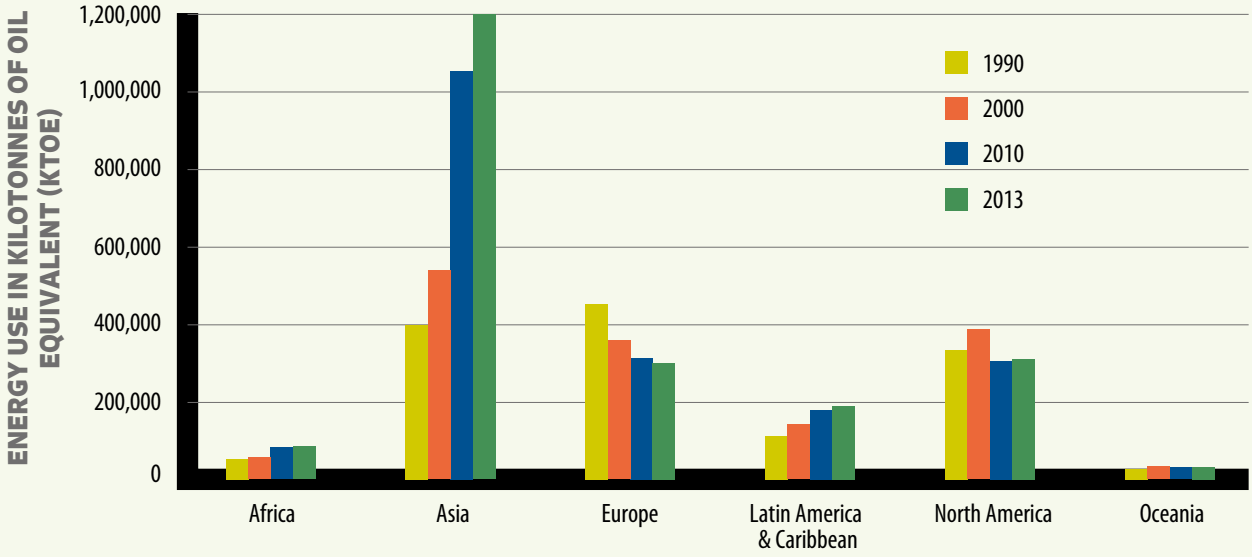
The world increased its total industrial energy consumption by about 60 per cent from 1990 to 2013. Most of the increase occurred in Asia, whereas Europe and the United States showed some degree of absolute energy decoupling in their productive sectors (although not necessarily in their consumption patterns because energy-intensive imports increased) in the 1990s and stabilization after 2000. In the same period, total energy consumption in Africa increased at a similar rate to the global average—60 per cent—although starting from a very low base (figure 4.6).

FIGURE 4.5 ABSOLUTE AND RELATIVE DECOUPLING



SOURCE: UNEP (2011).

FIGURE 4.6 GLOBAL ENERGY USE BY REGION (000 TONS OF OIL EQUIVALENT), 1990–2013



NOTE: KTOE = KILOTONNE OF OIL EQUIVALENT.

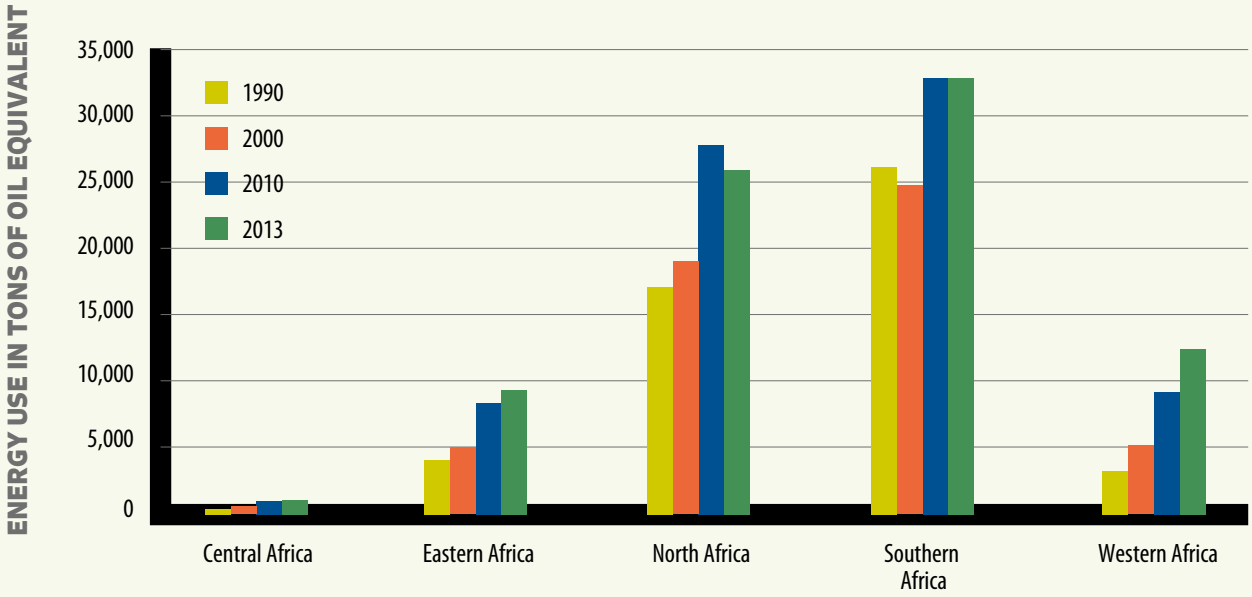
SOURCE: IEA (2015a, 2015b)

From 1990 to 2013, both the world economy and Africa recorded relative decoupling (table 4.1)—energy use rose at a slower rate than total output, as shown by falling energy intensity. Relative decoupling appears far higher for Africa than for the Asian and the Latin America and Caribbean regions. Although African energy intensity fell from 0.73 in 1990 to 0.64 in 2013, it remains the highest in the world, at 2.6 times the world average in 1990 and 2.7 times the world average in 2013, which suggests that Africa can save huge amounts of energy by introducing more energy-efficient technologies.

