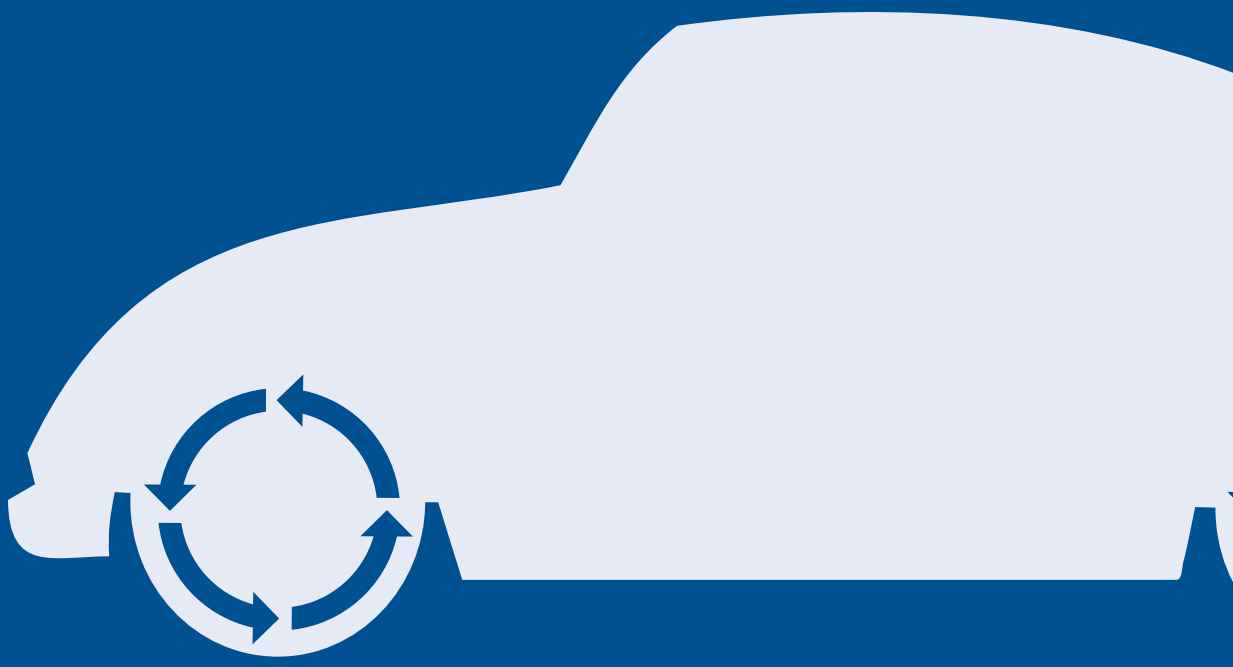
CHAPTER

5

ALTERNATIVE PATHWAYS FOR AFRICA: BUSINESS AS USUAL OR A GREEN AGENDA?



5.1 TWO SCENARIOS FOR AFRICA

To map the motivating factors for green growth and green industrialization in Africa and, more specifically, to identify points of entry for green growth interventions, as introduced in the previous three chapters, the first step is charting the socioeconomic futures of Africa and its subregions. One way of thinking about the future is through the use of scenarios.

The two scenarios developed for this analysis are designed to stimulate answers to questions such as, what will happen if we continue in a business as usual (BAU) fashion? What if we switch to a green agenda (GA)? In other words, what will happen if current growth trajectories continue, with uneven patterns of development and sporadic approaches to natural resource, waste and energy management? Alternatively, what could happen if Africa's industrialization was greened, using targeted improvements to urbanization, energy developments, population growth and changes to the very basis of our economies?

The two scenarios—BAU and GA—explore alternative trajectories for Africa from 2015 through 2050:

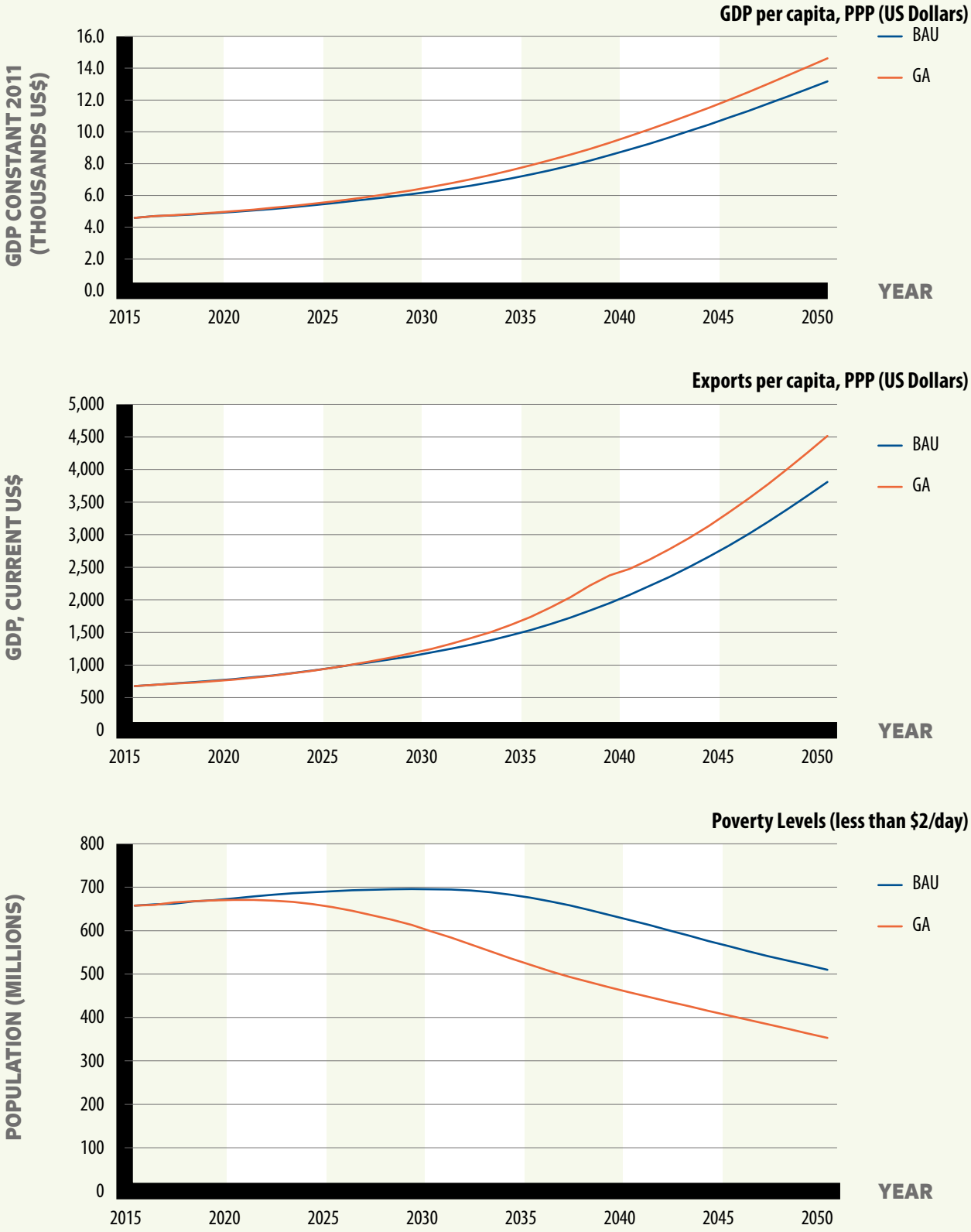
- **BAU** is a scenario portraying a continuation of current patterns and trends. The forecasts under BAU illustrate how the current development trajectory will affect different sectors, highlighting areas of concern.
- The **GA** is a scenario that models policy interventions in a range of sectors. Together, these interventions are intended to model a structural shift in the development trajectory of the continent towards a greener, more inclusive economic growth pattern than under BAU.

The GA scenario generates far better outcomes for key development indicators, especially per capita gross domestic product (GDP) and exports, and sees deeper and faster cuts in numbers of people in poverty, relative to the BAU scenario (figure 5.1). These findings strongly suggest that GA will bring more sustainable and inclusive benefits over the period (boxes 5.1 and 5.2).

The BAU and GA scenarios use Africa's subregions as a basis for analysis, with some illustrative country examples. The global context, too, is important, and the discussions on systemic drivers and some of the more central BAU scenarios relate Africa to the rest of the world on key aspects of green growth and industrialization. The methodology is explained in box 5.3 with detail in Annex 1.

... what could happen if Africa's industrialization was greened, using targeted improvements to urbanization, energy developments, population growth and changes to the very basis of our economies?

FIGURE 5.1 BAU AND GA—GDP PER CAPITA, EXPORTS PER CAPITA AND POVERTY LEVELS, AFRICA, 2015–2050



SOURCE: ONEWORLD, ADAPTED FROM INTERNATIONAL FUTURES (2015).

NOTE: BAU = BUSINESS AS USUAL; GA = GREEN AGENDA; GDP = GROSS DOMESTIC PRODUCT; PPP = PURCHASING POWER PARITY.

BOX 5.1 SUMMARY OF BAU SCENARIO

BAU	Rapid population growth continues, especially in East and West Africa; 65 per cent of the population will be urbanized by 2050. The majority of expected population growth occurs in urban areas. The foundation for the "demographic dividend" (box 5.4) is set but not realized by 2050. Growth in jobs is slower than growth in the working-age population. Economic growth is greatest in those subregions with the highest levels of population growth and urbanization. Growing infrastructure deficits check economic growth. Integration with global markets through trade and global and regional value chains remains low, as does intra-African regional integration. Water demand increases faster than population growth. Poor infrastructure, management, pollution and high climate variability are additional strains. Cooperation over shared resources—such as land (for example, transfrontier conservation areas), river basins and lakes shared by more than one country—is difficult, given low regional integration and strong competition for scarce supply. Essential resources cannot support average economic growth rates of 4–5 per cent a year. Energy demand heavily outstrips growth in supply. Investments do little to close the gap. Climate change and competition exacerbate water scarcity and reduce returns on hydropower and other investments. Substantial growth in renewable energy occurred, but dependence on fossil fuels increases. Shortfalls are met by price-volatile, high-GHG emitting imports. Skills gaps widen: the informal sector contributes 80 per cent of the labour force. Agriculture remains the primary employer but lags in its contribution to GDP. Agricultural yields remain lower than in other developing regions, disincentivizing farm investments. Climate volatility drives yields down further. Investments in food processing and storage are needed more than ever.
Climate change impacts	Droughts and extreme temperatures increase water scarcity. Hydropower production is lowered by 40 per cent in the worst-affected areas. Climate impacts on water and energy intensify resource competition—felt for the first time in "water-abundant" basins. Soil moisture declines, reducing yields. Rainfall increases, bringing flooding to urban areas. Periods between disasters shorten, increasing capacity pressure. Frequent and prolonged droughts bring sustained food insecurity and greater malnutrition. Fuel imports drive up emissions, as do unchecked land clearing and increased agricultural production.

BOX 5.2 SUMMARY OF THE GA SCENARIO

GA	Regional integration and infrastructure investments improve relative to BAU in that water resource governance is enhanced and regional trade increased. Policy implementation to limit pollution and to increase disaster risk preparedness makes water scarcity more manageable because all of the controllable scarcity factors are addressed. Growth and progress in agricultural transformation improve. Rising global competitiveness increases exports, and regional integration reduces reliance on imports. All relevant aspects of agro processing value chains are incentivized. Energy investments see major increases, including access to and mobilization of new funding sources for renewable energy. Greater carbon-market participation occurs, creating a revenue stream to finance green energy and technology. An enabling environment takes shape, including governmental green procurement programmes. Power purchase agreements are premised on informed trade-offs—for example, between water required for energy versus water required for expanded irrigation. Investments in energy increase by 20 per cent, and generation per capita increases by 30 per cent. Water data collection informs trade-off analysis. Energy demand still outstrips supply, but investments in energy production are accelerated, reducing fuel import dependence. Population growth is still rapid, but fertility rates start to fall as more sophisticated urban populations increase contraception use. Adding value to agriculture is incentivized, expanding the GDP while building urban skills which facilitates a transition to other manufacturing and services. Agricultural yields increase quickly as a result of intelligently scaled conservation agriculture, accelerated through incentives that target middle-tier small farmers. Climate impacts—for example, on soil moisture and nutrients and on water—are mitigated through conservation agriculture.
Climate change impacts	Improved coping capacities reduce water scarcity impacts 30 per cent. Load shedding from hydropower resulting from droughts and competing demands is cut 90 per cent. Agricultural yields improve rapidly as conservation agriculture raises soil moisture. Growth is inclusive, as middle-tier small farmers multiply the effect.

SCENARIO PARAMETERS

History has taught us that industrialization results in structural change. Although many of the shifts are welcome (poverty alleviation, more jobs), others may not, resulting in disruption and unintended consequences for the environment and for society (pollution, water scarcity and energy supply deficits, for example).

Each scenario is thus developed around the sectors most likely to be affected by, and to affect, industrialization in Africa. Those sectors—food and agriculture, water, energy and mineral extraction—are also central to Africa's economic growth and livelihoods. They operate within wider systems: the global economy, the global green agenda, continental economic growth and regional integration, population, urbanization and employment.

The interactions between sectors and the broader systems are complex, with high interdependencies. Water, for example, is a critical renewable resource and highly sensitive to rapid population growth and urbanization. In many parts of Africa, it is also a generator of electricity (hydropower), and its availability to the food sector is a critical success factor in increasing agricultural value added and in advancing industrialization across

BOX 5.3 SCENARIO-BUILDING METHODOLOGY

To build the alternative scenarios, a meta-systems approach was necessary, with interactions and numerous different levels of association between sectors. The two scenarios were developed using the International Futures (IFs) model for Africa and, where necessary, drawing on other international data and expert opinions to triangulate and address data discrepancies.

The IFs model is a large, long-term, integrated global modelling system that can create different scenario outcomes through linkages between subsystems (agricultural, demographic, economic, energy, environmental and sociopolitical). It is especially useful for modelling the potential success and size of effect of green growth policy interventions because of its integration of the agriculture (food security), energy, human health and water components into a representation of larger socioeconomic and environmental systems. IFs provides a way of thinking about the future, revealing intervention options that will allow Africa to achieve its human development goals within a sustainable pattern of economic growth that includes the renewable resource base.

The numerous linkages in the IFs model allow users to do the following:

- Examine the long-term impacts (until 2050) of a BAU approach.
- Explore how the widespread adoption of an aggressive green growth agenda could enable the continent to achieve higher, more inclusive economic and social development.
- Compare different outcomes to illustrate the benefits, costs and trade-offs in pursuing different political and economic agendas.

Comparisons are drawn with the global green economy scenarios developed for the United Nations Environment Programme (UNEP) for its Green Economy Report (UNEP, 2011) by the Millennium Institute, known as the T-21 model.

Models are, of course, only abstractions that simplify reality; they are tools to help think about future options. They also are highly dependent on the assumptions made and on the quality and quantity of data, which are difficult to obtain in much of Africa. Projections of the future by IFs should not, therefore, be taken as predictions of how an issue, country or region will evolve.

the continent. A similar story is true for energy. These are "high-pressure" sectors that can also yield socioeconomic opportunities throughout the wider system—with multiple co-benefits.

Consequently, compelling arguments exist for Africa to adopt an agenda that reduces the pressure on key resources, evidenced in the BAU scenario, through green growth while stimulating more inclusive economies and promoting infrastructure development as outlined in GA scenario. The continent, with its nascent industrialization, is well placed to do so.

BOX 5.4 UNDERPINNING CONCEPTS

Natural capital and ecosystem services

Natural capital—a fundamental, if undervalued, part of the global economy—comprises ecosystem assets (such as fresh water) and natural resources (such as fossil-fuel deposits) (Dickson et al., 2014) that, according to the United Nations (UN) Convention on Biological Diversity, account for at least 40 per cent of the world's economic activity and meet 80 per cent of the needs of the poor. These assets generate a range of essential ecosystem services that exist only as a function of the extent and condition of the ecosystem.

A useful UNEP (2007) definition provides clarity on the concept of natural capital and its components: "Natural capital includes land, minerals and fossil fuels, solar energy, water, living organisms, and the services provided by the interactions of all these elements in ecological systems." Those assets, in turn, enable the flow of ecosystem services, or the benefits that people derive from the ecosystem, including provisioning services (food and water), regulating services (flood and disease control), cultural services (recreation) and supporting services (nutrient recycling). Natural resources are a driver and a possible constraint of economic growth. The higher the GDP, the higher the demand for natural resources; growing demand leads to higher production, which depletes stocks. Declining stocks, on the other hand, reduce potential medium- to long-term production from natural resources, potentially constraining economic growth (UNEP, 2011).

Renewable-resource scarcity

Scarcity of a renewable resource is defined by its high cost and limited availability to the user—because the resource has been mismanaged, is polluted, cannot reach the user because of inadequate infrastructure or is negatively affected by change or variability in the climate. Degradation of ecosystems is an important contributor to scarcity, as the resources of an ecosystem yield critical services; for example, water is an important ecosystem service that is less readily available in degraded ecosystems. In Africa, many ecosystems (including river basins) are transboundary—they are shared by more than one country (sometimes as many as 10). Inadequate regional integration thus also exacerbates scarcity through a lack of shared infrastructure for managing common resources, especially water.

Economic regional integration and resource scarcity

Economic integration in Africa's subregions, usually measured in volumes of regional trade, is critical to the continent's development and cross-border natural resource management, because

- Integration fosters transboundary water management and subregional energy planning and trade;
- Slow regional integration impedes Africa's participation in global value chains and their regional counterparts, both critical entry points for green industrialization; and
- Infrastructure, currently a very tight bottleneck, will benefit from greater investment as a result of closer regional integration.

The demographic dividend

Demographic dividend is defined as the acceleration in economic growth that results from a decline in a country's mortality and fertility rates and the consequent change in the age structure of the population. With more active citizens, fewer people to support and the right policy frameworks, a country could gain immediate benefits from an increase in the number of employed people, creating opportunities for faster economic growth through increased investment.

- Africa's population is expected to double by 2050, reaching 2.4 billion people, and the working-age population will continue to grow over the next few decades—laying the foundation for a demographic dividend.
- Economic growth in Africa has not, however, translated into improved living standards, higher education levels or better health care for the majority. A skewed distribution of benefits from growth, alongside continued high population growth, has slowed per capita gains and left many people in poverty.
- The benefits of a demographic dividend are neither guaranteed nor unlimited. Governments have a narrow window of opportunity to use strong social and economic policy to create employment opportunities and economic growth.
- A raft of policy interventions is needed to achieve a rapid decline in the birth rate, combining investments in human capital and poverty reduction, increases in education and health budgets, and much greater effort to widen access to family planning. (Bangladesh is an example of success along this path. Growth in the textile industry there has increased employment opportunities for women, who as they have gained increased economic independence, started to access family planning.)

The parameters for each scenario are the following, with jobs and infrastructure integral to each:

- *Renewable resources:*[1] How will the main stress multipliers, such as climate change and variability and environmental degradation, deplete essential renewable resources, particularly water? What is the combined impact from these and other stresses, such as increased demand from a rising population?
- *Energy:* With the huge gap between rising demand and current supply and its uncertain trajectory, what are the key trends for demand, supply and investment?
- *Agriculture:* What is its future, given rising pressures on land, growing climate impacts and its potential for contributing to rapid industrial growth?

Understanding the two scenarios and their implications requires an appreciation of the underpinning concepts and the linkages between them (box 5.4). For example, natural resource assets, such as aquifers, are fundamental to economies and livelihoods and are central to interpreting the scenarios, but water scarcity is as much about how people *invest* in and *manage* the resource as it is about how little or how much rain falls. Further, transboundary water governance—important for dealing with water scarcity—is needed, given the large number of shared water basins, and it is better enabled in those subregions that display economic integration through trade, for example, yet again highlighting the role of water in economic management and growth. Finally, although a demographic dividend from burgeoning urban populations is desirable, reaping that dividend is unlikely to be realized unless natural capital is conserved for providing vital ecosystem services.

SYSTEMIC DRIVERS AND SCENARIO SECTORS

Before considering each sector examined in the two scenarios, we should understand the main system dynamics in play from now until 2050: economic growth and regional integration, population growth and urbanization, and employment.

ECONOMIC GROWTH AND REGIONAL INTEGRATION

Economic growth across Africa is likely to come primarily from the service sector, with industrial growth in increments rather than a boom. Services are a vital stimulant of industrialization and structural transformation and, although economic growth rates will vary considerably among the five African subregions, the following assumptions and findings are universal:

- Economic growth is highest in those subregions experiencing the highest levels of population growth and urbanization.
- Growth in the service sector is both a result of and a catalyst for increasing industrialization and structural transformation, thus becoming increasingly important to African economies.
- Growth in that sector sees capabilities built in industries critical to manufacturing, such as transportation and logistics.
- Increased contributions to GDP from manufacturing suggest growth in industrialization in those subregions that have experienced increased growth in manufacturing .
- Productivity improvements in manufacturing and in its supporting industries promote further industrialization.
- Although the service sector can expand quite easily, manufacturing growth is constrained by wide infrastructure deficits, which increase production costs along the entire value chain.

The growth of the service sector is a mutually reinforcing driver for expansion and diversification of industries. Increasingly, manufacturing activities within a global value chain require participation in more complex and more standardized coordination and transport processes. The rapid growth of African services therefore bodes well for further integration into global value chains and for industrialization. Despite high rates of economic growth in the past decade, however, Africa starts from a low base on regional economic integration.

POPULATION GROWTH AND URBANIZATION

Africa has the highest rate of population growth in the world's primary regions, rising by 2.55 per cent annually in 2010–2015. After 2050, Africa is expected to be the only major region to still have fast population growth (UN, 2015). The population of the continent will double by 2050, and rates of urbanization will be the fastest in those subregions with the highest rates of population growth (UN, 2015). This trend is most evident in West and East Africa, where rising population numbers have provided an expanding workforce and increasing consumer demand—both key drivers of economic growth.