Among the five African regions, Southern Africa had the highest industrial energy consumption in 2013, of which South Africa accounted for 80 per cent and one third of Africa's total (figure 4.7). Countries with a higher degree of industrialization (South Africa and the North African countries) generally had the highest levels of energy use but lower levels of energy growth. In contrast, less industrialized regions experienced ever-increasing energy use over the same period, as reflected in their lack of decoupling. This pattern of energy growth is predictable because poorer countries establish greater levels of economic activity, and those with a stronger industrial sector seek to improve energy performance.

Table 4.2 shows selected African countries, ranked by their decoupling performance, from 1990 to 2013. Egypt, Tunisia, South Africa and Morocco—the four countries with the highest improvements in relative decoupling (that is, a negative relative decoupling index (RDI))—were also the top four countries for MVA in 2013. Although a definite correlation between relative decoupling and MVA or GDP could not be found for those African countries with the relevant data, the ranking of countries in Table 4.2 suggests that relatively strong economies in terms of GDP and MVA achieved the greatest decoupling between 1990 and 2013.

FIGURE 4.7 ENERGY USE, BY AFRICAN REGIONS, 1990–2013 (IN TONS OF OIL EQUIVALENT)



SOURCE: IEA (2015a).

TABLE 4.1 RDI AND ENERGY INTENSITY, REGIONAL AND GLOBAL, 1990–2013

	RDI	Energy intensity	
Region	1990 — 2013	1990	2013
Africa[1]	-0.12	0.73	0.64
Asia	0.03	0.31	0.32
Europe	-0.47	0.22	0.12
Latin America & Caribbean[2]	-0.01	0.37	0.36
North America[3]	-0.45	0.30	0.17
Oceania[4]	0.01	0.33	0.33
Total World	**-0.15**	**0.28**	**0.24**

1 28 countries out 54.
2 22 out 44 countries.
3 2 (USA, Canada) out 5 countries.
4 2 (Australia, New Zealand) out 26 countries.

SOURCE: IEA (2015a), UNIDO (2015a).