Population growth in Africa will continue beyond 2050, even with the forecast fall in the birth rate from 4.7 births per woman in 2010–2015 to 3.1 in 2045–2050. Although continued rapid population growth places heavy pressure on already scarce resources and service delivery, when combined with accelerated urbanization, growing numbers of working-age people have the potential to drive industrialization. More working-age people channelled into labour-intensive activities, coupled with declining fertility and mortality rates—in part through family-planning investment and political support—are needed to lay the foundation for a demographic dividend.

... growing numbers of working-age people have the potential to drive industrialization.

EMPLOYMENT

Africa's economic growth has translated into neither growth of employment opportunities nor higher quality of existing jobs:

- African countries are not creating jobs at the same pace as the growth in working-age population, hence rates of participation in formal employment are falling;
- Low levels of labour productivity and poor infrastructure are the main reasons for slow growth in manufacturing and rising unemployment;
- Africa's youth bulge, paired with the demographic shift towards cities, will place ever heavier demands on informal settlements, service provision, and political and social stability; and
- Continued high levels of informal employment will result in persistent vulnerability among much of the population, given that the informal sector accounts for 50–80 per cent of employment in Africa.

Although those factors paint a grim picture for African cities, if correctly harnessed a growing working-age population concentrated in urban centres has the potential to drive rapid economic growth[1], a trend seen recently in emerging economies, notably China. Africa has an opportunity to capitalize on this demographic dividend, in part by promoting inclusive growth, as envisaged by the African Development Bank's Strategy for 2013–2022 (AfDB, 2013).

RENEWABLE RESOURCES

Water and other renewable resources in Africa are in scarce supply, with a widening gap between supply and demand. The reasons are clear.

Africa's infrastructure deficit increases water scarcity. To meet the demand for water and sanitation across the continent, Africa needs to increase its $3.6 billion annual investment in water infrastructure nearly four times (AfDB, 2013). Institutional weaknesses are reflected in inefficiencies at local and national levels, inadequate attention to technology choice, low pump density, restrictive maintenance systems and the lack of a supply chain to maintain machinery (Barber, 2014).

Climate change and volatility intensify existing natural resource stresses. Extreme weather events, combined with changing temperature and precipitation patterns, decrease the availability of water where and when it is needed most (Petrie, et al 2014). Vital economic and livelihood sectors—in particular, agriculture and energy (hydropower)—are water dependent. Increased water scarcity and the frequency of extreme events (such as drought) have serious ramifications for food security, which, in turn, has vast implications for human health.

Continued low levels of regional integration undermine transboundary water management as countries sharing water systems see more value in protecting what they regard as national interests than in cooperating with each other to maximize shared benefits. Africa has 63 of the world's 263 shared basins, which cover about 64 per cent of the continent (UNEP, 2010). Most basins are shared by only two countries, but some are shared by many more. Of the 13 basins worldwide shared by five to eight riparian nations, 4 are in Africa. The Congo, Niger, Nile and Zambezi rivers are shared by 9 to 11 countries. Improved cooperative water governance is a necessity and will enable enhanced energy production, improved agricultural yields, critical infrastructural development and greater resilience to climate change.

Rapid population growth sharply increases demand for water. Population growth, coupled with economic development, raises water demand for domestic, agricultural and industrial uses, which in turn increases effluent output. As African populations continue to grow and industrialize, the supply of renewable resources will come under increasing pressure (Dubey and Narayanan, 2010; Juma, et al., 2014).

A burgeoning middle class places additional stress on the water supply. Africa's urban household incomes are twice those of rural households, and urban households make greater demands on services such as piped water (Barber, 2014). Households connected to water pipes use, on average, three times more water per capita than do unpiped households. Access to water is thus tightly linked to household income.

ENERGY

Historical trends in energy demand and supply highlight a similar pattern to that for renewable resources—a significant infrastructure deficit, underinvestment (relative to growing demand) and population pressure. Without a change in the pace of investment, the gap between supply and demand will widen further, with effects on health, education, economic growth and food security. The following circumstances are the leading gap-wideners.

Population growth is the main driver for energy demand throughout Africa. Population growth stimulates demand for energy and the associated services it provides for social and economic development, such as heating, lighting, mobility, manufacturing and industrial production.

Higher incomes and increasing industrialization fuel demand for energy. When countries can meet the energy needs of their citizens and enterprises, they become wealthier, more resilient and enabled to advance health and human development.

Energy access remains low across Africa. Economic growth has not led to universal energy access. In Central, East, Southern and West Africa, more than 620 million people live without access to electricity (IEA, 2014). High poverty levels are directly linked to the type of energy consumed: except in South Africa, wood and charcoal are the largest fuel source, mainly for heating and cooking. The pressure placed on forest resources is unsustainable—forests cannot renew themselves at the pace necessary to meet growing demand, resulting in serious repercussions for surrounding ecosystems and livelihoods.

Exploitation of renewable energy is rising, but currently supply cannot satisfy demand. Africa starts from a low base on renewable energy and hydropower exploitation and needs time to catch up with global trends and local demand. Current renewable energy sources constitute only 1 per cent of grid-based capacity (Africa Progress Panel, 2015). Hydropower has seen recent expansion, but investment returns are already under pressure as a result of climate change and competing development demands, such as irrigation.

Installed capacity figures understate the energy deficit. The amount of power available to consumers often is far less than total installed capacity, mainly because of poor maintenance of power stations, leading to inefficiencies in grid operation and unstable supply. Further, a lack of reliable fuel supply (such as natural gas) and insufficient transmission capacity lower the capacity in operation. Transmission and distribution losses cut the supply to end users by as much as 20 per cent in some countries, and the loss rate of electricity transmission in Central, East, Southern and West Africa is more than double the world average (IEA, 2014).

AGRICULTURE AND FOOD

Although an enhanced agricultural sector is pivotal to poverty alleviation and food security in Africa, it is a somewhat neglected sector in many African countries.

Africa's agricultural output consistently lags behind that in other developing regions. The Green Revolution of the 1960s and 1970s boosted crop yields in Latin America and Asia, based on irrigation, mechanization, chemical fertilizers and high-yield varieties. In Africa, however, few farmers have been able to capitalize on those advances because of limited irrigation; poor infrastructure; severe soil degradation; the high cost of fertilizers; and inadequate extension services, farmer-credit schemes and seed-distribution networks. Most governments have not paid enough attention to agriculture, consequently failing to meet the Maputo targets of investing 10 per cent of their budget in agriculture. Africa's yields are less than half of those in Asia and about one fourth of the continent's potential (NEPAD, 2013).

High population growth and urbanization place increasing pressure on the production of staple crops. Households increasingly rely on buying their food rather than producing their own, making them dependent on markets and increasing their vulnerability to fluctuations in food and energy prices. This shift offers a big opportunity for domestic agricultural value chains because rising domestic demand will require expansion of domestic agroprocessing activities, as well as a wide range of associated services in transport, storage and packaging.

Food security concerns are further challenged by climate change. Africa is the continent most vul-

nerable to climate change, given its current levels of water scarcity, highly variable rainfall, high average temperatures, poor infrastructure and heavy reliance on rain-fed agriculture.

Historically low productivity and land-use levels are being redressed, but the pace of change is not fast enough to meet the demands of growing populations and emerging agro-industries. Measured from a base year of 2005/2007, an estimated additional 51 million ha of arable land area will become available for cultivation in Central, East, Southern and West Africa by 2050 (Alexandratos and Bruinsma, 2012), the majority in Central Africa, West Africa and East Africa. This land is put to other uses, however, such as grazing and woodlands, so transforming it into cropland is not cost free.

Despite increases in output, agriculture has a declining share in African economies, as services and manufacturing increase. Africa relies heavily on agriculture for its contribution to GDP (37 per cent), to exports (40 per cent), to employment (70 per cent), and to the food and energy needs of the roughly two thirds of Africans who depend on subsistence farming for their livelihoods (Cilliers, Hughes and Moyer, 2011). Agriculture's declining share of GDP, as services and manufacturing become more central to economic development, is increasing rural–urban migration and placing further stress on urban infrastructure, housing settlements and service provision.

THE GLOBAL GREEN AGENDA AND AFRICA

The world is in an era of unprecedented transition. As a result of intense, human-driven development, global warming is raising temperatures at unprecedented levels that are fast approaching a critical threshold, or the point of no return. Extreme events are increasing in frequency and intensity, and sea levels continue to rise, with horrific prospects for the world's coastal regions and low-lying small islands.

Unemployment, particularly under-employment and informal employment, is rising alarmingly in developed and developing countries at a time when the problems linked to rapid urbanization, such as pollution and poorly provisioned services, are hitting the urban poor the hardest.

The global population is set to increase from 7 billion people (as of 2011) to 9 billion by 2050, at a time when the problem of feeding current populations and eradicating poverty remains unsolved. For the first time in recorded history, more than half the world's population lives in urban areas, and cities now account for 75 per cent of energy consumption (UNEP, 2011). Simultaneously, ecological scarcities are seriously affecting the foundational sectors that supply the world's food: forests, fisheries, freshwater and agriculture (UNEP, 2011). Unemployment, particularly under-employment and informal employment, is rising alarmingly in developed and developing countries at a time when the problems linked to rapid urbanization, such as pollution and poorly provisioned services, are hitting the urban poor the hardest (UNEP, 2011).

The need for a new way forward has, arguably, never been so great. Favourable economic development is high on every politician's agenda, and now the world believes that such development is much more achievable through green growth. Although traction for the green economy has

grown steadily since the Rio +20 conference held in 2015, attended by world leaders, and a follow on to the first global sustainable development conference in Rio in 1995, was certainly a marker year for green growth.

The Paris Agreement on climate change (December 2015) cemented the world's evolving green growth agenda. Importantly, this agreement, concluded at the 21st Conference of the Parties (COP) under the United Nations Framework Convention on Climate Change (UNFCCC), came soon after the Sustainable Development Goals of 2015 were adopted to promote sustainable development as a means of addressing the still-abundant needs of the bottom of the social and economic pyramid. Kick-starting the 2030 Agenda for Sustainable Development, the Sustainable Development Goals offer the world an opportunity to reframe economic policy. The core elements lend focus to building and creating green economies and to growth that is inclusive, comprising sustainable consumption and production, socially equitable outcomes and investments for environmental sustainability (UNEP, 2015), such as climate-resilient and natural resource–friendly infrastructure. Those topics are at the heart of this chapter's scenario analysis, which identifies possible growth pathways for Africa. Similarly, the focus on the enabling institutions' policies and incentives that will enable the 2030 Agenda (chapter 2) applies to the policy recommendations for Africa that emerge from the scenario analysis.

Although the recent traction for green growth—also evidenced in mainstream global policy dialogues, such as G20 communiques—has likely stemmed from disillusionment with the ability of prevailing economic systems to deliver what is needed most, the growing body of evidence of environmental risks, resource scarcities and associated social disparities points to a new way forward (UNEP, 2011). Africa in particular has an advantage in accelerating its participation in the global green agenda, primarily because of its unique position, due to lagging levels of industrialisation relative to the rest of the world, of being able to leapfrog through how it invests in infrastructure, urbanizes and accelerates its uptake of renewable energy.

The following two scenarios have been developed specifically for Africa by OneWorld Sustainable Investments (OneWorld) using the International Futures (IFs) model developed by the Pardee Center for International Futures at the University of Denver, although BAU models occasionally contextualize Africa within global scenarios.

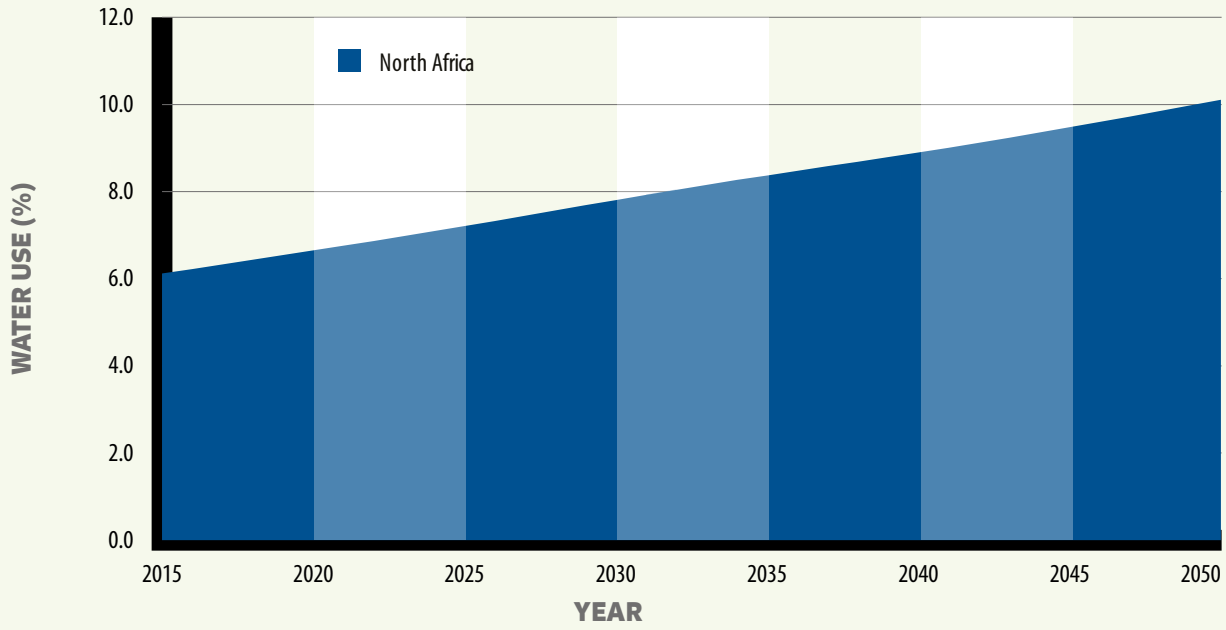
5.2 THE BAU SCENARIO

By 2050 at the latest, water and energy will be in alarmingly short supply, and investment in supply will have failed to meet growth in demand. Population is the main driver of this deficit. Still, water and energy demand will tend to increase faster than the population (because demand will also increase from industry, agriculture and domestic consumption, with rising incomes and urbanization).

Water use in North Africa offers an extreme example of the growing water scarcity that other subregions of Africa, too, will face (figure 5.2), with water use far in excess of renewable water resources. This increases pressure on other resources, such as aquifers, for which data are seldom available and which need to be recharged by rainfall. Parts of the continent rely on inter-basin transfers, which are another unsustainable solution to closing the gap between demand and supply.

Population growth in Africa is the fastest in the world, with total numbers expected to double by 2050. More than half the global population growth (54 per cent) between now and 2050 will be due to the growing number of Africans, who will increase from about 1.2 billion people in 2015 to almost 2.5 billion in 2050. This steep increase stems from declining infant mortality rates, life expectancy gains and still-high fertility in many poorer coun-

FIGURE 5.2 WATER USE AS A PERCENTAGE OF RENEWABLE WATER RESOURCES, NORTH AFRICA, 2015–2050



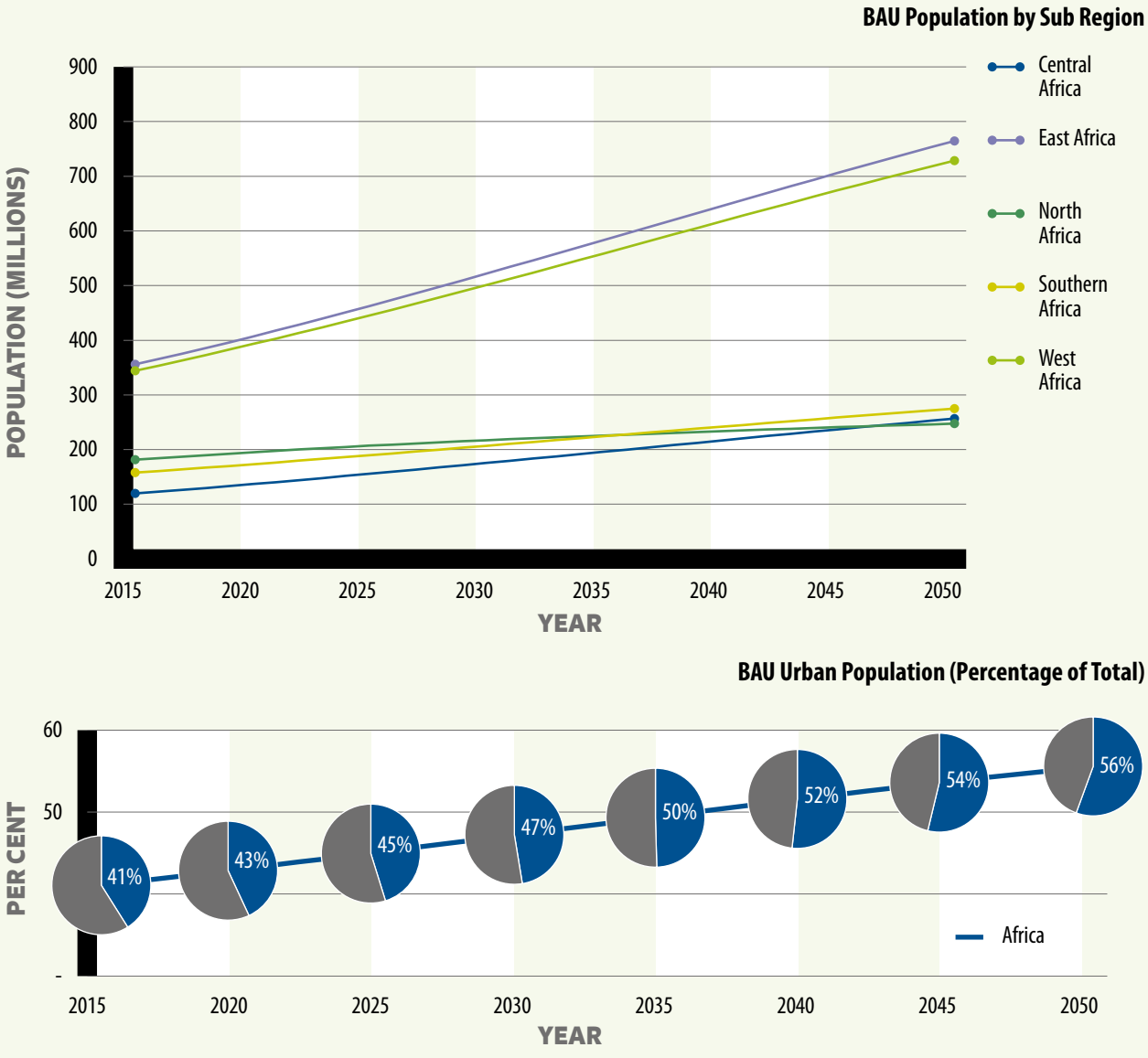
SOURCE: ONEWORLD, ADAPTED FROM INTERNATIONAL FUTURES (2015).

tries. The majority of this growth will happen in East and West Africa (figure 5.3, upper panel), shifting the demographic balance of the continent.

The majority of Africa's expected population growth will be in urban areas, with the urban population reaching more than 55 per cent of the total by 2050 (figure 5.3, bottom panel). Urbanization growth will be highest in West Africa, taking that subregion's urban share of population to nearly 70 per cent by 2050. Central, East, Southern and West Africa is expected to account for 17 per cent of the global urban population by 2050 (PRB, 2015).

Population growth and urbanization will present challenges and opportunities for each subregion. West Africa's demographic dividend will be concentrated in urban areas and, as discussed in Box 5.4 on the demographic dividend, could power economic growth and industrialization (figure

FIGURE 5.3 BAU POPULATION GROWTH AND URBANIZATION, 2015–2050

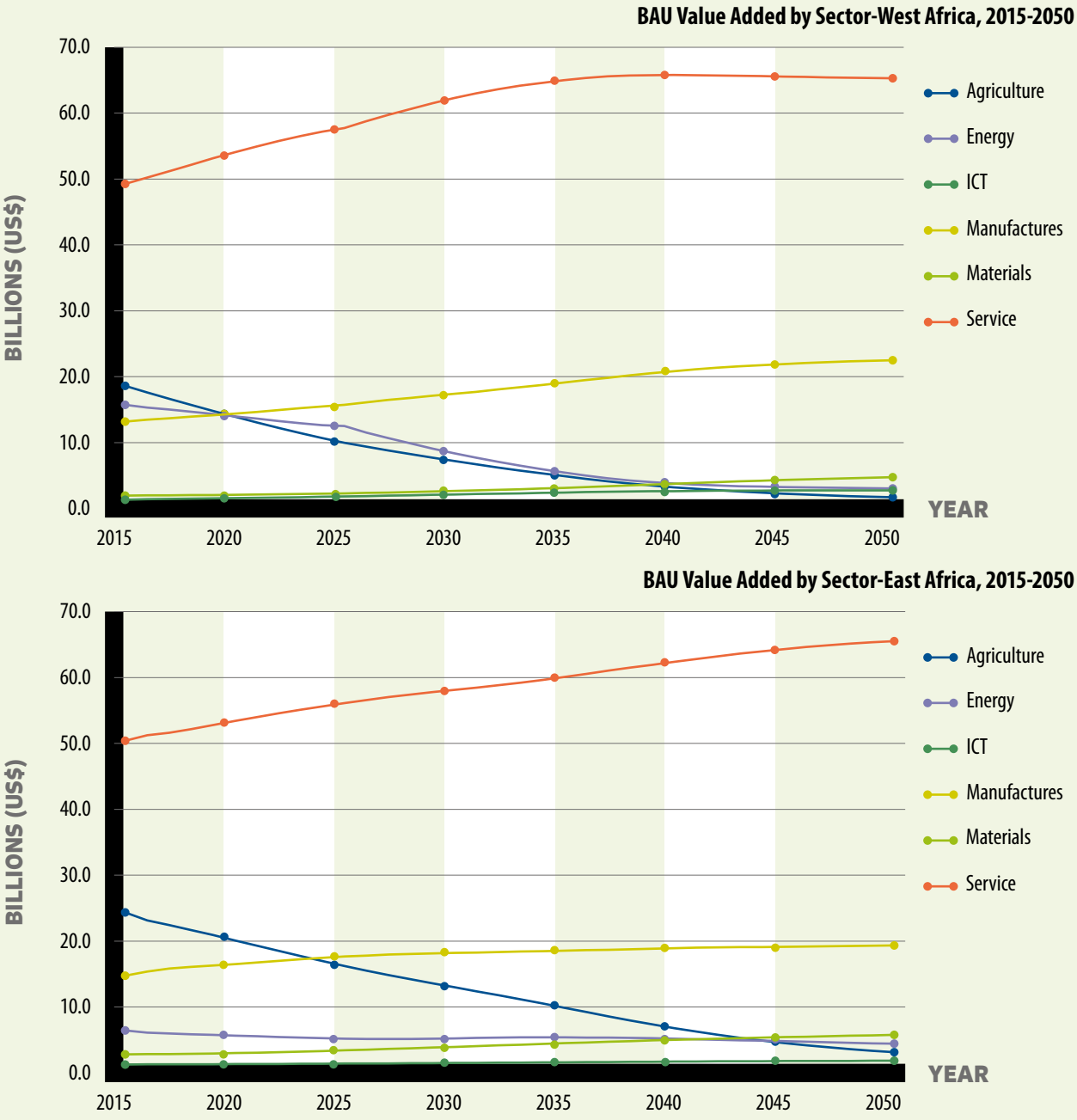


SOURCE: ONEWORLD, ADAPTED FROM INTERNATIONAL FUTURES (2015).