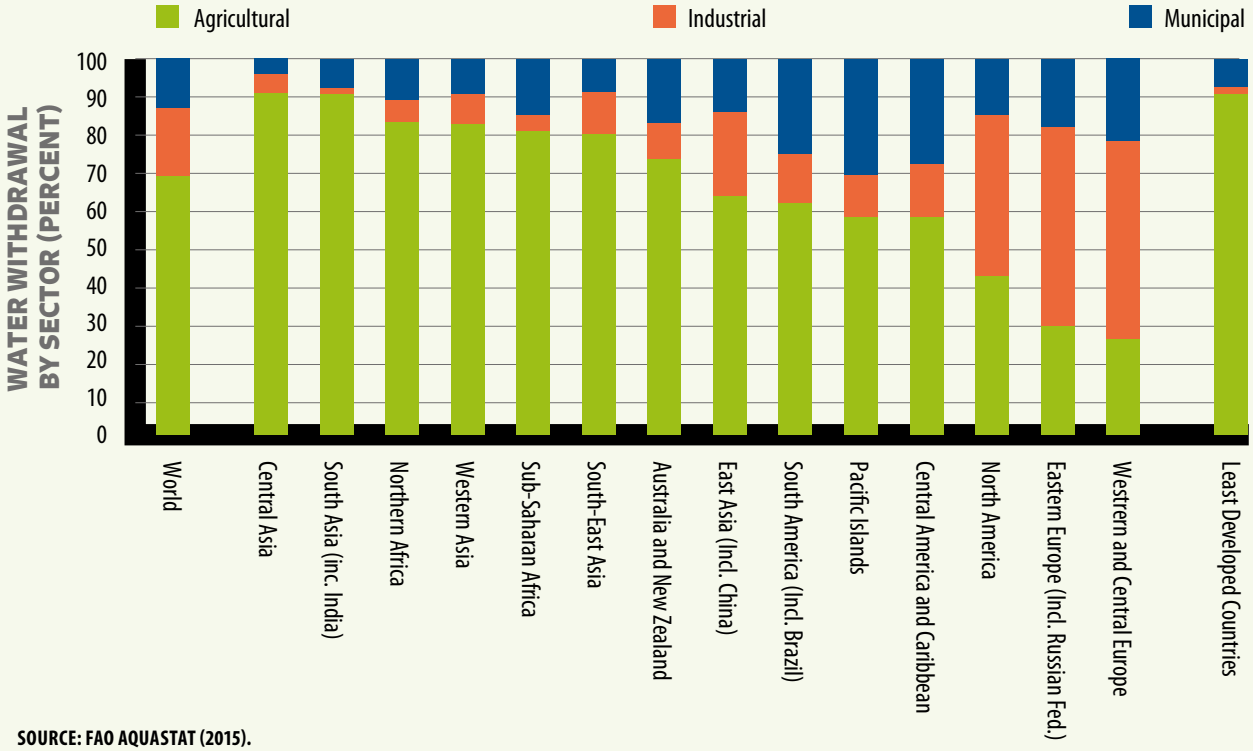
TABLE 4.2 RDI AND ENERGY INTENSITY, SELECTED AFRICAN COUNTRIES, 1990–2013

	RDI	Energy intensity	
Territorial Unit	1990 — 2013	1990	2013
World	**-0.15**	**0.28**	**0.24**
Africa[1]	-0.12	0.73	0.64
Egypt	-0.54	1.46	0.75
Tunisia	-0,40	0.51	0.32
South Africa	-0.21	0.71	0.61
Morocco	-0.12	0.33	0.28
Kenya	-0.05	0.39	0.47
Ghana	0.51	0.69	1.02
Nigeria	0.73	0.98	1.50
Senegal	0.83	0.15	0.26
Ivory Coast	0.90	0.08	0.15
Ethiopia	0.93	0.49	0.75

1 includes all African countries with available data.

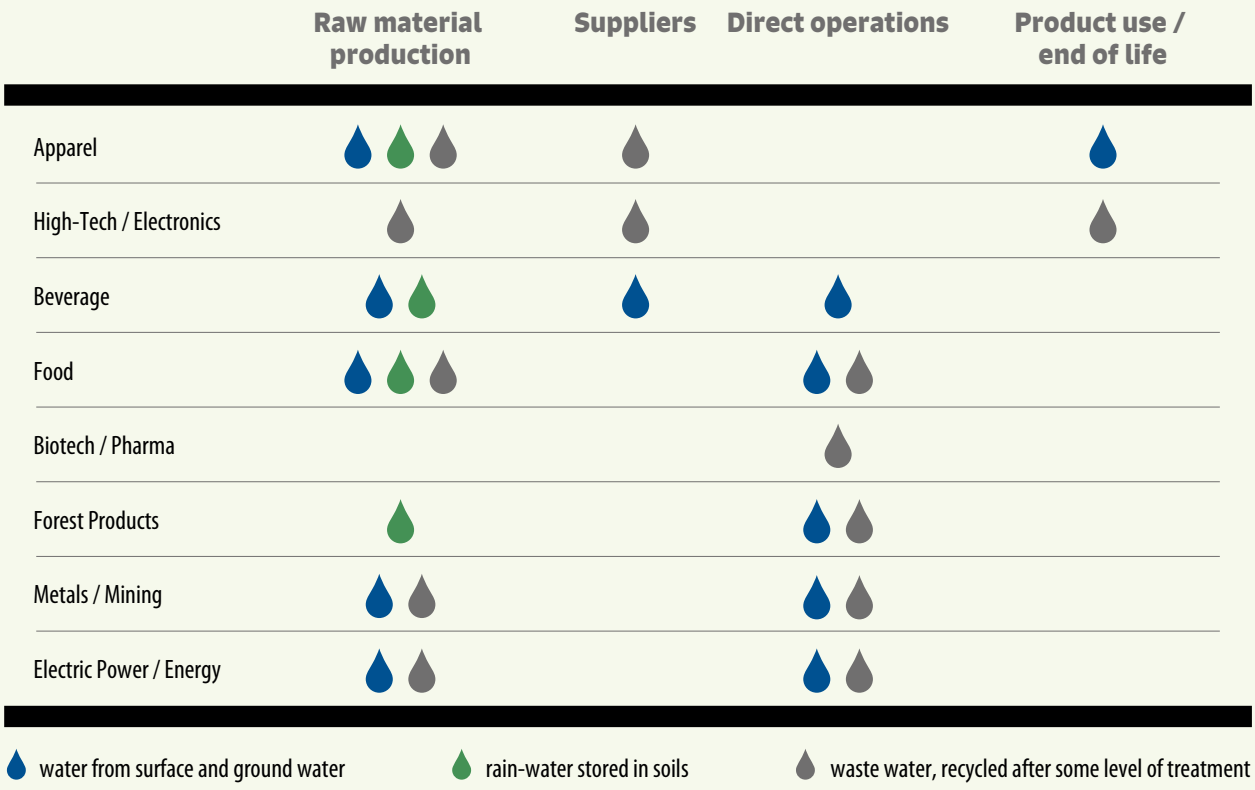
SOURCE: IEA (2015a) AND UNIDO (2015a).

FIGURE 4.8 WATER USE, BY GLOBAL REGION AND SECTOR, 2010



SOURCE: FAO AQUASTAT (2015).

FIGURE 4.9 RELATIVE WATER INTENSITY BY INDUSTRIAL SECTOR, GLOBAL



NOTE: WATER DROPS INDICATE THE VALUE CHAIN SEGMENTS THAT HAVE RELATIVELY HIGH BLUE, GREEN AND GRAY WATER FOOTPRINT INTENSITIES. BLUE REFERS TO WATER FROM SURFACE AND GROUND WATER; GREEN REFERS TO RAIN-WATER STORED IN SOILS; GRAY IS WASTE WATER, RECYCLED AFTER SOME LEVEL OF TREATMENT.

SOURCE: MORRISON ET AL., (2009), TABLE 3, P. 20, CITED IN UNESCO (2015), P. 62.

By contrast, Ghana, Nigeria, Senegal, Côte d'Ivoire and Ethiopia experienced an increase in their relative energy use over the period. The aggregate nature of the data, however, prevents one from concluding whether the figures reflect a deterioration in energy efficiency or a shift into more energy-intensive sectors.

INDUSTRIAL WATER-USE DECOUPLING IN AFRICA

Surprisingly little is known about industrial water use globally, especially in Africa. Although industrial water consumption accounts for about 20 per cent of the world's freshwater withdrawals, the proportion varies greatly among regions (figure 4.8). Those shares are only approximate, however, because water withdrawal by small and medium-sized industry often is conflated with domestic consumption (UNESCO, 2012, p. 59). In Africa, industrial water withdrawal accounts for about 5 per cent of the total, with agriculture using 85 per cent and human settlements 10 per cent (UNESCO, 2009, p. 99). This breakdown is consistent with the economic structure of the continent, given that much of the population still works in agriculture.

The production processes of some industrial sectors common in the African industrial landscape are water intensive, including apparel, beverage, food, and metals and mining (figure 4.9). The quality and coverage of the data do not permit an estimation of aggregate water use in Africa as a ratio of MVA, as was done for energy in table 4.2. An analysis of water use at the firm or plant level, however, suggests that considerable gains can result from large cuts in water use and effluent flows, offering payback periods of less than two years (Chapter 6).

4.4 GREENING INDUSTRIALIZATION AT THE SYSTEM LEVEL

Large gains in decoupling can be achieved by promoting greater resource efficiency at the establishment level, whether the manufacturing plant, farm or office (as will be shown in Chapter 6). Cleaner Production Centres, such as those established by UNEP and UNIDO in many African and Asian nations, have been instrumental in achieving these improvements. Although establishment-level changes are important, they meet only part of the systemic green industrialization challenge. Four categories of systems can be identified, as follows: environmental systems and landscapes; infrastructure; inter-sectoral and inter-ministerial systems; and value chains.

ENVIRONMENTAL SYSTEMS AND LANDSCAPES

Environmental assets, such as water courses, are inherently systemic. Rain falls in a particular region, from which it may be collected or from which it might flow through riverine channels over large distances. These courses may span very large areas, characteristically crossing a number of national boundaries. The Niger River, for example, is longer than 4,000 kilometres, its wide basin of tributaries covering nine riverine nations, as it runs from the mountains of Guinea to the Niger-Delta region of Nigeria (figure 4.10).

FIGURE 4.10 TRANSBOUNDARY WATER BASINS: WEST AFRICA'S NIGER RIVER

SOURCE: WIKIPEDIA.

Africa has 63 transboundary river basins, covering 64 per cent of the continent's land area and containing 93 per cent of its total surface water resource (UNEP, 2010). It also has major transboundary aquifers, such as the Nubian Sandstone Aquifer under Chad, Egypt, Libya and Sudan.

Water resource users come from households, fisheries, agriculture, industry, mining and infrastructure. Because water is a finitely constrained resource, its use in one part of the system affects its use in another part. Similarly, waste effluents released into the river at a particular place will have an effect on many other sectors and uses downstream. Groundwater exhibits similar problems of shared use and effects.

The water system is not only riverine but also involves seas and oceans, which offer resources for a range of competing activities. Hence, an increasing number of economies target the Blue Economy for income-generating opportunities and handle the systemic uses and abuses of seas and oceans (as noted for the AU Blue Economy Strategy, and as described for Mauritius in Chapter 6). Maintaining the integrity of these environmental assets against industrialization is a major challenge that cannot be met at the individual establishment level alone. Their management necessarily has to be systemic.

INFRASTRUCTURE

The same systemic approach is needed for many infrastructural inputs into production. Consider, for example, the central, eastern, southern and western coast-to-interior corridors being developed across Africa (figure 4.11). These projects are viable only when they operate at a systemic level, crossing countries and sectors. Hence, because the challenge is to promote green infrastructure and to provide infrastructure that promotes the greening of industry, infrastructural greening necessarily requires a systemic response, bringing together governance, politics, economics and practical management.