NOTE: BAU = BUSINESS AS USUAL.

5.4, upper panel). By contrast, East Africa will lag behind on its urbanized population share by 2050 because of it is relative un-urbanized. East Africa's rural majority will translate into slower growth in manufacturing and a continued reliance on agriculture in the medium term (to 2025) (figure 5.4, bottom panel).

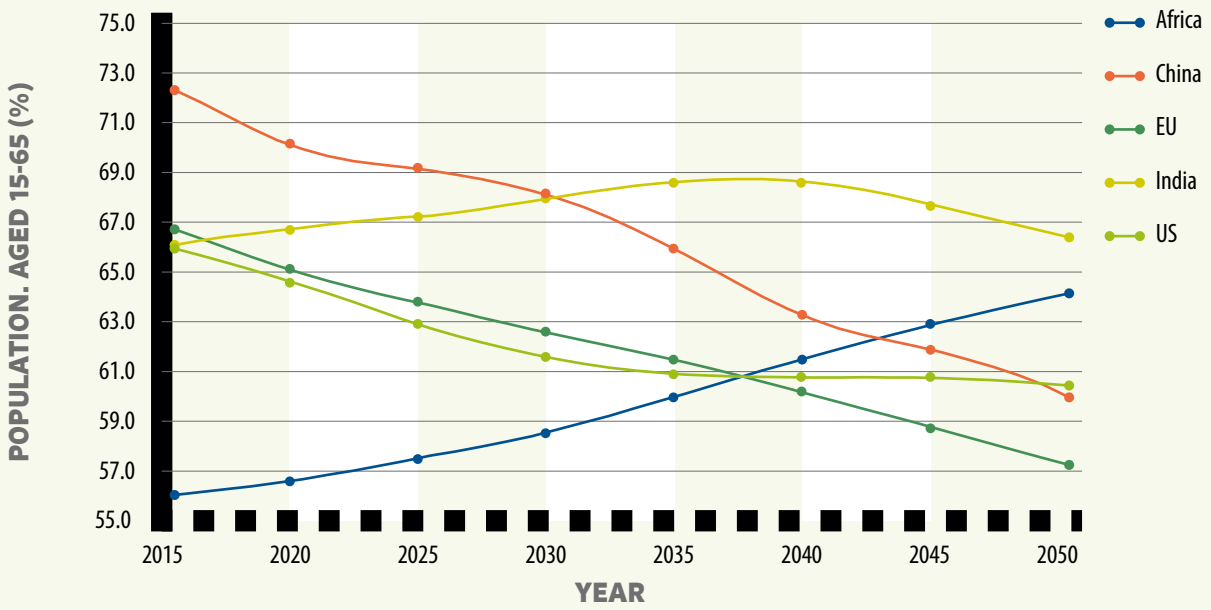
FIGURE 5.4 BAU VALUE ADDED BY SECTOR-WEST AND EAST AFRICA, 2015–2050



SOURCE: ONEWORLD, ADAPTED FROM INTERNATIONAL FUTURES (2015).

NOTE: BAU = BUSINESS AS USUAL; ICT = INFORMATION AND COMMUNICATIONS TECHNOLOGY.

FIGURE 5.5 BAU DEMOGRAPHIC DIVIDENDS, AFRICA AND SELECTED ECONOMIES



SOURCE: CILLIERS, HUGHES, AND MOYER, (2011).

NOTE: BAU = BUSINESS AS USUAL.

Although economic growth is strong in West Africa and parts of Central Africa, income per capita will not double for30 years, while the proportion of people living in poverty will remain high, at 30–50 per cent on average across countries.

Potentially good news for Africa's large proportion of vulnerably employed is the anticipated steady decline in the share of people who are informally employed.

Benefits of the demographic dividend will not be felt before 2050, although declining fertility and mortality rates and a growing working-age population establish its foundation. Africa's demographic transition is atypical, starting substantially later than demographic shifts in Asia, Europe, Latin America and North America (figure 5.5). In Africa, by 2050, more than half the population (64 per cent) will be of working age. Africa is expected to reach its peak share of working-age population by 2090 (65 per cent), meaning that the continent will most likely reap the benefits of the demographic transition—which depend on strong support for family planning and rapidly declining fertility rates—only in the second half of this century (Drummond et al., 2014).

Africa will not, however, create jobs at the same rate as the working-age population expands. Under BAU, the 10–24-year-old age group will make up more than 30 per cent of the Central, East, Southern and West Africa population in 2050 (PRB, 2015), and the

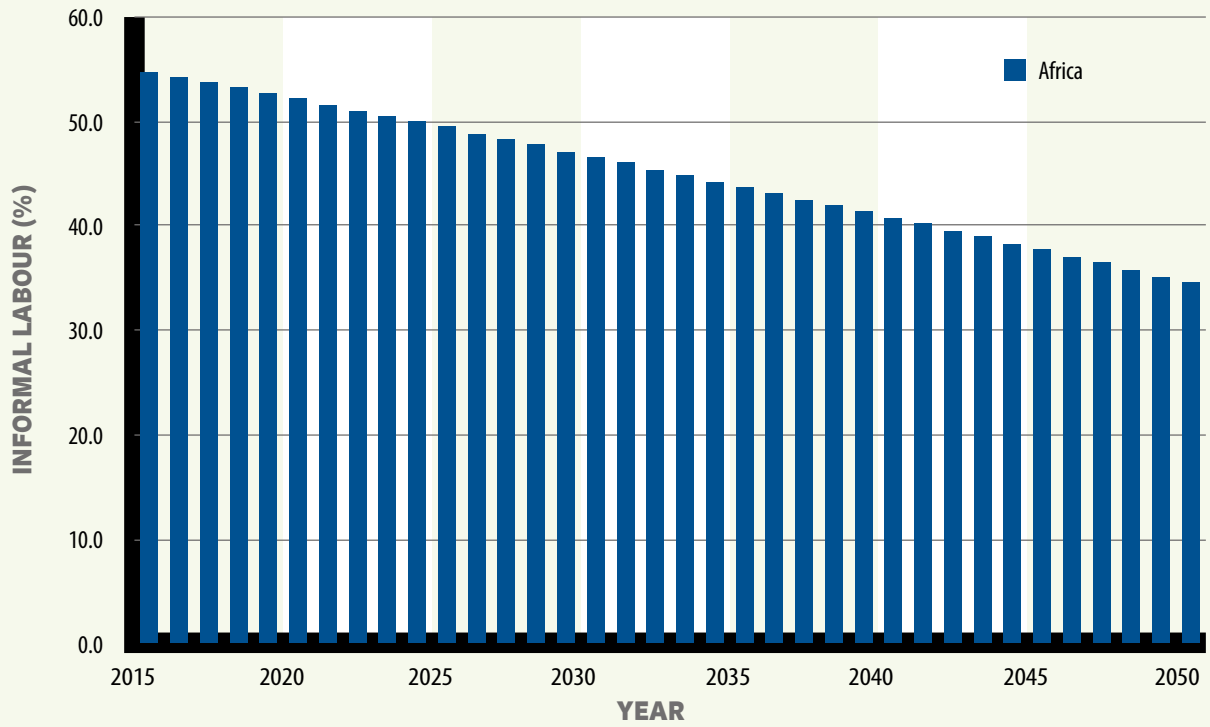
majority of Africa's new jobs will come from service industries, in line with global employment trends. Although projections for Africa for 2050 (OneWorld, 2015) paint a picture of structural transformation from rural, agrarian activity to urban, industrial employment, poverty will not decrease through increased employment because the infrastructural investment will continue to fall short.

Potentially good news for Africa's large proportion of vulnerably employed is the anticipated steady decline in the share of people who are informally employed (figure 5.6). Growth in formal employment will translate into more stable and regular income, employee rights and benefits, operation within regulatory frameworks, and greater incentives for skill development and upward mobility. Expanding the formal sector should lead to gains in data quality for employment numbers, income levels and occupational capacities, which in turn strengthen the ability of states to formulate interventions, for example in labour market reforms, and to be held accountable.

Improvements in formal employment depend, however, on the success of the demographic transition. Without the forecast growth in services and manufacturing, the excess labour resulting from agriculture's decline will result in higher rates of vulnerable employment, worsening an issue that is already critical.

Economic growth will be fastest in subregions with the strongest population growth and urbanization. Population growth in West and East Africa in the next 35 years will far outpace that in all other subregions. By 2050, West Africa is predicted to overtake North Africa in the percentage of total

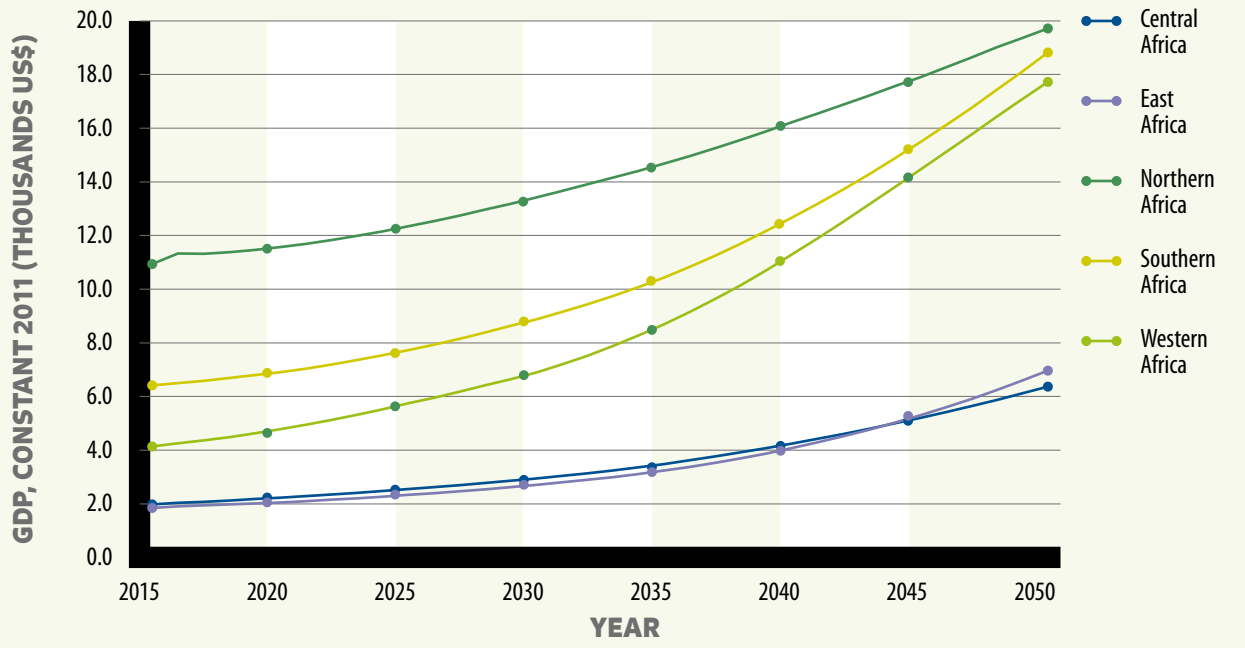
FIGURE 5.6 BAU INFORMAL LABOUR AS A PERCENTAGE OF TOTAL LABOUR FORCE, AFRICA, 2015–2050



SOURCE: ONEWORLD, ADAPTED FROM INTERNATIONAL FUTURES (2015).

NOTE: BAU = BUSINESS AS USUAL.

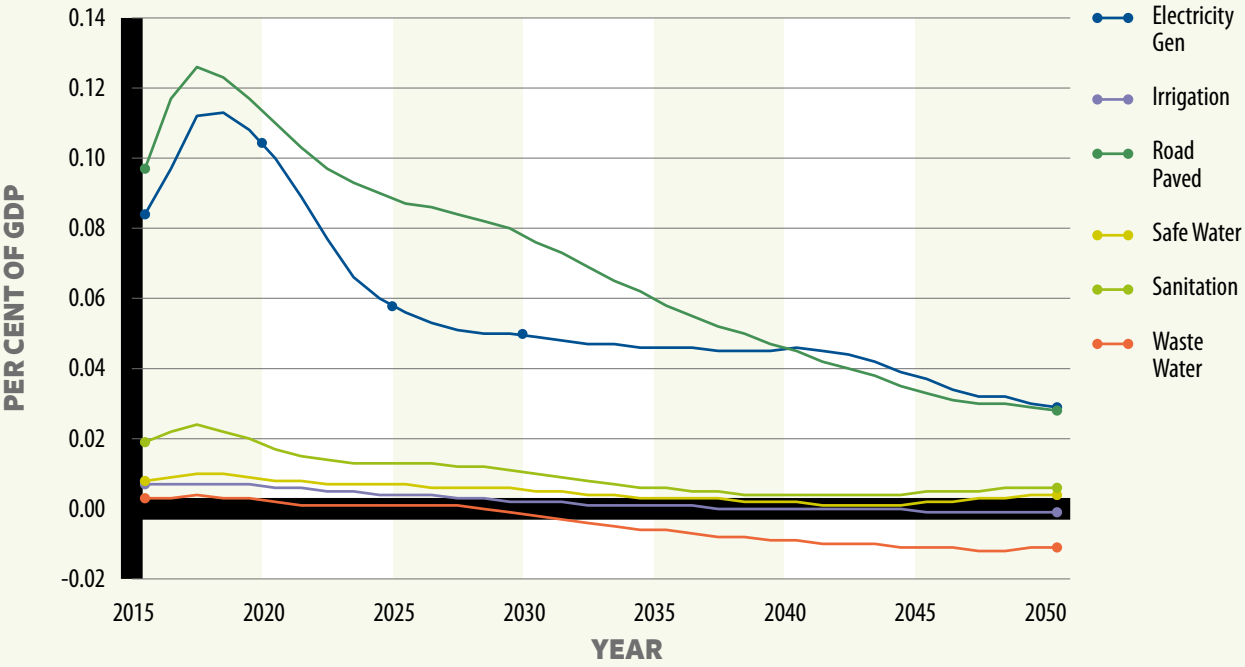
FIGURE 5.7 BAU GDP, AFRICAN REGIONS, 2015–2050 ($ PER CAPITA, PPP)



SOURCE: ONEWORLD, ADAPTED FROM INTERNATIONAL FUTURES (2015).

NOTE: BAU = BUSINESS AS USUAL; GDP = GROSS DOMESTIC PRODUCT; PPP = PURCHASING POWER PARITY.

FIGURE 5.8 BAU INFRASTRUCTURE INVESTMENT SHORTFALL, AFRICA, 2015–2050 (% OF GDP)



SOURCE: ONEWORLD, ADAPTED FROM INTERNATIONAL FUTURES (2015).

NOTE: BAU = BUSINESS AS USUAL.

population living in urban areas. That demographic shift, from the South and North to the East and West, will parallel an economic shift, as East and West Africa are also projected to grow fast economically. West Africa will experience higher levels of urbanization than will East Africa, leading to greater levels of industrial growth and thus higher GDP per capita. The predicted emergence of West Africa as an engine of growth underscores the transformational power of population growth when paired with urbanization (figure 5.7).

Growing infrastructure gaps will crimp economic growth. Across the continent, the largest deficits in infrastructure investment required are in paved roads and electricity generation (shown as the investment shortfall as a share of GDP; figure 5.8). Although investment in infrastructure increases considerably under the BAU scenario, the continent is still starting from a low baseline. Central, East, Southern and West Africa's road network is 204 km per 1,000 square km against a world average of 944 km (AfDB, 2010). This places a great burden on industrial growth, making it more expensive to source raw material inputs and to get final products to market.

Integration with global markets will remain low. The channels for integration are trade, global and regional value chains, and regional integration. An important signal, or predictor of low regional integration, is agriculture's inability to become a fully leveraged sector, or to mature (OneWorld, 2015). Other signals include continued low levels of cooperation in transboundary water management and the gap in infrastructural investment.

IMPLICATIONS FOR AFRICA'S RENEWABLE RESOURCES, ENERGY AND AGRICULTURE

If unchecked, growth in Africa's population, infrastructure deficit and unemployment, coupled with erratic economic growth that does not create jobs and alleviate poverty, will minimise Africa's ability to realise the demographic dividend and will increase pressure on water, energy and food security. The combined impact on Africa's endeavours to industrialise will be largely negative.

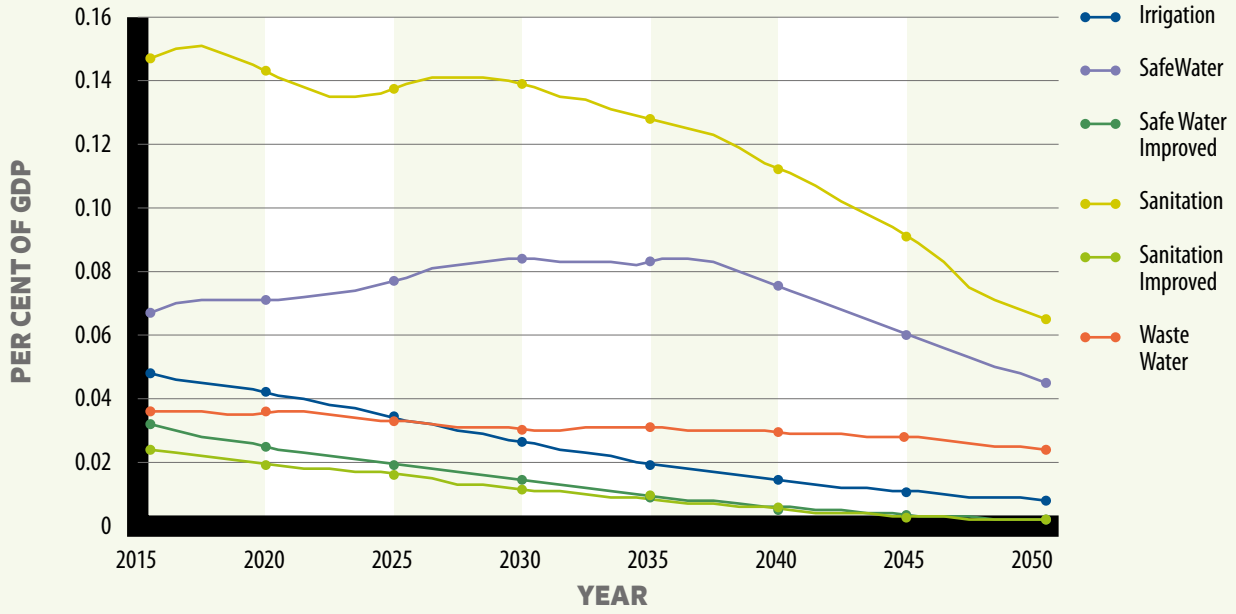
Not only do a rising population, urbanization and inadequate infrastructure stress water systems. Pollution, low maintenance, weak management, and high rainfall variability as a result of climate change also strain them.

RENEWABLE RESOURCES

Not only do a rising population, urbanization and inadequate infrastructure stress water systems. Pollution, low maintenance, weak management, and high rainfall variability as a result of climate change also strain them. Governance is an increasing problem, as cooperation over shared resources is becoming harder without close regional integration and given competing demands between sectors and countries.

Already low infrastructural investment relative to demand will decline even further in Africa's subregions. Compared with GDP, which continues to grow, overall public investment in water infrastructure will continue declining, even as demand for water climbs steeply because of population pressure. Despite currently heavy investment in Central and North Africa for "megaprojects" in transport, energy and mining, the expected challenges of meeting water security are not reflected

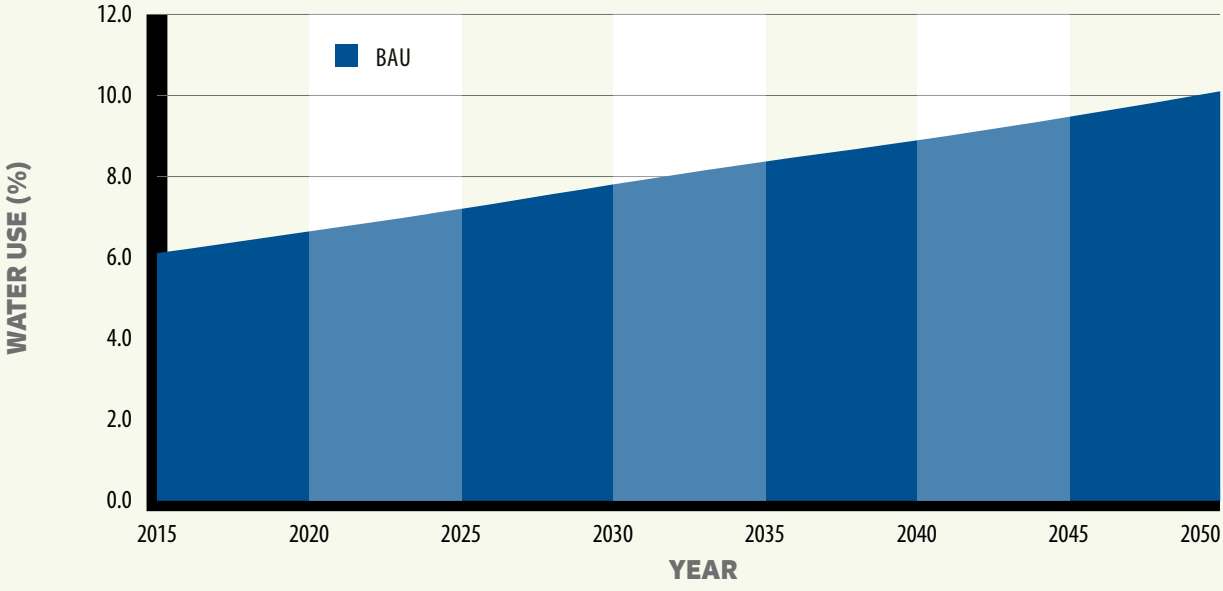
FIGURE 5.9 BAU PUBLIC WATER AND IRRIGATION INFRASTRUCTURE INVESTMENT AS A PERCENTAGE OF GDP, AFRICA, 2015–2050



SOURCE: ONEWORLD, ADAPTED FROM INTERNATIONAL FUTURES (2015).

NOTE: BAU = BUSINESS AS USUAL.

FIGURE 5.10 BAU WATER USE AS A PERCENTAGE OF RENEWABLE WATER RESOURCES, 2015–2050



SOURCE: ONEWORLD, ADAPTED FROM INTERNATIONAL FUTURES (2015).

NOTE: BAU = BUSINESS AS USUAL.

in the volume of planned investment (figure 5.9). As a report on infrastructure development concludes, "Water and waste management presented a sector needing more investment, as it will play a critical role in the near to medium, and long-term future of the continent and world at large" (Deloitte, 2014). Thus, despite continued strong foreign investment in Africa, the lack of water-infrastructure investment points to impacts for subregional water consumption in the long term, such as that predicted for North Africa, particularly Egypt, which is expected to see a decrease of 75 per cent in per capita water availability by 2100 (UNEP, 2006).

Along with population growth, expected climate change impacts will accelerate the rate of environmental degradation, further undermining efforts to conserve renewable resources. For a global average temperature increase of 1.5–2 degrees Celsius, countries close to the equator will experience a likely increase of 4–5 degrees, which seriously jeopardizes existing farm systems and cropping patterns. Land already under pressure from rising populations and industrialization will be further hurt by the changing climate.

Areas particularly vulnerable to high rainfall volatility, such as East Africa, will see steep falls in returns on investment and, concomitantly, increasing energy insecurity in hydropower-dependent regions. Variation in the provision of energy will increase as hydrological cycles become disrupted, primarily because of poor water-systems management. Overall water use as a proportion of renewable water resources will continue rising (figure 5.10).

With expected changes in the amount, timing, form (rain, snow) and intensity of precipitation, as well as changes in water flow within watersheds, renewable water resources are expected to decrease in predictability and in the ability to renew themselves. Competing demands for water

... renewable water resources are expected to decrease in predictability and in the ability to renew themselves.

resources in Southern Africa, coupled with climate change, will seriously stress water governance in a subregion that shows the lowest level of regional integration on the continent. For example, scenarios developed for hydropower production in the Zambezi basin show that electricity generation from major hydropower plants could decline by 10–20 per cent by 2050, as a result of increasing temperatures and expanding irrigation, which combine to increase water abstraction, evaporation and evapo-transpiration (Spalding-Fecher et al., 2014).

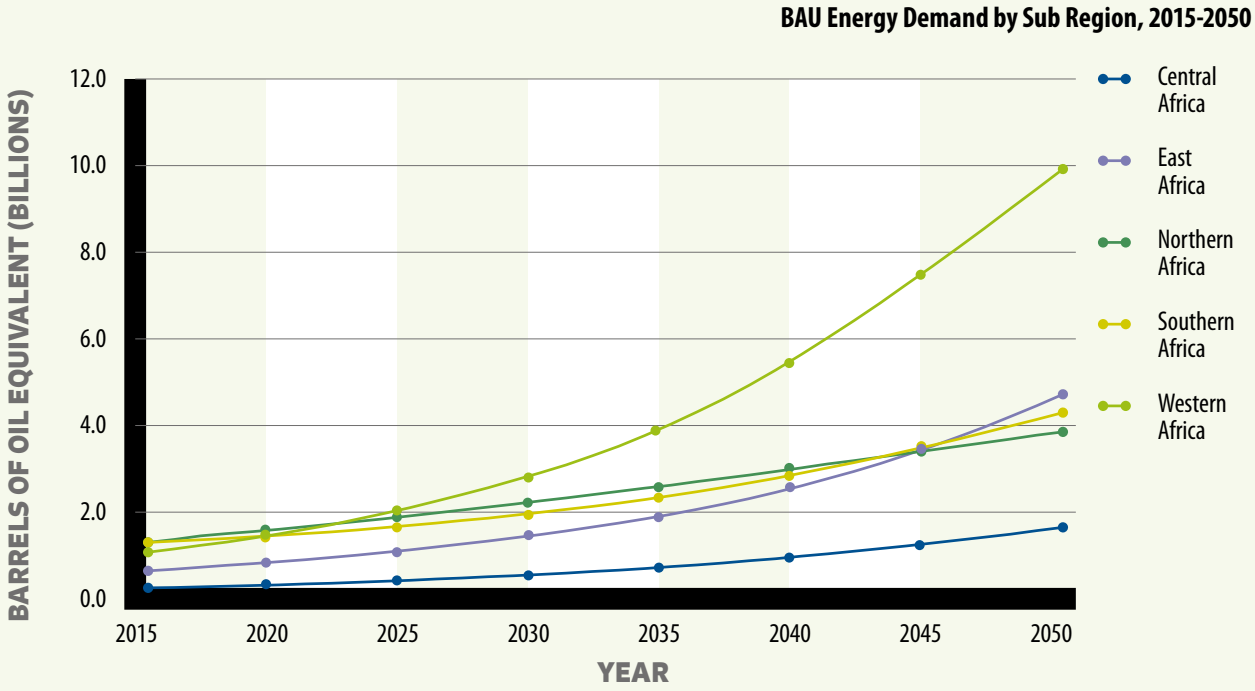
Water quality will be badly compromised. Compared with other world regions, Central, East, Southern and West Africa already has the lowest coverage of piped water, and more than - more than 40 percent of all people (321 million) without a source of improved drinking water live in sub-Saharan Africa (UNDESA, 2012). Rapid population and economic growth are increasing the demand for water for domestic, agricultural and industrial uses, which will raise effluent output. Water quality across Africa will therefore deteriorate by 2050 because of increasing effluent from wastewater and nutrients (fertilizers/pesticides) from agriculture, with potentially irreversible consequences for biodiversity and human health. Rapid urbanization and increased water consumption mean that demand will rise at double the pace of population growth, heightening competition for this resource and increasing the possibility of sociopolitical tensions.

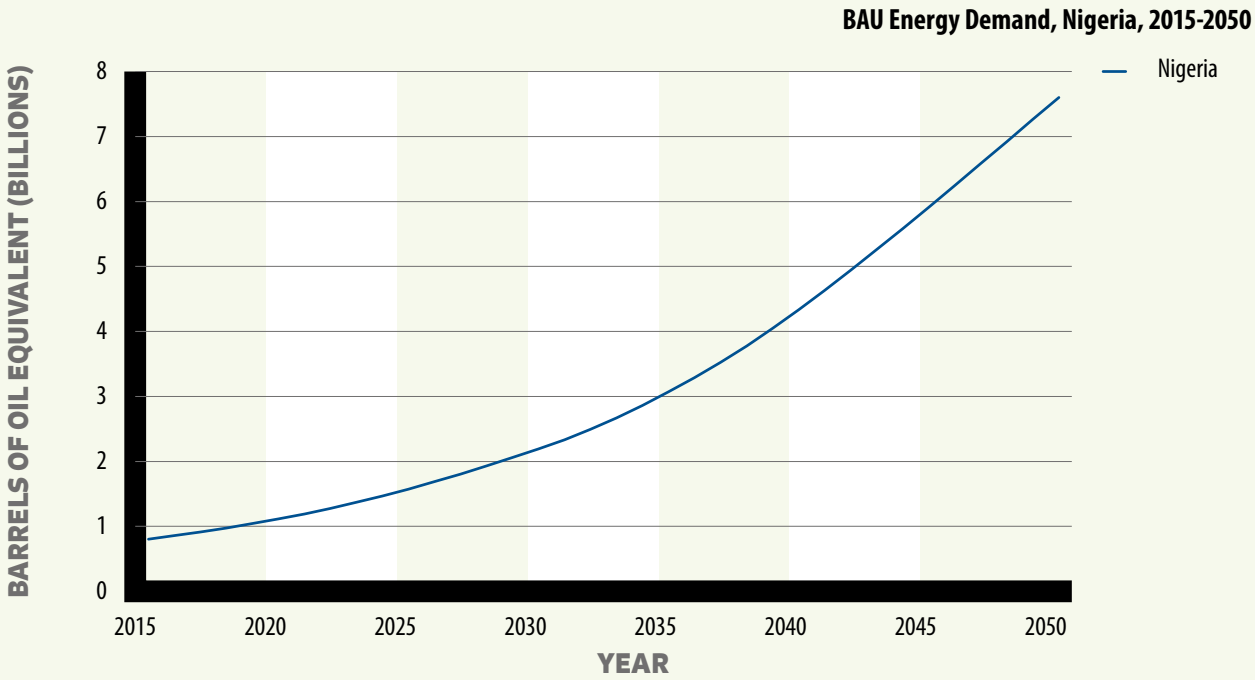
ENERGY

As with water, energy demand will outstrip supply, exacerbating energy access and security and slowing poverty eradication. Nigeria, with

the fastest growing population in Africa, will see a rise in energy demand accounting for most of the increase in energy demand in the West African subregion (figure 5.11, top panel). That country alone accounts for more than one quarter of total Central East, Southern and West Africa energy demand (figure 5.11, bottom panel).

FIGURE 5.11 BAU ENERGY DEMAND, AFRICAN SUBREGIONS AND NIGERIA, 2015–2050 (BILLION BARRELS OF OIL EQUIVALENT)

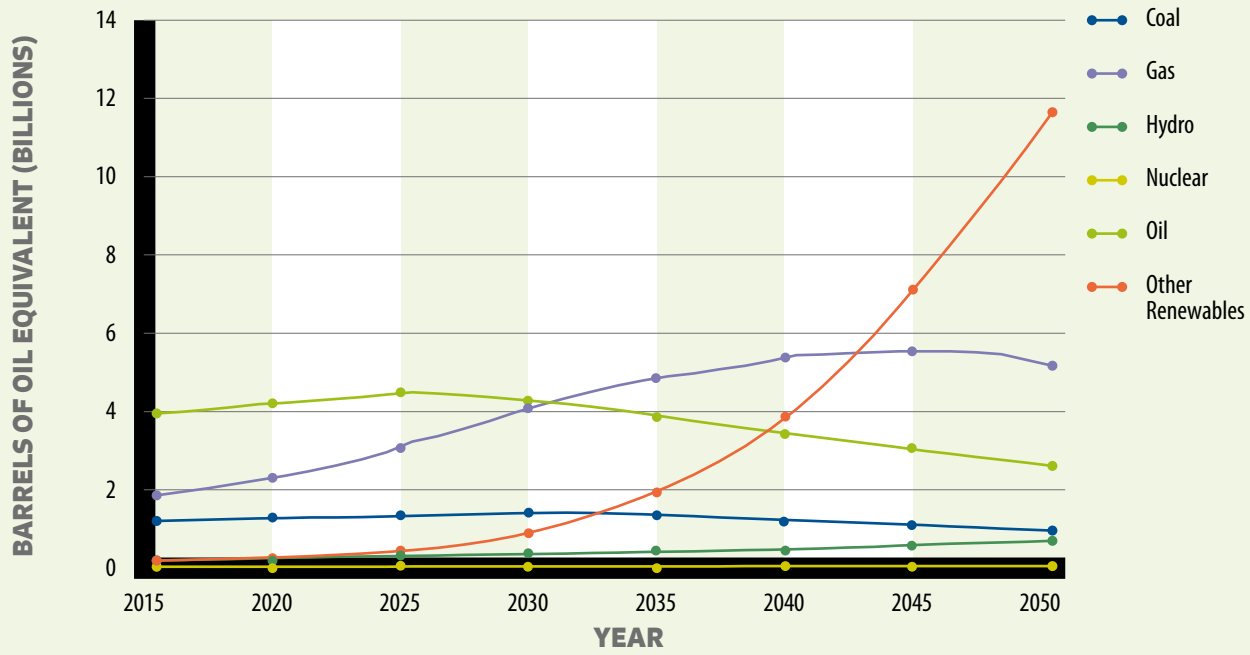




SOURCE: ONEWORLD, ADAPTED FROM INTERNATIONAL FUTURES (2015) AND IEA (2014).

NOTE: BAU = BUSINESS AS USUAL.

FIGURE 5.12 BAU ENERGY PRODUCTION, AFRICA, 2015–2050



SOURCE: ONEWORLD, ADAPTED FROM INTERNATIONAL FUTURES (2015).

NOTE: BAU = BUSINESS AS USUAL.

The Democratic Republic of the Congo (DRC) and Ethiopia are forecast to become the ninth and tenth largest countries in the world by 2050, with populations of 194 million and 165 million, respectively (PRB, 2015), adding to the increasingly higher energy demands expected of the Central and Eastern subregions.

The access rate to electricity will stay low and will fall further by 2050, particularly in Central, East, Southern and West Africa. Although, globally, nearly 1 billion people will gain access to electricity by 2050, half a billion will remain without it (27 per cent of Africa's population) (IEA, 2014). Worryingly, the share of Central, East, Southern and West Africa's population without access to electricity will increase—the only region in the world where this will happen.

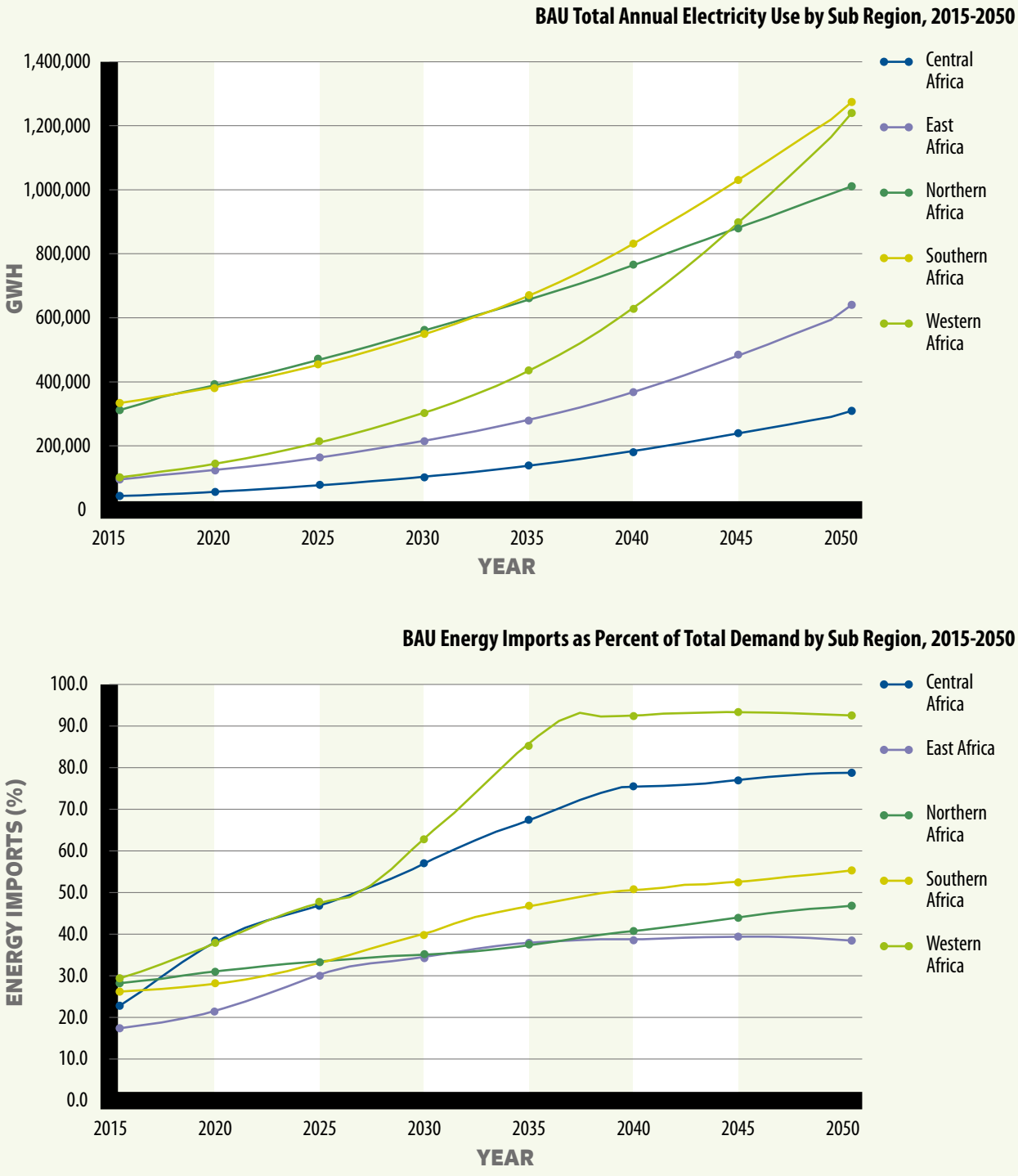
The gap between energy demand and electricity supply will widen. Electricity consumption will climb (consumption is expected to grow about 4.5 per cent a year due to population and industrial growth) as the middle class expands and countries industrialize, placing further pressure on generation, transmission and distribution systems. Demand for electricity will continue to outstrip supply, even assuming a BAU increase in investments in renewables and diversification of the fuel mix, with an attendant rise in electricity generation (figure 5.12) and decentralized energy policies that encourage off-grid power. Four-fifths of Africa's population now rely on biomass (straw, charcoal and firewood) to meet their energy needs; people in rural areas form the majority of those without access to electricity (Africa Progress Panel, 2015). By 2050, 1 billion tonnes of wood a year will be needed to meet demand for energy use (IEA, 2014).

Although large investments are forecast for expanding transmission lines by 2050, extensions still fall short of need. The gaps create huge shortfalls in the electricity system, particularly in rural

areas, because of inefficiencies in grid operation, insufficient transmission capacity and losses in distribution.

Figure 5.13 shows total annual electricity use and share of energy imports in demand, measured in gigawatt hours (GWh). Annual electricity use

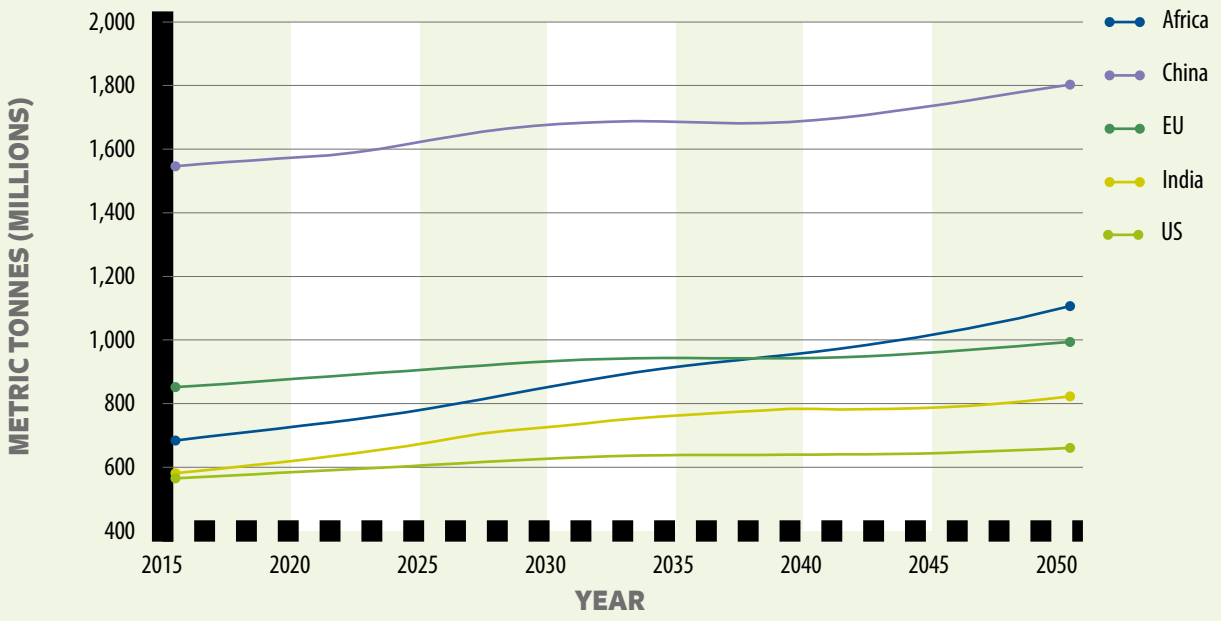
FIGURE 5.13 BAU TOTAL ELECTRICITY USE AND ENERGY IMPORTS, AFRICA, 2015–2050



SOURCE: ONEWORLD, ADAPTED FROM INTERNATIONAL FUTURES (2015).