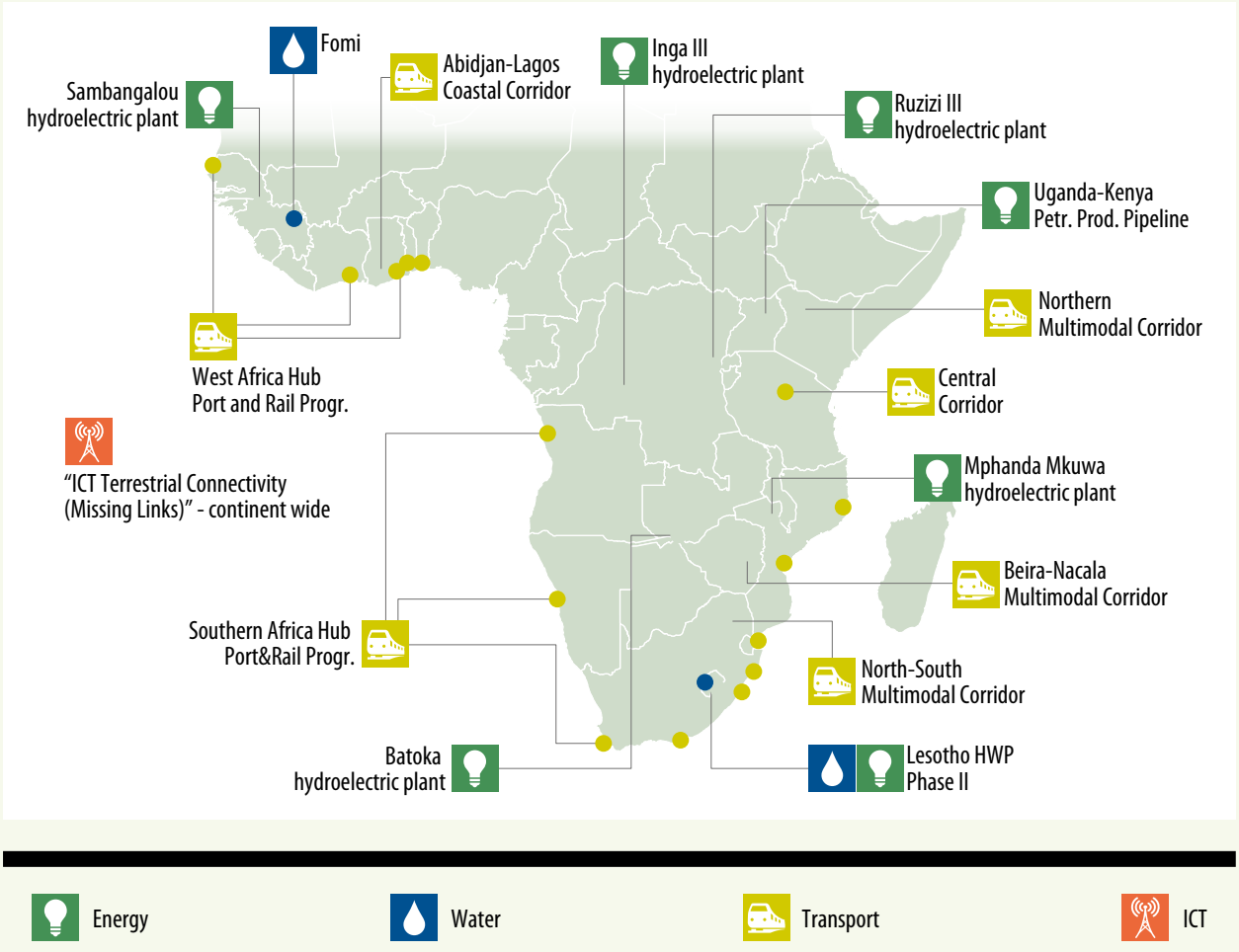
The green industrialization challenge crosses not only national borders but also individual sectors.

INTERSECTORAL AND INTERMINISTERIAL SYSTEMS

The green industrialization challenge crosses not only national borders but also individual sectors. Although decoupling in an individual factory can be seen as a focused challenge, and similarly the greening of a farm a challenge of greening agriculture, in almost all cases the greening of industrialization will require actions that cut across sectors. The problem with meeting this cross-sectoral agenda is that it generally cuts across ministerial and bureaucratic silos, too—for example, the global value chain (GVC) involved in the export of processed fruit and vegetables (figure 4.12).

Crops are produced in the agricultural sector (involving the Ministry of Agriculture), but they require inputs from the domestic manufacturing sector (Ministry of Industry), from imports (Ministry of Trade) and from knowledge-intensive institutions in the national system of innovation (Ministry of Education). Their outputs feed into the logistical sector (Ministry of Transport) and may involve government-approved certification (various ministries). Some of the output goes to the domestic market (regulation of retail) and

FIGURE 4.11 MAJOR INFRASTRUCTURAL AND DEVELOPMENT CORRIDORS, AFRICA, 2015



SOURCE: WORLD ECONOMIC FORUM (2015).