NOTE: BAU = BUSINESS AS USUAL

FIGURE 5.14 BAU AGRICULTURAL PRODUCTION, AFRICA AND SELECTED ECONOMIES, 2015–2050 (MMTS)



SOURCE: ONEWORLD, ADAPTED FROM INTERNATIONAL FUTURES (2015).
NOTE: BAU = BUSINESS AS USUAL; EU = EUROPEAN UNION; US = UNITED STATES.

is projected to soar in all subregions. Southern and North Africa start from a higher base (having higher electrification rates), but consumption will rise commensurately with predicted energy investments in all subregions (OneWorld, 2015) except West Africa—a population explosion node—where total annual electricity use already dramatically outstrips electricity production and shows a gap that widens sharply. Similar trends are occurring in Central, East and Southern Africa, where annual electricity use already surpasses production (net of losses) (OneWorld, 2015). Consumption is directly related to economic growth and will surge with accelerated economic growth in some countries and with upward trends in the extraction and consumption of commodities.

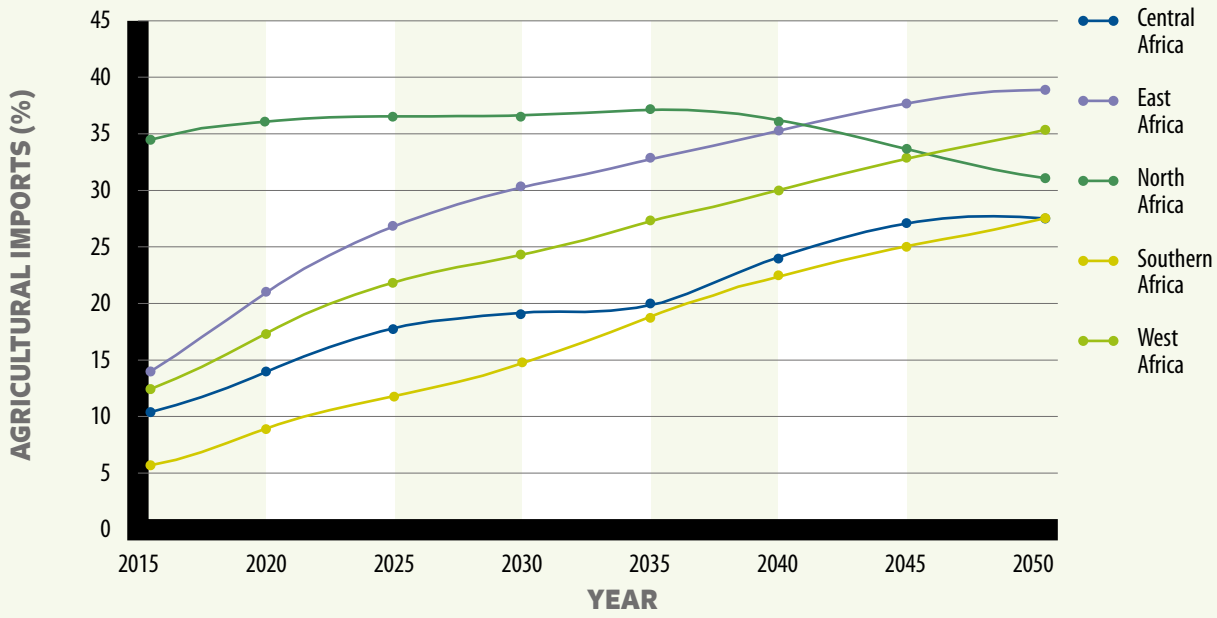
In this scenario, Africa's reliance on imports of fossil fuels as a share of demand will widen dramatically as countries attempt to close the supply–demand gap (figure 5.13). Fossil-fuel imports are regional and international. Regional imports are primarily from hydropower and coal-based electricity production, sometimes through bilateral power purchase agreements and in some instances through regional power grids. International imports tend to be concentrated in fuel oils—such as oil, gas and diesel—as well as in related technologies, particularly generators.

AGRICULTURE

Agricultural production will increase across the continent by 2050 as labour productivity, land under cultivation, irrigation infrastructure, and technology transfer (from developed and emerging economies) all expand or improve. Africa could outpace India, the United States, and the European Union in terms of agricultural output (figure 5.14). This is largely because of Africa's relatively untapped land and water resources.

Despite significant improvements in West and East Africa, the growth in agricultural yields will quickly

FIGURE 5.15 BAU AGRICULTURAL IMPORTS AS A PERCENTAGE OF DEMAND, BY SUBREGION, 2015–2050



SOURCE: ONEWORLD, ADAPTED FROM INTERNATIONAL FUTURES (2015).

NOTE: BAU = BUSINESS AS USUAL.

be outpaced by population growth in those areas, driving an increase in agriculture imports and raising dependency (figure 5.15).

Stresses on food security will push people to migrate to Africa's urban centres, as well as to developed countries. Increased migration will further compound issues of poverty, violence and unemployment in Africa's cities, with the potential to destabilize the continent and undermine any advances made towards socioeconomic goals.

THE AFRICAN AND GLOBAL BAU SCENARIOS: SOME SIMILARITIES AND DIFFERENCES

Under the T-21 World Model (UNEP, 2011), BAU is modelled on the assumption that current trends will continue—that is, high energy use and emissions and unsustainable exploitation of renewable resources, with minor progress in shifting to a green economy—much along the same lines as the Africa BAU scenario. Global pressure on natural resources increases as GDP grows worldwide, and that slows the rate of growth. Higher water stress, lower soil quality and fossil-fuel price volatility all affect GDP negatively under the global BAU, lowering indicators such as the Human Development Index.

The global BAU scenario for water is similar to Africa's in that demand and consumption increase (reaching 70 per cent above current values), with corresponding reliance on groundwater reservoirs and streams well in excess of sustainable withdrawal. Global agricultural yields also increase with steady growth between now and 2050, with 36 per cent growth in crop production value between 2010 and 2050, improving average nutrition by 7 per cent by 2050.

In this global model the service sector shows the fastest growth, but agriculture remains a signif-

icant employer (at 32 per cent). As with Africa, largely because of population growth, primary energy demand will grow by more than 57 per cent by 2050. Increases in production of fossil-fuel, nuclear and renewable energy will meet demand (in that order, by size). Thus, the share of fossil fuels in global energy consumption remains at 81 per cent. That does not bode well for Africa's climate future, given that the continent is already suffering the consequences of global warming induced by fossil fuel–producing greenhouse gas emissions. Of additional concern to Africa's BAU scenario (in which growing energy demand and increasing deficit are met by imports of fossil fuels), the global scenario projects oil supplies peaking soon after 2030, driving up the price sharply.

Under the global BAU scenario, resource consumption is unsustainable in any geographical location. Africa's infrastructure and industrialization deficit sets it apart from most other regions, however. In all three sectors, Africa's is a story of underexploited resources with great potential to harness water, develop abundant renewable energy resources and improve lagging agricultural production. Moving on all three fronts could galvanize unprecedented levels of industrialization but only by greatly scaling up infrastructure investment.

Africa is at a crossroads. Economic growth in some of its countries is among the highest in the world, typically as a result of oil and gas rather than systemic and structural economic change. In commenting on the so-called African growth tragedy and the Africa rising discourses, Chang found deficiencies in both: "Africa is neither structured for underdevelopment nor has it suddenly entered a new golden age" (Chang, 2015). His report argues that policies, especially industrial policy, have the potential to make a significant difference to the continent's future. Africa's natural resource barriers, coupled with the socioeconomic challenges highlighted under a BAU scenario, mean that African countries have serious grounds for integrating industrial policy and green economy by adopting an inclusive green growth agenda.

5.3 THE GA SCENARIO

The green agenda (GA) scenario is characterized by deeper industrialization, faster economic growth and speedier progress towards Africa's transformation relative to the BAU scenario. Productivity increases and numbers in poverty decline faster than under BAU.. Green growth policies become the new "business as usual", decreasing resource intensity and rebuilding Africa's ecosystem services. Inclusive growth is promoted, increasing employment and skills, enhanced natural capital and opportunities for small or medium-sized enterprise development. Socioeconomic indicators improve as Africa becomes more globally competitive, with increased exports and less reliance on imports. More of the economy circulates within the continent, as domestic production grows to meet expanding consumer demand and intraregional trade deepens. Businesses in the formal sector and multinational companies safeguard their licences to operate by adopting sustainable practices and cooperating with their communities, which ensures equitable allocation of limited resources.

Targeted policy interventions and enhanced participation in global value chains yield solid gains. Indeed, a critical success factor is setting priorities because not everything can be done at the same time, given the known inadequacies in African systems and sectors. The GA scenario highlights the benefits of such targeted interventions cascading through the system.

The GA scenario is a variant of the BAU model that originates from the IFs Model (OneWorld, 2015, box 1). The assumptions underpinning the GA are in box 5.5.

BOX 5.5 THE VARIABLES UNDERLYING THE GA SCENARIO

The interventions modelled in the GA provide critical insight into the interventions most likely to have a positive effect on Africa's development trajectory, both overall economic development and the equitable distribution of benefits; and into the magnitude of intervention needed to generate a sizeable shift within the economy.

In the GA scenario, three critical sectors for intervention stand out— water, energy and agriculture . For each sector, the following interventions are targeted for maximum effectiveness.

RENEWABLE RESOURCES

Under the GA scenario, total water demand increases relative to the BAU, mainly as a result of industrial demand. By sector, municipal demand from household users registers no change under the GA (figure 5.16, top panel). Although that seems unrealistic—per capita income and human development indicators under the GA increase, stimulating water demand as access to water infrastructure increases and the middle class expands—the imperative to allocate water for industrialization will supersede domestic demand in a trade-off. Similarly, agriculture shows a slight increase in water demand under the GA relative to BAU, which aligns with the boost in agricultural investment and production by 2030, followed by a decline to a level lower than BAU projections by 2050.

Although agricultural water demand may not increase substantially under the GA relative to BAU (given the gain in yields on greater *efficiency* rather than *quantity* of water use), we should expect municipal demand to increase relative to BAU (given rising household incomes under the GA) and thus water demand to be even higher than in the BAU scenario.

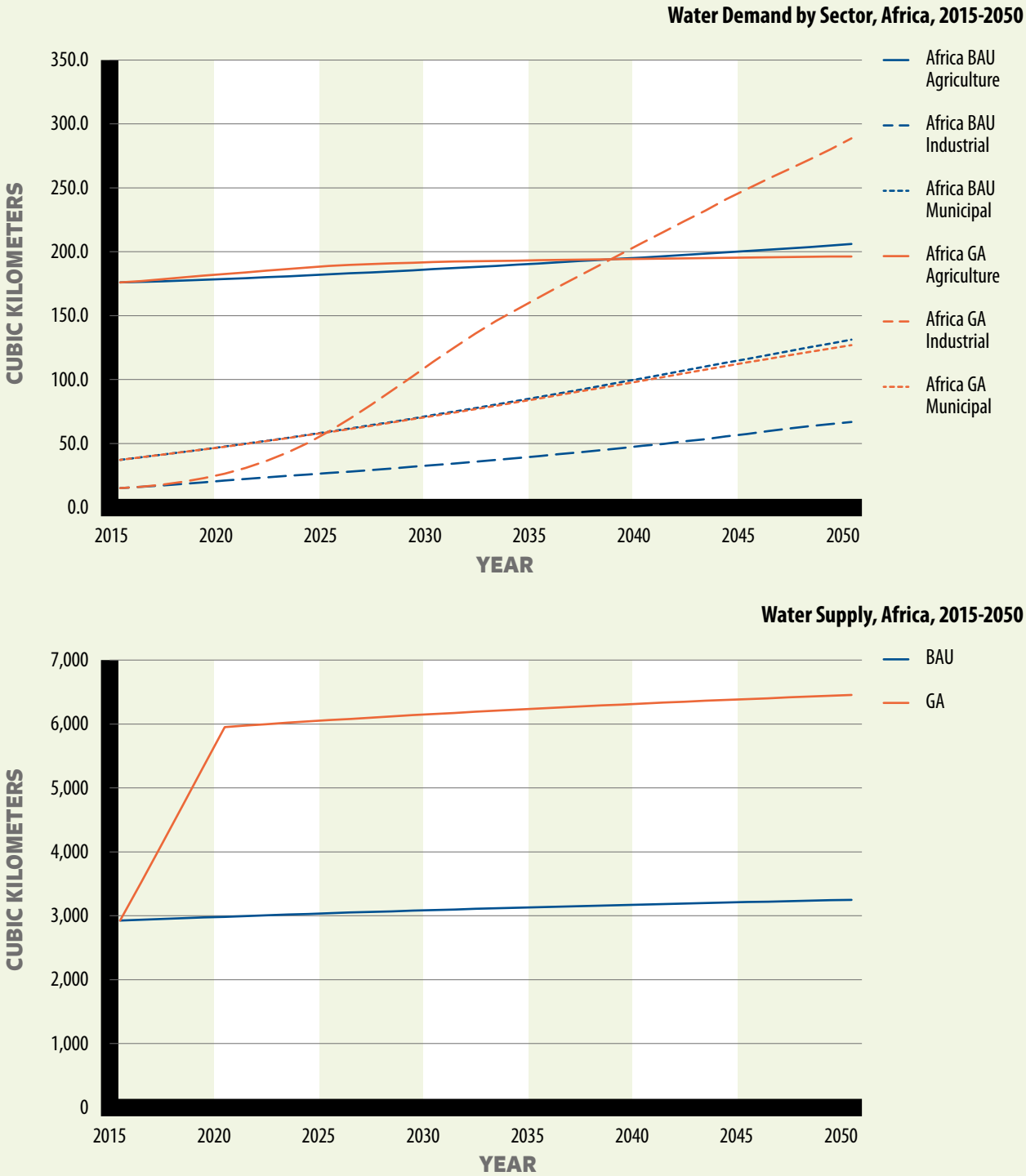
	GA interventions, 2015–2050	
Water	Renewable water supply increases by 100 per cent	This estimate is based on rainwater harvesting potential calculated by the International Centre for Research in Agroforestry (ICRAF) and the United Nations Environment Programme (UNEP) ((2005) for nine Eastern and Southern African countries. The minimum potential increase in water resources from widespread installation of rainwater harvesting equipment is 500 per cent. The estimate is downscaled because of regional differences in precipitation and is validated by global best practice examples—for example, in Australia and Germany.
Energy	Energy production costs fall by 5 per cent a year from 2015–2050	This estimate is based on predicted world renewable energy price declines—the cost of electricity from solar photovoltaic cells has fallen 50 per cent since 2010 (10–15 per cent a year) and is predicted to fall a further 40 per cent over the next 4 years and by 60–80 per cent over the next 20 years (IRENA, 2015; Pollin, 2015). The estimate is also based on steady declines in renewable energy production costs in South Africa. Since the onset of that country's renewable energy procurement programme, electricity costs from wind, solar photovoltaic and concentrated solar power (CSP) have fallen by an average of 25 per cent over three years (Eberhard, Kolker and Leigland, 2014). For our purposes, the annual decrease has been cut from 10–15 per cent to 5 per cent because of assumed higher production costs in less developed markets.
	Energy generation capacity per capita increases by 400 per cent	Estimate is based on two factors: 1 The increase it would take to bring Africa (currently 0.14 kWh per person) up to the present-day average energy generation capacity per capita of Brazil, China and India (0.5 kWh per person) by 2050; and 2 Projections in Greenpeace's Energy Revolution Scenario for a 500–700 per cent rise in electricity generation in Africa by 2050, lowered to account for population increase (Greenpeace, 2015).
	Energy investment in hydropower increases by 300 per cent	Estimate is based on projections in Greenpeace's Energy Revolution Scenario for a 200–300 per cent increase in hydropower energy investment by 2050 (Greenpeace, 2015).
	Energy investment in renewables increases by 3,000 per cent	Estimate is based on projections in Greenpeace's Energy Revolution Scenario for a 2,000–3,000 per cent increase in renewable energy investment by 2050 (Greenpeace, 2015).Estimate is in line with Pollin's (2015) projections for global clean renewable energy growth by 2035 (3,000 per cent growth globally).
Agriculture	Land equipped for irrigation increases by 60 per cent from 2015–2050	Estimate is based on two factors: 1 Alexandratos and Bruinsma's (2012) projections of land under irrigation by 2050, by region, ranging from a 23 per cent increase (South Africa) to a 39 per cent increase (West Africa) under BAU; and 2 Foster and Briceno-Garmendia (2009) estimate that full development of all economically feasible irrigation schemes (dam based and small scale) would double irrigated land under cultivation. With the full potential for expansion in mind (100 per cent), estimates in the GA scenario assume accelerated agricultural and infrastructure investment (Alexandratos and Bruinsma, 2012) but still take into account the historical trend of low investment in large-scale irrigation.
	Agricultural investment rises by 450 per cent from 2015–2050	Branca et al., (2012) estimate that the financing gap for agriculture (crops only) is $7.25 billion a year, cumulatively about $250 billion by 2050 (a 400 per cent increase). Including livestock, the figure increases to $400 billion by 2050 (a 660 per cent increase). Estimates cited here were selected from the 400–660 per cent range, based on aggressive agriculture-focused development.
	Agricultural losses fall by 50 per cent (because of inefficiencies, waste, crop failure, and so forth) from 2015–2050	Gustavsson (2011) estimates Central, East, Southern and West Africa food losses and waste at 160 kg per person a year, the vast majority lost in harvest, post-harvest and processing activities. Estimation of the GA trend is based on Central, East, Southern and West Africa reaching current levels of South and South-East Asian production and processing efficiency by 2050, equivalent to a 50 per cent decrease in losses.
	Road network density increases by 670 per cent by 2050	Estimate is based on the assumption that the planned expansion of major road networks under the Programme for Infrastructure Development in Africa (PIDA) is implemented by 2050, that is, from the current 10,000 km to 60,000–100,000 km, a 500–900 per cent increase.

BOX 5.5, CONTINUED THE VARIABLES UNDERLYING THE GA SCENARIO

	GA anticipated effects, 2015–2050
Water	In the GA scenario, water supply is estimated at 98 per cent higher than the BAU level in 2050 because of the following policy initiatives that, out of necessity, simultaneously and rapidly address the water infrastructure deficit and related ecological issues in Africa. With these interventions, Africa could realistically start to double its water supply as it makes a concerted effort to catch up with water access in other global regions: ▸ Widespread adoption of technologies such as rainwater harvesting; ▸ Increased investment in water treatment facilities for recycling and reuse; ▸ Land degradation addressed, and ecosystems within high-water-runoff areas (that act as critical water towers for river basins) restored; ▸ Investment in ecological infrastructure (protecting and restoring wetlands, removing alien invasive species, establishing riparian buffer strips, and so forth); ▸ Improved knowledge and resource management of groundwater resources; ▸ Increased investment in water infrastructure to improve access and efficiency; and ▸ Improved regional cooperation for equitable allocation and abstraction of shared water resources. ▸ East and West Africa offer the most potential for increases in rainwater capture. They are also the two regions with the fastest population growth and likely increasing rainfall trends in the next 50 years.
Energy	Relative to the BAU figures, renewable energy production under GA increases significantly as Africa aggressively accesses valuable, local renewable resources and reduces its dependence on fossil fuel production and imports: ▸ Renewable energy production in 2050 is 58.4 per cent of total production under BAU but 92.8 per cent of total production under the GA. ▸ Fossil-fuel production in 2050 is 8.74 per cent of total production under BAU but 1.86 per cent of total energy production under the GA. ▸ Total electricity production is 962 per cent higher than the BAU level in 2050. ▸ Energy import as a proportion of demand is 13 per cent lower than the BAU level in 2050.
Agriculture	Relative to the BAU levels in 2050, the GA levels are as follows: ▸ Agricultural production per capita is 103 per cent higher. ▸ Agricultural yield per hectare is 114 per cent higher. ▸ Agricultural exports as a share of GDP are 2,485 per cent higher. ▸ Dependence on agricultural imports is 91 per cent lower. ▸ Value added in agriculture is 98 per cent higher. ▸ Access to rural roads is 66 per cent higher.
Environment	Relative to the BAU levels in 2050, the GA levels are as follows: ▸ Forest land use is 1.1 per cent higher. ▸ Annual carbon emissions for the continent are 60.5 per cent lower. ▸ Precipitation change from carbon dioxide emissions is 7.8 per cent lower. ▸ Temperature change from carbon dioxide emissions is 10.7 per cent lower.
Economy and development	Relative to the BAU level, share or index in 2050, the corresponding GA figures are as follows: ▸ GDP per capita is 11 per cent higher. ▸ Exports per capita are 18.6 per cent higher. ▸ Informal GDP share is 16.9 per cent lower. ▸ Poverty levels ($2 per day) are 30.8 per cent lower. ▸ Calories per capita are 7.6 per cent higher. ▸ Democracy Index is 1.4 per cent higher. ▸ Economic Freedom Index is 1.2 per cent higher. ▸ Gender Empowerment Measure is 2.5 per cent higher.

Industrial demand for water will increase under the GA relative to BAU as the manufacturing base expands. Under GA, export promotion policies targeted towards agro-industry will greatly affect demand for water, as demand for raw agricultural inputs increases and as agricultural processing and higher value added activities grow.

FIGURE 5.16 BAU AND GA—WATER DEMAND AND WATER AVAILABILITY, AFRICA, 2015–2050



SOURCE: ONEWORLD, ADAPTED FROM INTERNATIONAL FUTURES (2015).

NOTE: BAU = BUSINESS AS USUAL; GA = GREEN AGENDA.

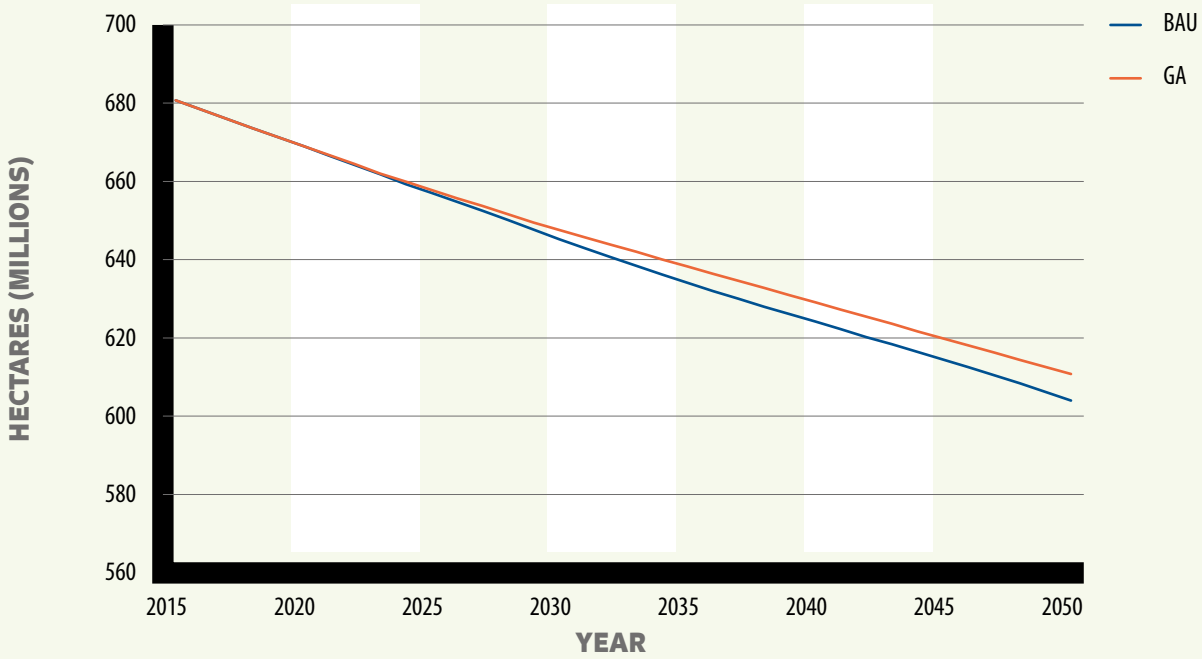
As water demand increases, water-scarce regions in Africa will need to scale up interventions to increase water supply. Under GA, water supply doubles, improving significantly relative to BAU because of the following efforts:

- Widespread adoption of technologies such as rainwater harvesting;
- Increased investment in water treatment facilities for recycling and reuse;
- Land degradation tackled, and ecosystems restored within high-water-runoff areas that act as critical water towers for river basins;
- Investment in ecological infrastructure (protecting and restoring wetlands, removing alien invasive species, establishing riparian buffer strips, and so forth);
- Improved knowledge and management of groundwater resources;
- Increased investment in water infrastructure to improve access and efficiency; and
- Improved regional cooperation for equitable allocation and abstraction of shared water resources.

The success of these interventions varies among regions, but East and West Africa—the two regions that will experience the highest population growth rates and increasing rainfall trends within the next 50 years resulting from climate change—offer the most potential for increases in rainwater capture.

Given water's integral role in socioeconomic development, improvements to the water supply cascade throughout the system, stimulating knock-on effects for food security, energy production and industrial growth. UNEP (2013) estimated that increased investment in improved natural resource management and land restoration would save 242 billion tonnes of water by 2030 in South Africa, translating into a 1.1 per cent decrease in the country's water stress index from BAU.

FIGURE 5.17 BAU AND GA—FOREST LAND AREA, AFRICA, 2015–2050 (HECTARES)



SOURCE: ONEWORLD, ADAPTED FROM INTERNATIONAL FUTURES (2015).

NOTE: BAU = BUSINESS AS USUAL; GA = GREEN AGENDA.

Improvements in water supply will become increasingly important with a changing climate. Each of the interventions under the GA also helps to reduce vulnerability to climate impacts.

The rate of deforestation slows relative to BAU, with policy interventions and increased investment in energy generation, agricultural production and associated infrastructure. Gains in energy production—which under the GA are entirely from renewable energy, including hydropower—and in energy access will increase consumption of clean energy. Consumption of bioenergy (primarily wood and charcoal) will fall, as access to the grid expands. Agricultural yields under the GA are higher primarily as a result of improved production techniques and technologies in land under cultivation, rather than an expanded area under cropping, which relieves some of the pressure to deforest for agricultural expansion. Those two GA interventions—in power and agriculture—reduce deforestation relative to BAU, and the gap between the two scenarios widens (figure 5.17).

ENERGY

Renewable energy generation capacity, abetted by, for example, green procurement programmes and falling costs, grows steeply and narrows the supply–demand gap. It reduces the heavy reliance on fossil-fuel production and imports seen in BAU (figure 5.18).

Based on variables applied to the GA scenario, access to electricity improves significantly relative to BAU (OneWorld, 2015). These results are in line with similar modelling exercises for the continent. UNEP's (2014c) assessment of the effect of green investment in Burkina Faso found that investment in renewable energy would increase electricity supply by 140 per cent in 2050, compared with BAU, with the share of renewables in the energy mix increasing from 20 per cent to 60 per cent.

AGRICULTURE

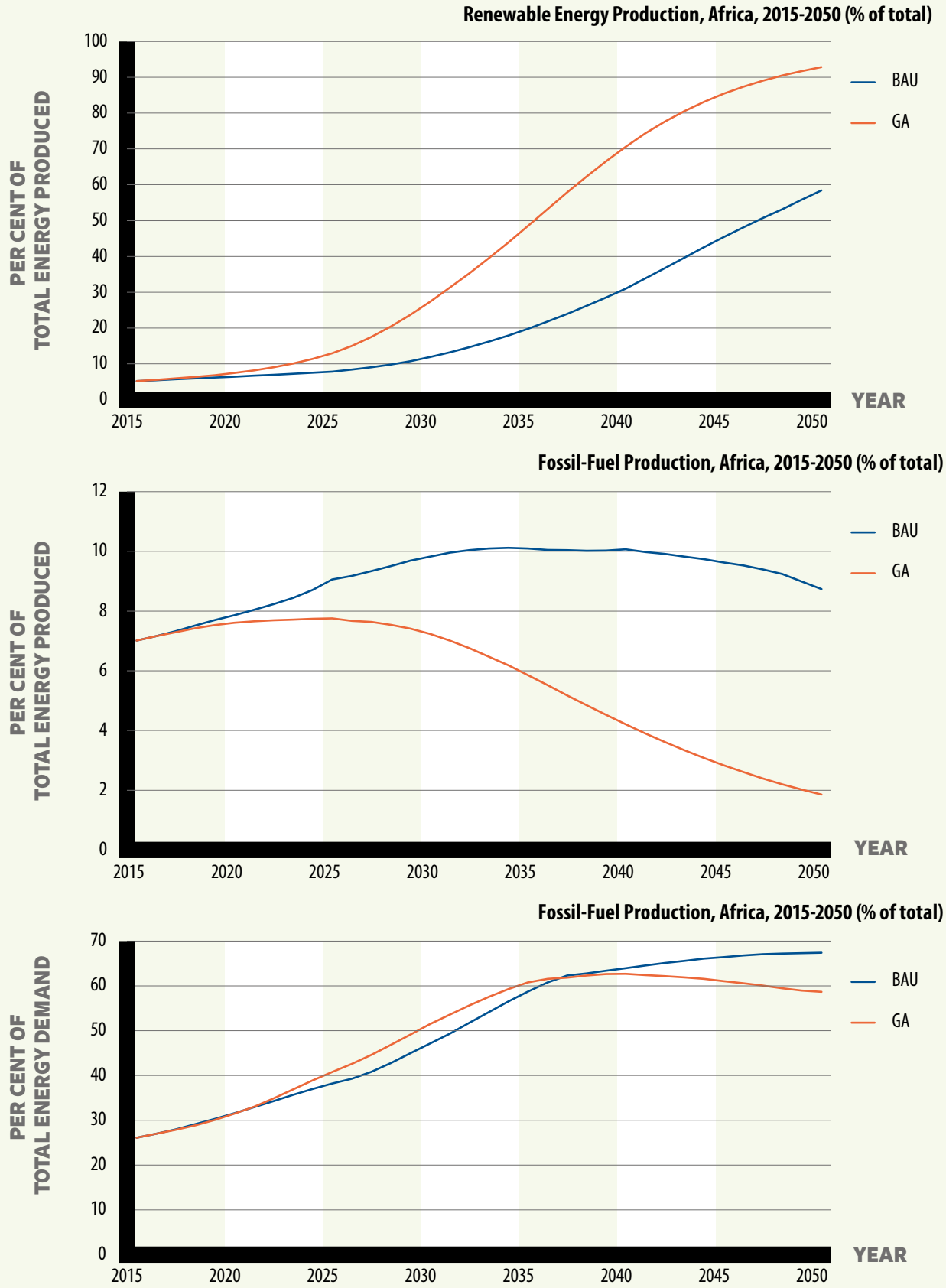
In the GA scenario, huge increases in productivity result from an aggressive greening of Africa's agriculture and expansion of irrigation, reducing dependence on rain-fed agriculture. Yields increase substantially relative to BAU.

Consumption of bioenergy (primarily wood and charcoal) will fall, as access to the grid expands.

Recent green economy modelling exercises have shown similar results, albeit on a smaller scale. Scenario modelling for Kenya's green economy transition found that agricultural yields improved by 15 per cent by 2030 compared with BAU (UNEP, 2014a), and similar modelling in Senegal saw agricultural production pick up relative to BAU as a result of improved agricultural techniques and increased uptake of advanced technologies (UNEP, 2014b). In South Africa, green investments in agriculture are modelled to increase yields by 23.9 per cent under a scenario in which the government allocates 2 per cent of GDP to green sectors (UNEP, 2013).

The projected increase in yields under the GA generates much-improved agricultural production per capita in terms of tonnes produced per hectare, enhancing food security in part through lowering dependence on food imports (figure 5.19). Major increases in yields enable the continent to feed its fast-growing population and capitalize on its comparative advantage, as it expands as an exporter of high value added agricultural products and agricultural raw materials.

FIGURE 5.18 BAU AND GA—RENEWABLE ENERGY AND FOSSIL-FUEL PRODUCTION, AND FUEL IMPORT DEPENDENCE, 2015–2050



SOURCE: ONEWORLD, ADAPTED FROM INTERNATIONAL FUTURES (2015).

NOTE: BAU = BUSINESS AS USUAL; GA = GREEN AGENDA.

One outcome is a dramatic increase in agricultural exports and, although these start to level off in around 2045, a positive contribution to GDP is made under GA relative to under BAU (figure 5.20, right panel).

Studies around the developing world highlight that medium-sized farmers are more likely to improve resource efficiencies and adopt new technologies because they farm at a scale at which doing so makes economic sense. Their operations also are often inclusive of small farmers who help to improve productivity and maintain economies of scale (Sheahan and Barrett, 2014). The socioeconomic benefits of a green agenda are so apparent that the argument for not following a green industrialization pathway is weak.

Africa's accelerated irrigation expansion under the GA improves productivity and helps to mitigate the negative impacts of climate change. Under climate scenarios for higher temperatures and drier conditions, an important response in Africa's already dry areas, is to expand irrigated areas to supplement rain-fed production.

Agricultural output will increase even more with accelerated uptake of technologies, increased labour productivity and sustainable water management. Currently underexploited arable land (with low yields largely because of underutilization of water resources and of available land) provides the opportunity for leapfrogging to more sustainable and more inclusive agricultural development pathways. Unprecedented access to new research and technologies from successful "green revolutions" in Asia and Latin America, if harnessed, can accelerate the pace of change.

The combination of interventions in management of renewable resources, accelerated renewable energy generation and increased productivity across the agricultural sector—including through light manufacturing—have cumulative socioeconomic benefits. Those benefits include helping to realize the demographic dividend, substantially enhancing the transition from the informal to formal labour sector, strengthening infrastructure investment and broadening the base of economic growth.

POPULATION AND EMPLOYMENT

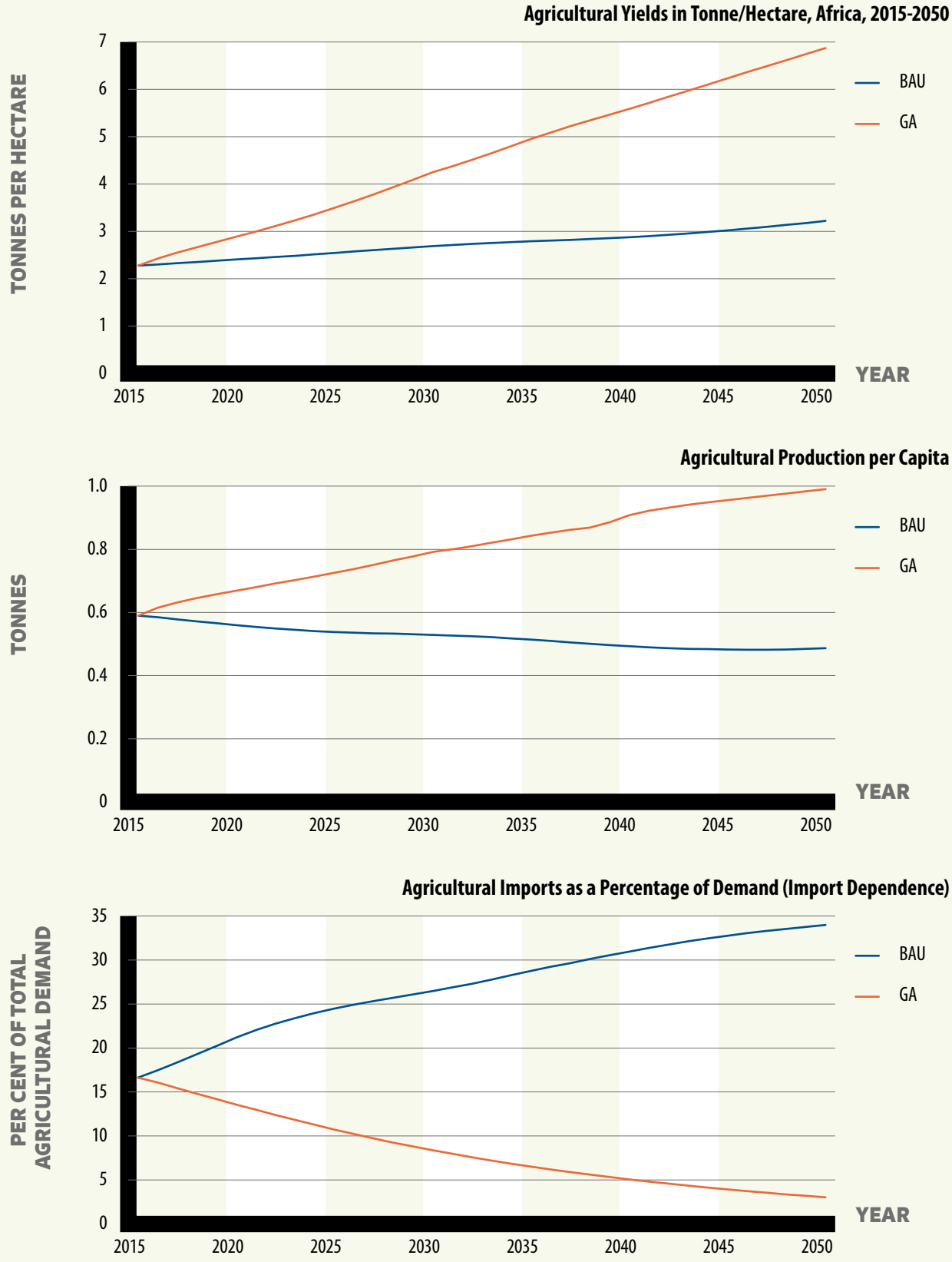
Central, East, Southern and West Africa's current fertility decline is slower than in other regions (including North Africa) that have already undergone a fertility transition and reaped some of the economic benefits, although the region faces un and under employed youth problems. Accelerating the fertility decline—as under GA—is essential, both to decrease Africa's dependency ratio and to realize the demographic dividend faster.

Widespread implementation of multisectoral GA interventions will hasten Africa's fertility transition, with enormous system-wide benefits. Better access to electricity and clean water leads to higher incomes, falling infant mortality rates, and upward trends in physical, social and knowledge capital. The overall effect is greater political and economic stability, a critical factor in reducing birth rates further.[3]

The transition towards the formal economy—with its increase in services and manufacturing as a share of GDP and a decline in informal labour as a

Currently underexploited arable land ... ... provides the opportunity for leapfrogging to more sustainable and more inclusive agricultural development pathways.

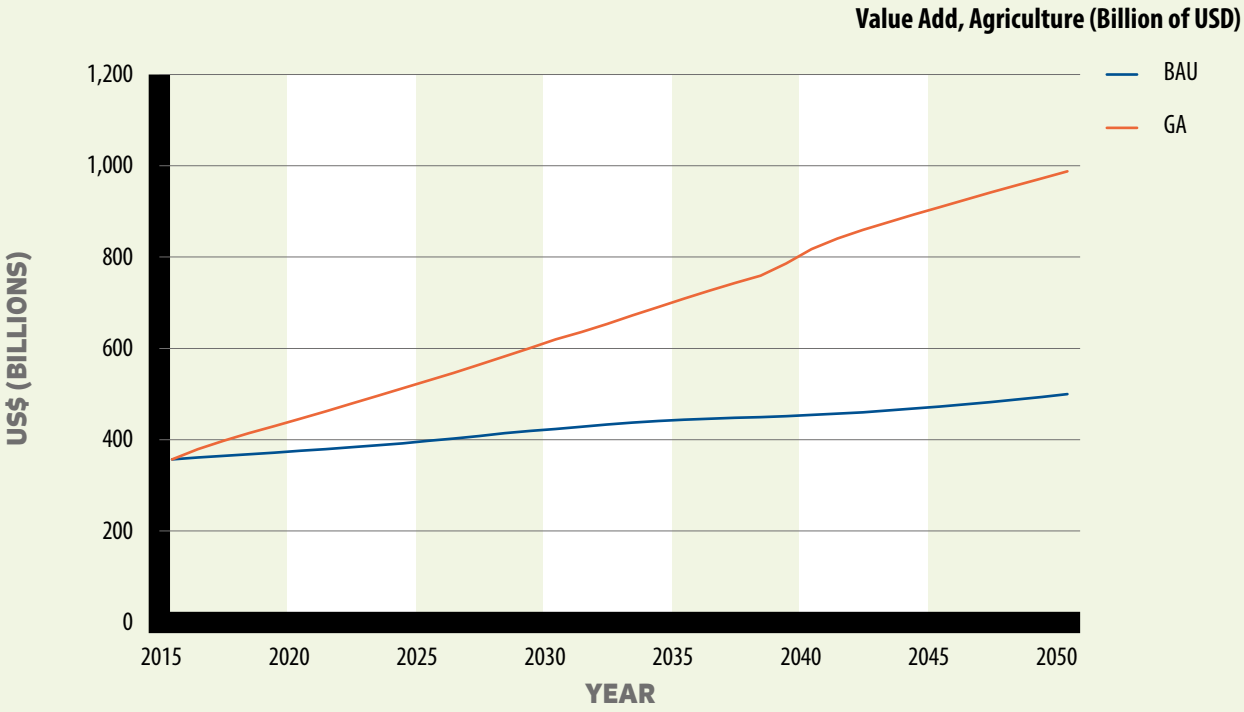
FIGURE 5.19 BAU AND GA—YIELD, PRODUCTION PER CAPITA AND IMPORT DEPENDENCE, 2015–2050

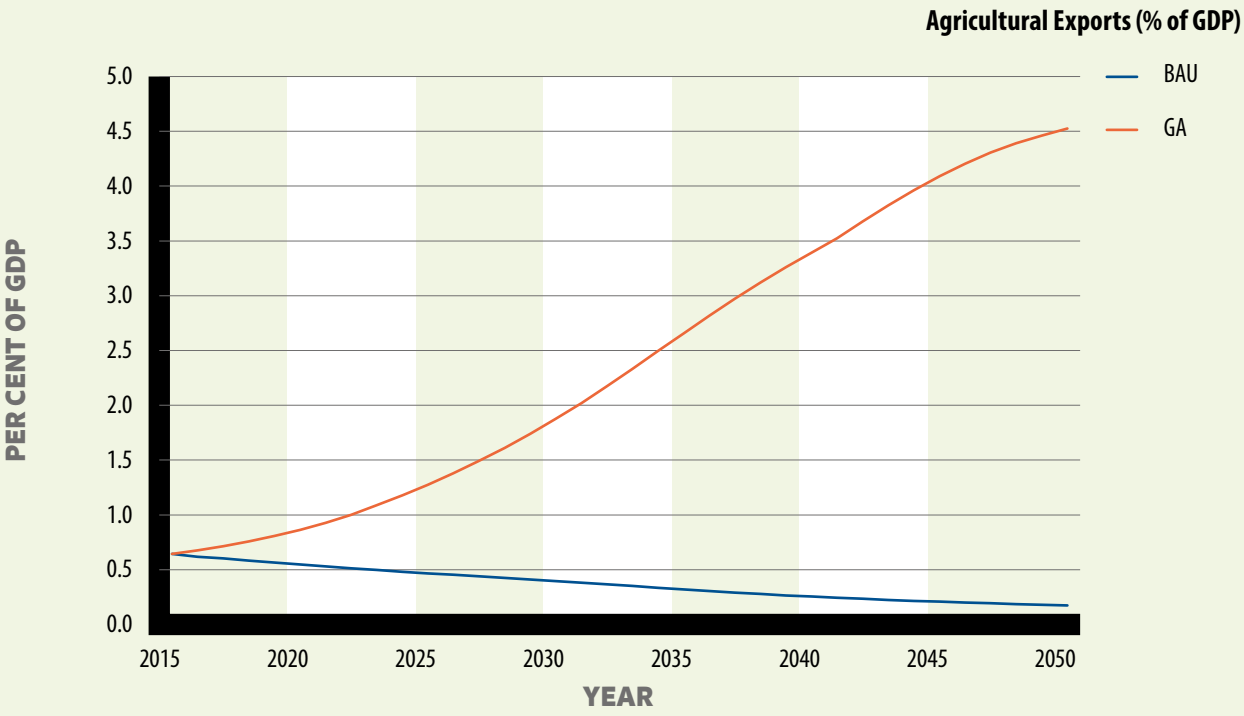


SOURCE: ONEWORLD, ADAPTED FROM INTERNATIONAL FUTURES (2015).

BAU = BUSINESS AS USUAL; GA = GREEN AGENDA.