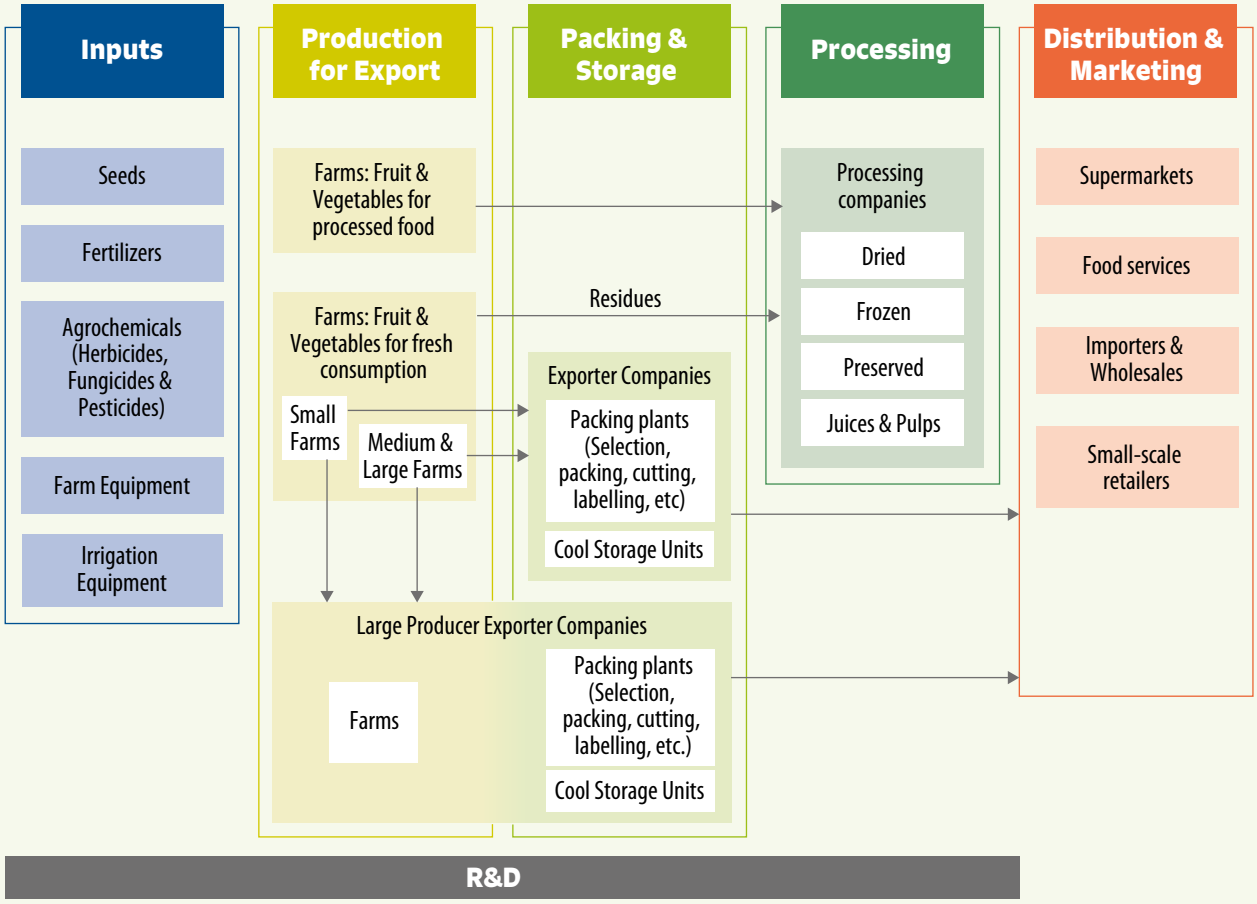
some into export markets (Ministry of Trade and Export Promotion). All this requires coordinated, systemic greening along the value chain—cutting across sectors and ministries (Chapter 6)—and at the establishment level.

VALUE CHAINS

In the remainder of this chapter we concentrate on the value chain system, a key arena for resource allocation in production. The value chain describes the full range of activities required to bring a product or service from conception, through the different phases of production (involving a combination of physical transformation of inputs and the incorporation of various producer services), delivery to final consumers and final disposal after use (see figure 4.12, although it does not include recycling and restitution of the environment after product use).

The increasing importance of value chains in recent decades follows from the growing division of labour that became pronounced in the last quarter of the 20th century, primarily specialization of businesses. Specialization means that firms focus on those capabilities ("core competencies") in which they have distinct strengths and in which they benefit from barriers to entry from other firms. All other activities are outsourced up the chain to suppliers or down the chain to users.

FIGURE 4.12 THE PROCESSED FRUIT AND VEGETABLE GLOBAL VALUE CHAIN



SOURCE: GEREFFI AND FERNANDEZ-STARK (2011).

From the early 1970s—and particularly after the mid-1980s, when China entered the global economy—this fragmentation and outsourcing took an increasingly global form, leading to the dispersion of manufacturing around the globe and the growing geographical separation of production from consumption. This pattern of global outsourcing, building on competencies in the emerging economies, but driven by the needs of large firms and retailers in advanced economies, underwrote the surge in the developing world's share in global manufacturing value added and trade. Unlike most Asian economies (especially China), which have benefited from this global dispersion of production, African economies have reaped these benefits far less.

By 2012, more than two thirds of global trade in goods and services was in intermediate products and services. The World Trade Organization estimated that a quarter ($5 trillion out of $19 trillion) of global trade in 2010 involved double-counting, that is, the value of intermediate products traded directly across national borders and indirectly, through subsequent incorporation in final products (UNCTAD, 2013; UNECA, 2014). As Chang (2015) notes, this flow of resources and revenue within GVCs represents a huge concentration of profits and power within the large multinational firms that can accrue technological dominance, brand recognition and access to low-cost capital because of the large scale at which they operate. The rising share of trade in these large firms and

the associated movement of revenue between different jurisdictions raises vital questions about where corporate profit and turnover should be taxed.

This trade occurs along two different types of GVC (Kaplinsky and Morris, 2015). The first type is "vertically specialized chains", in which the different components can be produced in parallel, transport costs are relatively low and intermediate products do not degrade. These are largely characteristics of manufacturing and service value chains, in which the value added gained from the developing country component often is small. For example, the Apple iPhone4 was exported from China at a free on board price of $175 but incorporated only $6.50 of value added in China; the remainder consisted of imported intermediate components (Xing and Detert, 2010). The second type of GVC is "additive value chains", in which the various stages of production are necessarily sequential, transport costs are high and intermediate products may degrade. These value chains are mainly in the resource sector (agriculture, minerals and metals, and energy).

From the African perspective, whereas two thirds of GVC trade is in vertically specialized chains, its contribution to African exports is less than one quarter, much of that in Egypt, Mauritius and South Africa. The overwhelming share of African exports is in additive, commodity-based GVCs; thus, their greening is particularly important in greening African economies.