FIGURE 5.20 BAU AND GA—VALUE ADDED IN AGRICULTURE AND AGRICULTURAL EXPORTS, 2015–2050



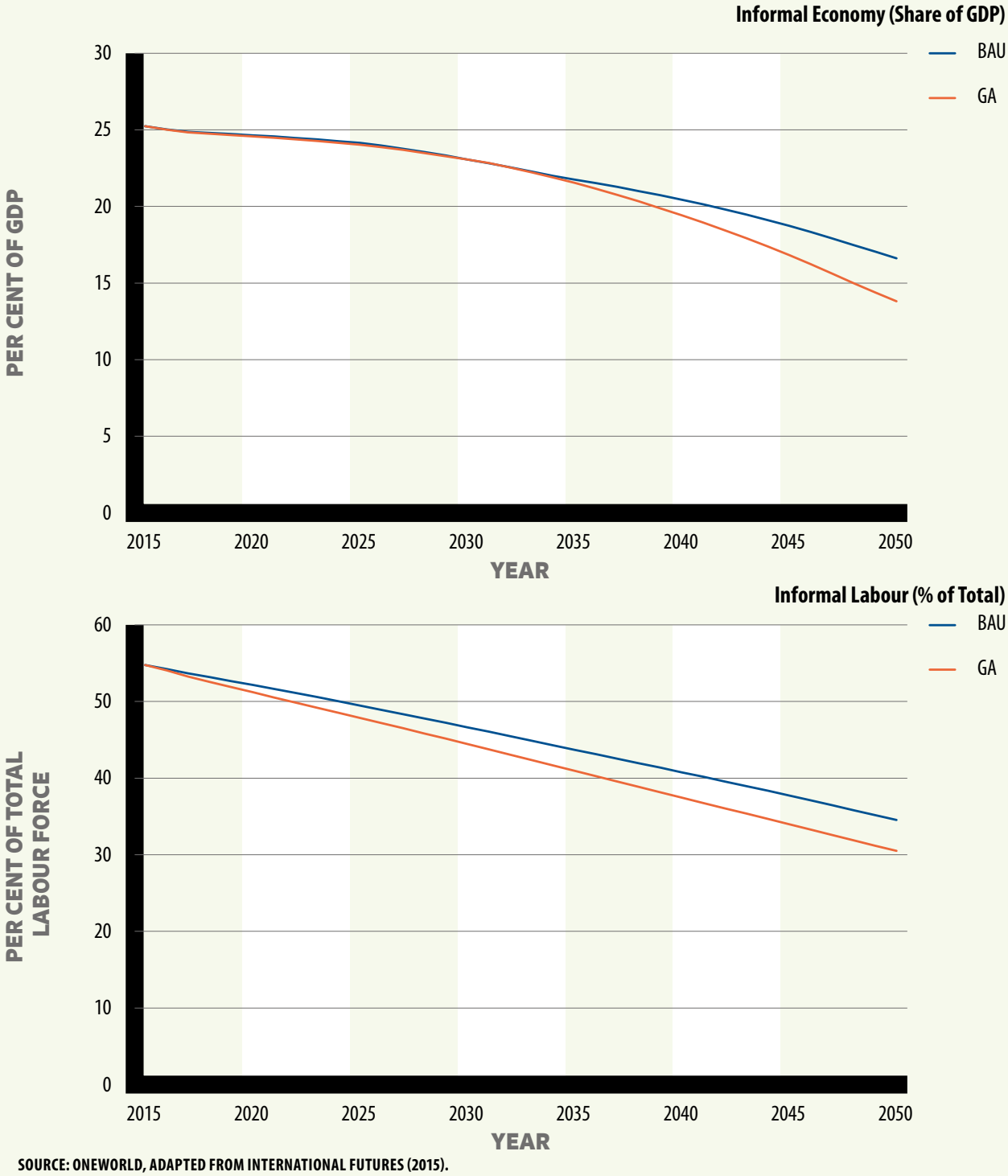


SOURCE: ONEWORLD, ADAPTED FROM INTERNATIONAL FUTURES (2015).

NOTE: BAU = BUSINESS AS USUAL; GA = GREEN AGENDA; GDP = GROSS DOMESTIC PRODUCT; USD = US DOLLARS.

share of the workforce—is an important co-benefit of the GA scenario (figure 5.21). Increased investment only in South Africa's natural resource management sector is projected to generate 701,000 new formal-sector jobs by 2030, up from the 568,000 projected under BAU (UNEP, 2013). In Burkina Faso, 160,000 additional jobs are projected by 2050 under a green economy scenario (UNEP,

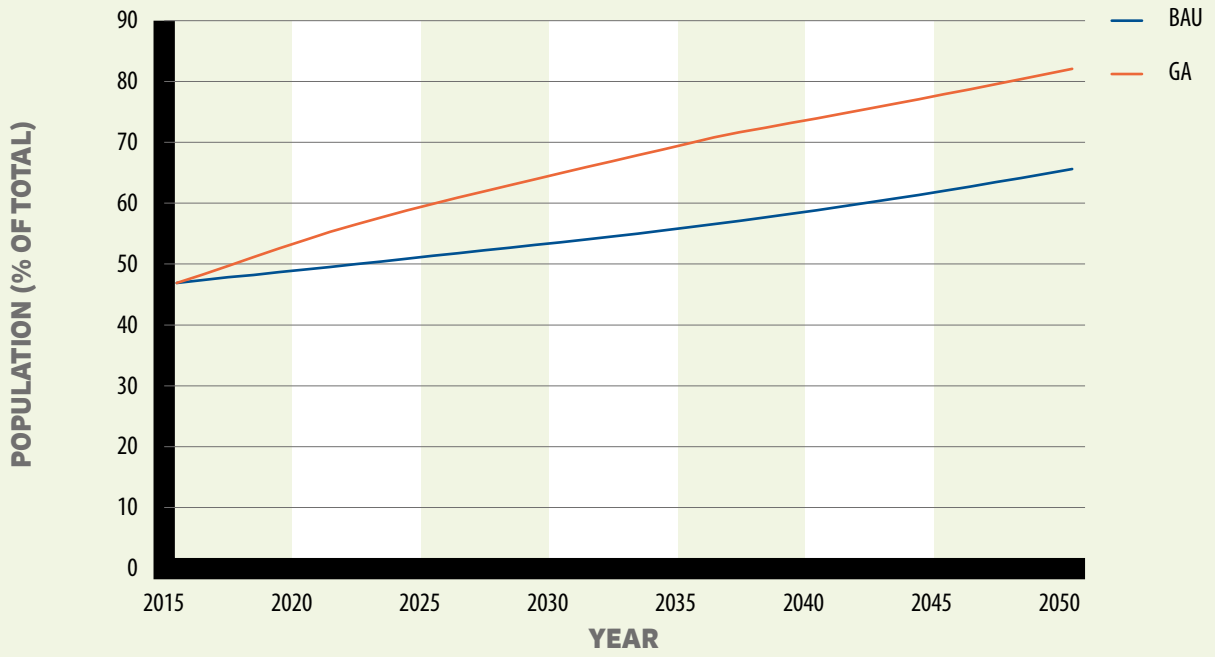
FIGURE 5.21 BAU AND GA—SHARES OF THE INFORMAL ECONOMY AND INFORMAL LABOUR, 2015–2050



SOURCE: ONEWORLD, ADAPTED FROM INTERNATIONAL FUTURES (2015).

NOTE: BAU = BUSINESS AS USUAL; GA = GREEN AGE

FIGURE 5.22 BAU AND GA—ACCESS TO RURAL ROADS, 2015–2050



SOURCE: ONEWORLD, ADAPTED FROM INTERNATIONAL FUTURES (2015).
NOTE: BAU = BUSINESS AS USUAL; GA = GREEN AGENDA.

2014c). Senegal's renewable energy sector is estimated to generate between 7,600 and 30,000 new jobs by 2035 (UNEP, 2014b).

ECONOMIC GROWTH, DEVELOPMENT AND INFRASTRUCTURE

The cumulative result of the interventions will boost GDP per capita growth and exports per capita. (The Ethiopian eco-industrial case study in Chapter 6 provides early evidence of this trend.) With this growth in GDP per capita, poverty levels (measured at less than $2 per day) decline significantly under the GA scenario compared with BAU (see figure 5.1).

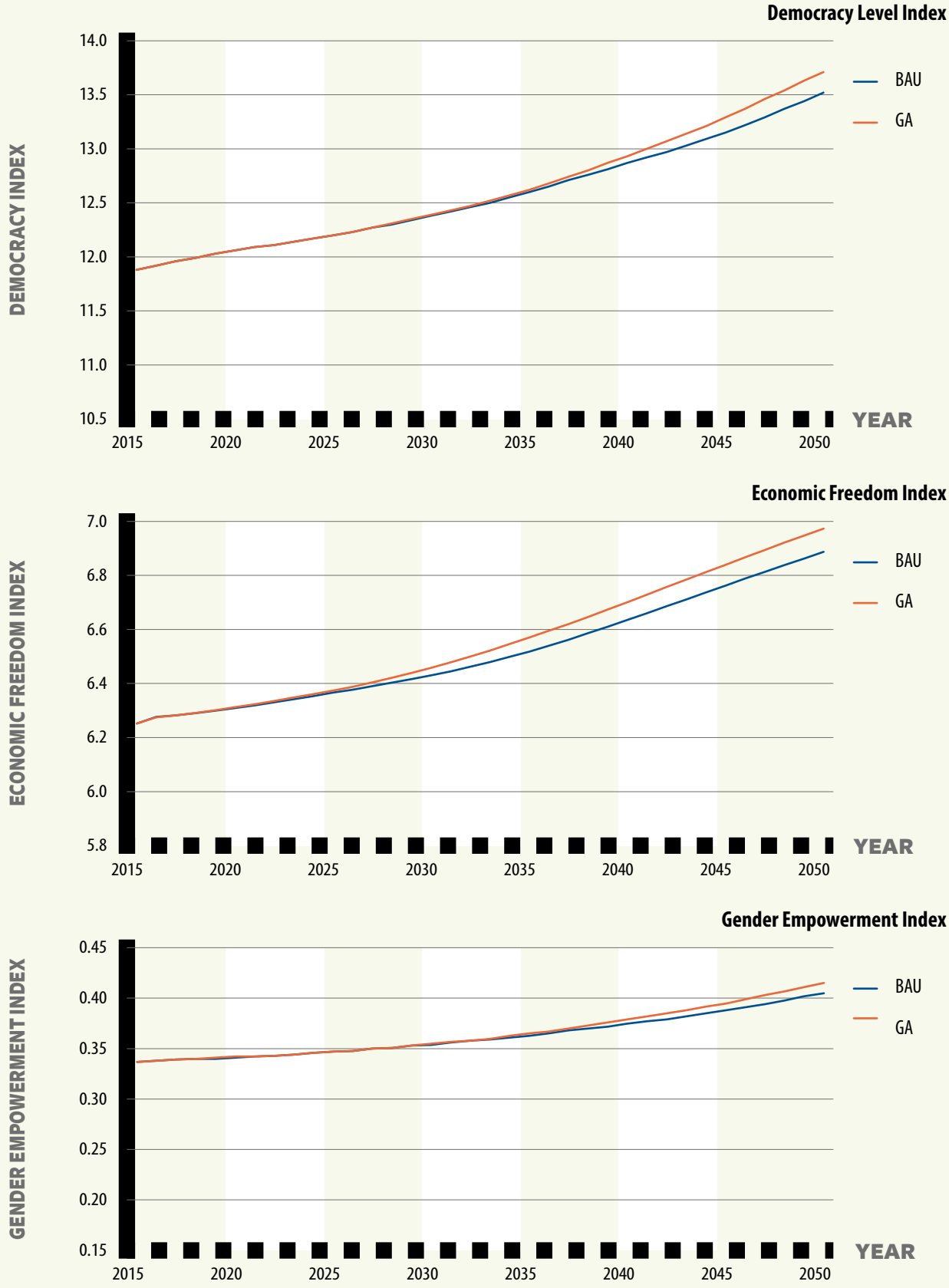
These results are in line with the findings of several green economy assessments (UNEP, 2014a, b, and c). UNEP (2014a) found that Kenyan GDP growth under a green economy scenario was 12 per cent higher in 2030 than under BAU, with an additional 3.1 million people shifted above the poverty line.

Expenditure on research and development increases dramatically in the GA from the BAU scenario (from 0.4 per cent to nearly 2 per cent of GDP by 2050) (OneWorld, 2015), bringing benefits in improved technology uptake and facilitating, for example, a robust shift to more productive agriculture resulting from improved agro-processing.

Africa's GA scenario infrastructure investments increase road networks (figure 5.22), improving market access and trade, thereby helping to increase Africa's participation in regional and global value chains.

The cumulative results of adopting a green agenda and green industrialization pathways are positive for many of the continent's develop-

FIGURE 5.23 BAU AND THE GA—INDICES FOR DEMOCRACY, ECONOMIC FREEDOM AND GENDER EMPOWERMENT, 2015–2050



SOURCE: ONEWORLD, ADAPTED FROM INTERNATIONAL FUTURES (2015).

NOTE: BAU = BUSINESS AS USUAL; GA = GREEN AGENDA.

ment indicators, reflecting co-benefits to society, including gains in democracy, economic freedom and gender empowerment—all of which improve more under the GA than under BAU (figure 5.23).

THE GA SCENARIO AND THE GLOBAL GREEN INVESTMENT SCENARIO: SOME SIMILARITIES AND DIFFERENCES

Some of the assumptions and outcomes of the GA scenario are comparable to the global green investment scenario (G2) developed under the T-21 World Model (UNEP, 2011), particularly green investments showing positive outcomes and trends across the social, economic and environmental spectrum.

G2 provides an opportunity to contextualize Africa's green growth globally. Africa's GA scenario outcomes are aligned with those of G2 (the broader assumptions are similar), although some drivers and baselines differ, sometimes greatly, particularly with respect to Africa's infrastructure and industrialization deficits and far lower greenhouse gas emissions. G2 represents a similar strategy to the GA scenario for Africa of embedding green investments and enabling a policy framework into long-term commitments (UNEP, 2011).

The GA is aligned with the G2 assumption that 2 per cent of global GDP channelled into green investments will yield 10 per cent growth in global GDP, gradually over time, with positive social and environmental benefits. As with the GA scenario, G2 prioritizes sectoral policy targets that position the world to better absorb the impacts of climate change and volatility.

G2 emphasizes energy and climate change. The GA also prioritizes energy investments, particularly renewables, to address three key issues: Africa's massive energy infrastructure and resource deficits; paucity of enabling conditions for Africa to industrialize; and diversion of energy reliance from hydropower investments (given their decreasing returns because of environmental and climate impacts and increased competition for water) and from fossil-fuel imports (which are price volatile, expensive and environmentally unfriendly). In addressing these issues the GA recognizes that Africa needs a reliable and adequate energy supply to industrialize, and that it has a tremendous opportunity to leap-frog by prioritizing green energy investments using its vast, renewable resource base. This is a cornerstone of Africa's green industrialization pathway.

Although G2's promotion of investment in key ecosystem services and low-carbon development slightly slows economic growth in the short to medium term, growth is faster and more sustainable further out. The African and global green scenarios are more resilient than the modelled' BAU scenarios, driven by lower emissions from clean energy investments, reduced dependence on volatile fuels and more efficient and sustainable use of natural resources. The GA also prioritizes—by necessity—investments in Africa's rainwater harvesting and storage infrastructure, in transport networks and in improved agricultural land-use practices.

Under the GA scenario, water scarcity becomes manageable even though water demand increases because each of the factors contributing to scarcity is addressed simultaneously with the greening of the massive, new infrastructure investments.

In agriculture and its industrialization, G2 argues that green investments should be allocated to agriculture more predominantly where that sector is a major driver of economic and social development (UNEP, 2011). This is true for most of Africa, which houses the majority of the world's least developed countries. G2 shows that in these

cases, investments in more sustainable agriculture could increase yields and production, improving nutrition and food security and paving the way for agro-industrialization.

The GA for Africa makes similar assumptions with attractive returns, noting though that the infrastructure deficit must be bridged—urgently. The GA includes irrigation expansion, improved water access, greener farming practices and the incremental investments (organic fertilizer, pest control, and food processing) that G2 considers.

Cumulatively, these investments improve crop productivity under both scenarios. In G2, annual incremental investments of about $198 billion increase productivity by 17 per cent in 2050 (UNEP, 2011). Both G2 and the GA show positive trends for value added in agriculture: it increases to 9 per cent relative to BAU in 2050 under G2, mainly because of G2's higher yield per hectare estimate in the medium to longer term.

Gradual social and environmental gains also are seen in both G2 and the GA. Under the global BAU scenario, investments drive faster economic growth than the green alternatives in the short term (in terms of total and per capita GDP), with only marginal differences on the social side (poverty, employment and nutrition). Matters are very different in the medium to longer term: G2 and the GA both outperform BAU in economic and social development. Both of these green scenarios also have lower negative impacts on the environment, such as energy intensity, water use and natural capital footprint, which contributes to their faster medium to longer term economic growth.

The final positive trend observed and compared is inclusive growth, particularly employment. Under G2, economic development in a global green economy pushes employment up to 4.9 billion, or 3–5 per cent above BAU. Under GA, Africa's urban population continues to grow at a similar pace as under BAU, but a greater share are employed because of green industrialization, growth of jobs, and local enterprise development.

Increased industrialization and services also facilitate the transition towards the formal economy in Africa (see figure 5.21). They are important co-benefits of the GA scenario, which also stem from greater investments in renewables, climate-resilient infrastructure, resource-use efficiencies, land restoration and new green enterprises. (This point is backed by global case studies and to some extent by the country case studies in Chapter 6.) The cumulative return of all these investments will be millions of new jobs and inclusive growth across the continent.

5.4 SOME CONCLUSIONS: THE IMPORTANCE OF THE ENABLING ENVIRONMENT

Africa is sitting on a "'gold mine", as one of the few major regions left with viable natural resources and abundant opportunities for economic growth and industrialization. Pursuing a green agenda with urgency—BAU shows the huge resource depletion possible in a mere 35 years—can create the right enabling environment.

One critical enabler is infrastructure, an arena in which Africa needs huge investments; green industrialization will be impossible without them. BAU demonstrates that investments of this scale must be greened to harness and protect critical renewable resources and to stimulate inclusive growth and employment. Without the right enabling environment, however, the deficit in Africa's infrastructure investments will continue to grow alarmingly. With increasing weaknesses in unsustainable infrastructure (because it is neither climate resilient nor resource efficient), the deficit will remain a threat to Africa's growth prospects.

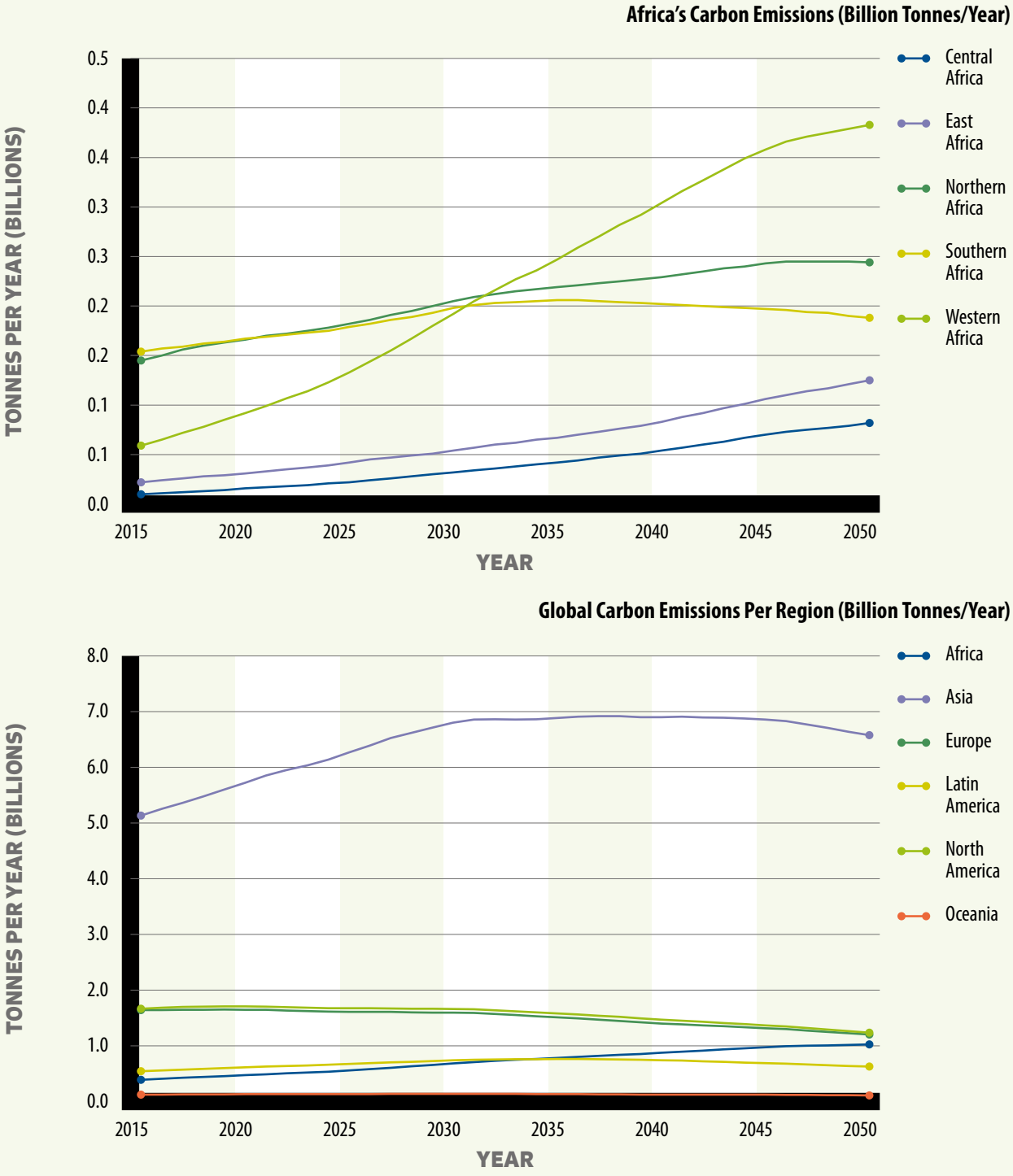
The costs to renewable resources of the green agenda are steep, but they can be met. A green agenda raises questions of trade-offs, but it also demonstrates how Africa can control and mitigate many of the factors threatening growth. The continent can even adapt to climate change, whose cause is largely not attributable to Africa (figure 5.24), if serious thought and focused action are applied to building resilience. Applying lessons from global examples of best practice and regional successes can help African countries improve water resource management, mitigate the economic and social impacts of extreme events, and access international and domestic sources of climate finance.