Value chains are a vehicle for promoting green and inclusive industrialization in three main ways.

Any chain is only as strong as its weakest link. Production occurs along the entire supply chain, and effective greening therefore requires action within each of these links if the entire chain is to function as desired. Moreover, evidence on the ground shows that production almost always crosses sectors. Hence greening is a systemic challenge and requires actions along the whole value chain, as evidenced in research by Kemp et al., (2013) on the energy efficiency of crop-drying technologies in the cassava chain in Nigeria and the maize chain in Kenya. The findings show clear signs of more energy-efficient investments being made in crop-drying methods. If energy use in the value chain as a whole is considered, however, drying technologies represent only a trivial component. The energy wasted in inefficient logistics (for example, dirty diesel combustion in the trucks hauling produce from farm to drier)— in part, a result of subsidized fuel—is far more than any marginal gains in the crop-drying component and has largely been ignored in the greening policy agenda.

Traditionally, industrial policy has focused on developing supply capabilities; however, the character of supply chains—including their "greenness"—is shaped by final market demand. In many advanced economies, final markets demand the greening of value chains, and that is increasingly the case for middle-income markets in Africa and other emerging economies, a process sharpened by the rapid advance of global supermarket chains in Africa and elsewhere. Thus, although traditional industrial policy has focused on the growth of supply capabilities, the value chain lens forces the greening agenda to respond to the demands of different final markets (box 4.7). Because Walmart acquired MassMart (a South African retailer expanding quickly throughout Africa) in 2012, the US behemoth will likely increasingly require the greening of its African supply chains.

Because markets drive the structure of systemic supply chains, one must understand how value chains are governed (Gereffi, Humphrey, and Sturgeon, 2005). This may involve a mix of regulations (producers that fail to comply cannot be included in the supply chain) and incentives (achieving the chain goal is rewarded with higher

BOX 4.7 THE GREENING OF WALMART'S SUPPLY CHAIN IN CHINA

In 2009, Walmart announced the development of a worldwide Sustainability Product Index, which began with a survey to be completed by all Walmart suppliers. The survey consisted of 15 questions about energy use, climate impact, material efficiency, natural resource usage, and local community involvement. The surveys fed into the "Sustainability Index Consortium", an open platform database that allowed for analysis of the information collected from Walmart's 100,000 suppliers.

By 2012, 500 suppliers and 107 product categories had participated in the index. At a Global Sustainability Milestone Meeting in Beijing in 2008, Walmart's chief executive officer announced plans to expand participation to 70 per cent of suppliers by 2017, making clear that failure to participate in the index would lead to removal of the firm from Walmart's supply chain.

SOURCE: KAPLINSKY AND MORRIS (2014).

BOX 4.8 FOUR SETS OF STANDARDS WIDELY OBSERVED IN GVCS

- *Corporate standards internal to the chain.* They typically address quality, cost and delivery procedures and, increasingly, environmental processes. They specify the requirements of the lead firm (at the buying end of the chain) for supplier firms to ensure systemic chain competitiveness.
- *Industry standards.* They are industry specific or relevant across a range of sectors, such as ISO9000 on quality and ISO14000 on environmental management.
- *Standards set by governments.* They include food safety and energy efficiency, and those set by international bodies include the EU "farm-to-fork" food standards and vehicle emission standards.
- *Standards designed by civil society.* They include labour standards, organic standards and Fairtrade certification.

SOURCE: AUTHOR'S COMPILATION.

prices). The greening of chains thus necessarily requires the governance of performance along the whole chain, and chain participants are characteristically required to meet a series of complex standards, such as with the Forest Stewardship Council's certification in the timber, wood and furniture value chain (Chapter 6). Four major drivers of greening standards in GVCs are corporate standards, industry standards, government standards and standards inspired by civil society organizations (box 4.8).

The three characteristics of value chains—their systemic nature, the links between production structures and final markets, and the governance of production along the chain—have to be addressed in green industrialization. Their practical significance is shown in many of the greening case studies in Chapter 6.

4.5 KEY STAKEHOLDERS IN THE GOVERNANCE OF VALUE-CHAIN GREENING

Understanding who does what in greening establishments and systems is important if a green industrial policy agenda is to be successful. In the analysis of GVCs this is referred to as "chain governance" (Gereffi, Humphrey, and Sturgeon, 2005), but this concept of governance can be used to analyse the implementation of greening in all of the four sets of systems identified in the earlier section "Entry points to embed greening in industrialization". Essentially, two sets of chain governors exist—internal and external.

Internal chain governance is exercised by actors within the chain. In private sector–driven chains, these governors are firms, generally the "lead firms". In state-driven chains, the key decision makers include the managers of these state enterprises.

The role played by lead firms is critical in an increasing number of GVCs, including that of the greening agenda. Final market demand forces key actors in the chain to drive green standards systematically both down and up their value chains (for example, Forest Stewardship Council certification). In many GVCs, these lead firms are transnational corporations, particularly in chains in which African producers participate. In other cases, particularly in the more industrialized low- and middle-income economies, the lead firms may be locally or regionally owned.

The motivation for lead firms to pursue a greening agenda is not just a response to state regulation but also a strategy to maximize profit by reducing costs (for example, energy), penetrate more lucrative market niches (such as organic markets) and avoid reputational damage tied to poor environmental or social practices. Walmart's greening of its value chain to save costs, Tesco's greening of its horticultural value chain to avoid reputational damage, and Shell's greening of its Niger River Delta operations to maintain its social licence to operate are all examples of lead firms driven strictly by commercial interests to behave according to more ethical or environmental principles.

Not all lead firms pursue active greening, however, nor is a strong green vision of corporate leaders necessarily reflected in events on the ground. Moreover, lead firms selling in lower-income markets, in which consumers are less demanding of green credentials, have less incentive to drive greening.

The nation state generally is the prime external chain stakeholder with the capacity to green systems, often through a mix of pricing decisions, regulations and incentives. Pricing reflects the government-determined cost of key environmental inputs, notably water and energy. Subsidies for high-carbon inputs (such as fossil-fuel energy) obviously are detrimental to a greening agenda; conversely, forcing producers to pay for environmental externalities, such as pollution, and subsidizing the price of green inputs, such as renewable energy, facilitate greening.

Regulations may affect process standards in production, for example, by requiring chain participants to achieve certain minimum conditions for effluents and by placing limits on, for example, water abstraction. Regulations may also affect product characteristics—for instance, contaminant levels in foodstuffs.

Incentives constitute a series of "carrots" to persuade firms to green their operations and include

BOX 4.9 GLOBAL STANDARDS—RAPID GROWTH IN COVERAGE AND DEMAND

The world has more than 400 eco-labels, most relating to agriculture and forestry. Eco-labels are usually voluntary, and help consumers identify products that satisfy certain environmental standards so far as their production is concerned. In 2012 the 16 largest initiatives covered total estimated trade of $31.6 billion, of which 40 per cent was coffee, 22 per cent cocoa, and 15 per cent palm oil. A total of 9 per cent of forested area has been certified as being managed in ways which satisfy sustainability standards.

In the early years, global civil society was key in setting standards and exerting influence over the private sector to ensure compliance. In the past decade, however, the private sector has shown much greater leadership and involvement in, for example, industry-led dialogue and cooperation, broad governance of criteria, and systems for compliance monitoring. Most standards cover either environmental or social criteria, with a few combining the two. The most recent standards cover a single crop or commodity, such as sugar.

SOURCE: POTTS (2014).

financial advantages and tax relief for new investment. In some cases governments provide support to use business service firms to assist the greening of operations along the chain.

Foreign governments are a further potential source of governance that affects GVC greening. They set the regulations that determine market entry and, hence, the character of the supply chains in producing countries. Increasingly, governments in high income nations, such as the United States and regional blocs such as the European Union, set market-entry standards that determine the green content of supply chains, particularly for the agricultural and resource sectors, which account for the bulk of Africa's exports.

Global civil society organizations are a further pressure point promoting the greening of value chains. Their power comes from their capacity to threaten non-compliant multinational firms with reputational damage. An alternative strategy by civil society has been to engage big firms in a collective attempt to raise standards and certify best practice. Examples of multi-stakeholder platforms involving civil society and transnational firms include the Roundtables on Sustainable Palm Oil, and Soy, and the Better Sugar Initiative.

A final set of stakeholders relevant to deploying green and inclusive industrialization includes international agencies and bilateral trade schemes that actively promote GVC greening. Unlike state-led governance, which is predominantly implemented through mandatory regulations, this form of governance provides incentives to greening, generally in the form of direct assistance and training to producers in the chain, such as UNIDO's work to establish National Cleaner Production Centres (UNIDO, 2015b).

Box 4.9 describes the large number and spread of eco-labelling schemes. One consequence of this value-chain greening, especially where driven by lead firms, is that it frequently excludes small producers, especially women, for three reasons. The first is that participating in value chains that demand comprehensive, certified standards requires a minimum level of literacy, training and skills, and these attributes often are lacking in small-scale, poor and female-headed farms and enterprises. Second, certification often is costly and requires regular renewal; larger and formal-sector enterprises have the capacity to spread these fixed costs over larger volumes of output. Third, existing patterns of gender relations often systematically exclude females from greening programmes. For

example, a recent study of greening and capacity expansion in the cocoa value chain found that virtually all of the support given to farmers along the chain was directed to men's activities, yet the key tasks that determined productivity and greening were undertaken by women (Barrientos, 2014).

In a few words, building an inclusive green economy is the work of governments, businesses and people together, and implementing green industrial policy requires consultation, communication and cooperation among them. The process for designing industrial policy is therefore as important as all the documents and evidence used to guide this agenda. As shown in the Economic Report on Africa 2014, governments need to create coalitions of different actors so as to advance the industrial policy agenda, with greening and inclusion at its core.

The final chapter in this work, on recommendations and policy frameworks, addresses the construction of these multi-stakeholder processes. First, though, in Chapter 5 we examine the costs of inaction through a modelling exercise; then in Chapter 6, to draw broader lessons, we review experience across Africa of plant-level decoupling and system-level greening.

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4.7 ENDNOTES

1 The AU has launched, for example, preparation of the African Integrated Maritime Strategy 2050, which aims to harness the assets and opportunities represented by Africa's vast oceanic and coastal resources, sometimes referred to as the Blue Economy.

2 Our search for data on industrial pollution found one overview of air pollution problems resulting from all human activity (UNEP, 2006) and a few journal articles about industry-related pollution problems in specific countries (for example, Bello et al., 2013 for Nigeria; and Karikari et al., 2006 for Ghana).