The most important condition for success is, arguably, improved governance across Africa at national, regional and subregional levels. Africa's 16 landlocked countries depend on their neighbours with coastlines for many resources, such as access to ports, markets and skills. Investors, particularly the private sector, depend on sustainable market access and secure natural resources to ensure a return on their stake. Intercountry dependencies and shared resources often mean that potential investors have too little control over too many variables. To secure the interests of investors and the rights of citizens, African governments must tackle the infrastructure deficit within a framework of regional cooperative governance.

Better governance and investment decisions require governments to prioritize among the trade-offs linked to the resource demands of competing development claims, particularly among sectors and countries that share resources. Understanding trade-offs may help countries overcome the current inertia on transboundary and regional cooperation, which often is driven by the need to protect perceived vested national or sectoral interests, and which may well be less than the shared benefits of cooperation. Analysis of the trade-offs and shared benefits requires a longer term view in weighing the possible outcomes of development decisions: water is available now for expanding hydropower and irrigation, but will that still be true in 2050 if populations grow as forecast? Will greening new infrastructure accelerate the pace of investment, or will the related expense outweigh this benefit over the long run?

Adopting the green agenda may seem a trade-off for some, but it is not. Focused and incremental pursuit of the GA has obvious direct and indi-

FIGURE 5.24 ANNUAL CARBON EMISSIONS, AFRICAN SUBREGIONS AND GLOBAL REGIONS (BILLION TONNES PER YEAR)



SOURCE: ONEWORLD, ADAPTED FROM INTERNATIONAL FUTURES (2015).

rect benefits. Although a detailed cost–benefit analysis is unavailable, the GA scenario strongly suggests that greening industrialization does not come at too high a cost and, in particular, supports the assertion in the UNEP global green investment scenario that investment of 2 per cent of GDP generates an attractive 10 per cent increase in GDP (UNEP, 2011).

BAU generates a different set of costs. Current growth pathways not only pose a threat to economic growth and industrialization but also fail to make serious progress towards meeting objectives related to job creation, inclusivity, human development and environmental protection—all key components of the Sustainable Development Goals.

The GA implies—and requires—a substantial upfront investment to realize longer range goals. In return the GA offers a pathway on which benefits increasingly outweigh costs (because of the far-reaching direct benefits and co-benefits from implementing the GA), while ensuring that the continent is well on its way to structural transformation through green industrialization.

In other words, the green agenda moves Africa well beyond protecting its natural resource endowments; it also produces highly desirable economic co-benefits, including poverty alleviation. It demands a set of actions to take governments beyond BAU, however, and requires a close alignment of policy measures with that agenda.

Ethiopia is an excellent example of a country that combines complex policies that link greening, infrastructure, industrialization and climate resilience (Chapter 6). The country's internationally acclaimed Climate Resilient and Green Economy framework maps its broader strategy, in which industrialization is key. The government's quest to increase textile exports aligns with its zero waste and zero pollution policies by establishing eco-industrial parks. This alignment will, for example, help to ensure that wastewater treatment is part and parcel of manufacturing activities.

Aquaculture in Nigeria provides an alternative, market-driven example of inclusive growth through a resource-efficient, agro-industrial value chain that has improved its resource efficiency and incorporated indigenous knowledge to expand market share and promote inclusive employment (Chapter 6).

Although every country is different, applying to the whole continent the inclusive green growth principles inherent in Ethiopia's green framework could set Africa on a green industrialization course with a wide range of benefits, including higher growth, lower poverty levels, more sustainable resource management and realization of the demographic dividend—important shifts given projected severe population pressure and rapid urbanization.

Achieving such outcomes requires bold steps mapped coherently. The GA scenario (and UNEP's global green investment scenario) offers guidance on policy interventions and incentives. If implemented well, monitored closely and enforced tightly, they show great promise in setting African countries on a high-return investment path. A clear, well-articulated policy is essential to promote Africa's green industrialization agenda, but it needs complementary work on integrated approaches to greening water, energy and agriculture. A vital component is to tackle together investments in greening these sectors to manage related interdependencies and effects and to realize their collective importance for socioeconomic well-being because the whole is greater than the sum of its parts. Both scenarios highlight the rapidly expanding urban populations (expected to accompany Africa's high population growth) across the continent. Urbanisation is shown to exacerbate Africa's existing water, energy and food security challenges, emphasising the particular importance of integrated approaches to greening Africa's cities.

WATER

Africa has little choice but to optimally use whatever water it has at its disposal to benefit society, the economy and the environment. Multiple infra-

structure investments are needed by the public and private sectors. Climate change demands that all new water infrastructure be developed according to climate-resilient standards. Other issues include transboundary, national and sectoral governance, as well as trade-offs in allocating water among development priorities. A heavy investment is thus needed in trade-off analysis between sectors and countries that quantifies the social, economic and environmental benefits and consequences of water-reliant development that will also be affected by climate volatility and change. Governance and institutional arrangements may have to be revised to enable effective implementation of the decisions resulting from such analysis.

Water resource development and greater water-use efficiencies need stronger incentives.

African countries have opportunities to reduce water scarcity and improve quality. They range from improved transboundary water management and governance to engaging everyone—municipalities, businesses, SMEs and households—in water conservation and harvesting, for example, through rainwater harvesting at the household and industry levels.

Water resource development and greater water-use efficiencies need stronger incentives. Depending on how they are structured, such incentives could lead to pricing the true cost of water, a source of revenue necessary in the longer term to finance other important interventions, such as restoration of degraded land and removal of alien invasive species.

ENERGY

Scaling up renewable energy sources predicates both the GA and G2 and is one of the cornerstones of Africa's industrialization. Without energy, Africa cannot industrialize and as the other options are finite, too expensive and volatile price-wise (imported fossil fuels, nuclear) or decreasingly available (hydropower), renewables are the logical choice. Africa has several country success stories (Chapter 6) to build on. Green procurement programmes, tailored to a country's circumstances, can improve energy access, stimulate more locally generated electricity, yield important water-resource benefits and reduce dependence on increasingly unreliable hydropower and fossil-fuel imports. Central to achieving this progress has been the big drop in renewable energy costs, which is expected to continue.

Green procurement programmes must be matched to the way a country does business, which varies. Although South Africa has had unexpected success in increasing its renewable energy supply in a short space of time, incorporating the private sector, mitigating the energy crisis is the country and generating new jobs and community benefits (Chapter 6), the approach taken was feasible because the country has a robust financial services sector and highly engaged foreign and local investors. Inclusive growth has been a major benefit from the widespread growth in renewable energy in Kenya and South Africa, with strengthened participation of small and medium-sized enterprises, substantial job creation and increases in foreign investment and local content (local manufacturing of renewable energy technology components, local jobs and community benefits).

Green procurement programmes can and should be incentivized; as shown in South Africa (Chapter 6), the cost to governments and consumers can be little or nothing, making it an extremely attractive policy option. Governments need to guarantee

power purchase agreements and, if the cost of renewables is maintained at a lower price than the cost of alternative electricity production, as is currently the case for South Africa, furnishing those guarantees is not onerous.

The challenge is to replace "'free" energy sources, such as biomass, with renewable fuels. Poorer groups, however, may be unable to afford to pay the true cost of energy (or of water). This means that the full costs of fossil fuel extraction, such as coal in South Africa, or the associated external environmental costs such as degraded land from biomass collection, are currently often not factored into tariffs and this is difficult to adjust, particularly in poorer areas. . Social protection measures may be needed as an interim solution to shift people's consumption out of high-carbon energy (and reliance on free water). Alternative sources of income through diversified livelihoods are key, and the agriculture sector provides a short- to medium-term opportunity, particularly through value add processing from raw materials produced in the agriculture sector.

AGRICULTURE

Decisions for agriculture must be considered in conjunction with those for water and energy. The co-dependence between these sectors and with people's health and livelihoods—particularly in urban centres—is high.

Although the GA for agriculture suggests a group of interventions, ultimate growth in this sector is likely to be driven by world food demand and purchasing power. Relative to other hungry regions around the world, Africa has underused land and water resources that even include untapped access to rain-fed pasture (Alexandratos and Bruinsma, 2012). Moreover, agricultural production has a finite capacity to increase financial returns; intensive studies over recent years, across Asia and Africa, reveal that agricultural production is limited at around 3,000 calories per person (Choudhuri, 2016), meaning that agroprocessing, an important sector value add, is critical to optimising the potential of the sector . Africa thus has the opportunity to generate surplus food and earn export income, but the continent must ready itself to meet the external demand from countries where resources are exhausted and populations go hungry. This calls for government investment in skills, technology, institutions, infrastructure, appropriate policies and accountability mechanisms.

Africa must prepare for that demand by proactively determining a sustainable means of delivery that is at once socially, economically and environmentally fruitful. Some investment options to achieving the GA are as follows:

- *Expand climate-resilient water infrastructure*. Steps to raise irrigation capacity, for instance, although often private (that is, by commercial farmers), are in fact national and sometimes transboundary decisions that call for evaluation of water availability and competition from alternative uses, such as hydropower. Still, irrigation is an important infrastructural investment that increases the reliability of yields. Increased rainwater harvesting—a critical assumption under the GA scenario—will also require private investment (at household and industry levels), but achieving the scale needed is possible only with public incentives. The feasibility of this solution lies in its simple technology, knowledge of the environmental and economic benefits, and robust research on biophysical aspects such as climate. The short to medium goal is reduced water scarcity, and then sustained supply. The intervention potentially also has a longer range benefit of delivering catchment- or even basin-level water security.
- *Green agriculture*. Including green irrigation schemes, aggressive greening of agriculture is achievable through heightened efficiencies

(reduced pre- and post-harvest waste and crop losses), more efficient water use and improved land-use practices. A welter of policy interventions is required, such as enhanced extension services and technology support and secure tenure rights for land users. These moves call for government investment in skills, institutions, technology support, appropriate policies and accountability mechanisms.

- *Attract investment to value added agriculture*. Improved yields from green agricultural processes and expanded irrigation should spur greater investment in light manufacturing in the sector, especially given current low levels of agroprocessing. Creating an enabling environment will further promote those investments, in the form of better market access, improved standards and adherence procedures, and facilitated regional and international export growth. Value added agriculture, as in the Nigeria catfish case study (Chapter 6), has some of the greatest sectoral potential—beyond reaping the food security benefits—to generate inclusive growth along local supply chains and regional and global value chains.

GREENING URBANIZATION

Population growth and rapid urbanization present a primary opportunity—and challenge—for Africa as it sets about securing sustainable economic growth into the future. Cities—key engines of economic growth, job creation and innovation and major contributors to global warming and environmental problems—are at the heart of the transition to a green global economy (Hammer et al., 2011). Mayors from around the developed and developing world agreed at an OECD Urban Roundtable held in 2009 that because the well-being of cities will be intimately tied to promoting environmental and social inclusion through economically stimulating activities, cities will be fundamental to advancing green growth (Hammer et al., 2011). One of the mayors' arguments, central to a theme of this chapter that energy is a cornerstone of green industrialization, is that urban form matters: lower urban density is a driver for higher energy consumption for electricity and transportation. This, among other factors—such as feeding fast-growing urban populations and ensuring reliable access to safe water—makes careful planning imperative.

Many African cities bring some of the continent's deficits together and into sharp focus, including poor infrastructure (energy, water and sanitation), dirty air (local air pollution from transport, kerosene and paraffin), un- and underemployment, paucity of food, and social inequality. In overburdened cities (some of which are already megacities, with populations of more than or fast approaching 10 million) and in growing cities that can cope now, as well as in emerging cities, these challenges require urgent resolution. The BAU scenario highlights the need to green urbanization in Africa quickly; the GA scenario provides hope that doing so will deliver green growth through strengthened synergies between economic, environmental and social inclusion policies. Effective urban policy will fit into place one large piece in the puzzle of the enabling environment for Africa's industrialization. It may even deliver more on green growth than wider economic approaches, such as deeper industrialisation, simply because cities—as centres of skills, innovation and opportunity—are well placed to deliver concentrated eco-innovation, scaled-up green infrastructure, and green skills for the economy.

5.5 REFERENCES

Africa Progress Panel. 2015. *Power, People, Planet: Seizing Africa's Energy and Climate Opportunities. Africa Progress Report 2015*. Available from http://www.africaprogresspanel.org/wp-content/uploads/2015/06/APP_REPORT_2015_FINAL_low1.pdf.

African Development Bank (AfDB). 2010. Infrastructure deficit and opportunities in Africa. *Economic Brief*. vol. 1 (September). Available from http://www.afdb.org/fileadmin/uploads/afdb/Documents/Publications/ECON%20Brief_Infrastructure%20Deficit%20and%20Opportunities%20in%20Africa_Vol%201%20Issue%202.pdf.

———. 2013. *At the Center of Africa's Transformation: Strategy for 2013–2022*. African Development Bank Group. Available from http://www.afdb.org/fileadmin/uploads/afdb/Documents/Policy-Documents/AfDB_Strategy_for_2013%E2%80%932022_-_At_the_Center_of_Africa%E2%80%99s_Transformation.pdf.

AfDB and World Wildlife Fund (WWF). 2015. African ecological futures 2015. Available from http://www.afdb.org/fileadmin/uploads/afdb/Documents/Generic-Documents/xwwf_african_futures_report_english-lo-rez.pdf.

African Union) (AU). 2010. P*rogramme for Infrastructure Development in Africa (PIDA): Interconnecting, integrating and transforming a continent*. Addis Ababa, Ethiopia. Available from http://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/PIDA%20note%20English%20for%20web%200208.pdf.

Alexandratos, Nikos, and Jelle Bruinsma. 2012. *World agriculture towards 2030/2050: the 2012 revision*. ESA Working Paper No. 12-03. Rome: FAO. Available from http://www.fao.org/docrep/016/ap106e/ap106e.pdf.

Barber, D.A. 2014. Africa's poor water infrastructure draws big investments. AFK Insider Online. Available: http://afkinsider.com/77623/africas-poor-water-infrastructure-draws-big-investments/

Branca, Giacomo, Timm Tennigkeit, Wendy Mann, and Leslie Lipper. 2012. *Identifying opportunities for climate-smart agriculture investments in Africa*. Rome: FAO. Available from http://www.fao.org/docrep/015/an112e/an112e00.pdf.

Chang, Ha-Joon. 2015. *Smart industrial policy for Africa in the 21st century*. Paper prepared for UNECA. Addis Ababa, Ethiopia.

Choudhuri, S., and G. B. Dixie. 2015. "A cool tool or flashy toy? The agricultural transformation matrix." Paper prepared for the World Bank. Washington, D.C.

Cilliers, Jakkle, Barry Hughes and Jonathan Moyer. 2011. *African Futures 2050*. Institute for Security Studies. Pretoria, South Africa. Available fromhttps://www.issafrica.org/uploads/Mono175.pdf.

Deloitte. 2014. *Deloitte on Africa: African construction trends report 2014*. Available fromhttps://www2.deloitte.com/content/dam/Deloitte/za/Documents/manufacturing/za_africa_construction_trends_2015_10032015.pdf.

Dickson, B., R. Blaney, L. Miles, E. Regan, A. van Soesbergen, E. Väänänen, S. Blyth, M. Harfoot, C. S. Martin, C. McOwen, T. Newbold and J. van Bochove. 2014. *Towards a global map of natural capital: Key ecosystem assets*. Nairobi, Kenya: United Nations Environment Programme.

Drummond, Paulo, Vimal Thakoor and Shur Yu. 2014. "Africa rising: harnessing the demographic dividend." International Monetary Fund (IMF) Working Paper No. WP/14/43. Available fromhttps://www.imf.org/external/pubs/ft/wp/2014/wp14143.pdf.

Dubey, B., and A. S. Narayanan. 2010. Modelling effects of industrialization, population and pollution on a renewable resource. Mathematics Group, Birla Institute of Technology and Science, Pilani, India. *Nonlinear Analysis: Real World Applications*, vol. 11, No. 4: 2833–2848. Available fromhttps://www.researchgate.net/publication/242999317_Modelling_Effects_of_Industrialization_Population_and_Pollution_on_a_Renewable_Resource.

Eberhard, Anton, Joel Kolker and James Leigland. 2014. *South Africa's Renewable Energy IPP Procurement Program: Success Factors and Lessons*. Washington, D.C.: World Bank Group, Public-Private Infrastructure Advisory Facility. Available from http://www.gsb.uct.ac.za/files/PPIAFReport.pdf.

Foster, Vivien, and Cecelia Briceno-Garmendia, eds. 2009. *Africa's Infrastructure: A Time for Transformation*. Paris: Agence Française de Développement, and Washington, D.C.: World Bank. Available fromhttps://openknowledge.worldbank.org/handle/10986/2692.

Greenpeace. 2015. *Energy [r]evolution: a sustainable world energy outlook 2015*. Greenpeace International, Global Wind Energy Council, and Solar Power Europe. Available fromhttp://www.greenpeace.org/international/Global/international/publications/climate/2015/Energy-Revolution-2015-Full.pdf.

Gustavsson, Jenny, Christel Cederberg, Ulf Sonesson, Robert van Otterdijk and Alexandre Meybeck. 2011. *Global Food Losses and Food Waste: Extent, Causes and Prevention*. Study conducted for the International Congress SAVE FOOD! at Interpack2011, Düsseldorf, Germany, by the Swedish Institute for Food and Biotechnology (SIK), Gothenburg, Sweden, and FAO. Rome: FAO. Available fromhttp://www.fao.org/docrep/014/mb060e/mb060e.pdf.

Hammer, Stephen, Lamia Kamal-Chaoui, Alexis Robert and Marissa Plouin. 2011. *Cities and green growth: a conceptual framework*. OECD Regional Development Working Paper No. 2011/08. Paris: OECD Publishing. Available from http://dx.doi.org/10.1787/5kg0tflmzx34-en.

International Centre for Research in Agroforestry (ICRAF) and United Nations Environmental Programme (UNEP). 2005. *Potential for Rainwater Harvesting in Africa: A GIS Overview*. Available from http://www.unep.org/pdf/RWH_in_Africa-final.pdf.

International Energy Agency (IEA). 2014. *Africa energy outlook: a focus on energy prospects in sub-Saharan Africa*. World Energy Outlook Special Report. Paris, France: OECD/IEA. Available fromhttps://www.iea.org/publications/freepublications/publication/WEO2014_AfricaEnergyOutlook.pdf.

International Labour Organization (ILO). 2013a. *Assessing current and potential green jobs: the case of Mauritius*. Policy Brief. Geneva: ILO. Available fromhttp://www.ilo.org/wcmsp5/groups/public/---ed_emp/---emp_ent/documents/publication/wcms_184298.pdf.

———. 2013b. *Sustainable Development, Decent Work and Green Jobs*. International Labour Conference, 102nd Session. Geneva: ILO. Available fromhttp://www.ilo.org/wcmsp5/groups/public/@ed_norm/@relconf/documents/meetingdocument/wcms_207370.pdf.

International Renewable Energy Agency (IRENA). 2015. *Renewable power generation costs in 2014*. Abu Dhabi, United Arab Emirates. Available fromhttp://www.irena.org/documentdownloads/publications/irena_re_power_costs_2014_report.pdf.

Juma, Dauglas Wafula, Hongtao Wang and Fengting Li. 2014. Impacts of population growth and economic development on water quality of a lake: case study of Lake Victoria Kenya water. National Centre for Biotechnology Information (NCBI). *Environmental Science and Pollution Research International*, vol. 21, No. 8, pp. 5737–5746. Available from http://www.ncbi.nlm.nih.gov/pubmed/24442964.

May, John. 2012. *West Africa: the demographic dividend is not a given*. Global Health Policy Blog. Center for Global Development. Available from http://www.cgdev.org/blog/west-africa-demographic-dividend-not-given.

New Partnership for Africa's Development (NEPAD). 2013. *Agriculture in Africa: Transformation and Outlook*. Available fromhttp://www.un.org/en/africa/osaa/pdf/pubs/2013africanagricultures.pdf.

OneWorld Sustainable Investments (OneWorld). 2015. Accessed and adapted from the Frederick S. Pardee Center for International Futures (IFs), Josef Korbel School of International Studies, University of Denver. Available from http://pardee.du.edu/access-ifs

Petrie, Belynda, Arthur Chapman, Amelia Midgley and Ruth Parker. 2014. *Risk, vulnerability and resilience in the Limpopo River Basin: climate change, water & biodiversity - a synthesis*. Compiled for USAI D Southern Africa Resilience in the Limpopo River Basin (RESILIM) Program by OneWorld Sustainable Investments Cape Town, South Africa. Available from https://www.usaid.gov/sites/default/files/documents/1860/Risk,%20Vulnerability%20and%20Resilience%20in%20the%20Limpopo%20River%20Basin%20-%20A%20Synthesis%20(1).pdf

Pollin, Robert. 2015. *Greening the Global Economy*. Cambridge, MA: MIT Press.

Population Reference Bureau (PRB). 2015. *2015 world population data sheet: with a special focus on women's empowerment*. Population reference manual. http://www.prb.org/pdf15/2015-world-population-data-sheet_eng.pdf.

Sheahan, Megan, and Christopher B. Barrett. 2014. "Understanding the agricultural input landscape in sub-Saharan Africa: recent plot, household, and community-level evidence." World Bank Group Policy Research Working Paper No. 7014. Africa Region, Office of the Chief Economist.

Spalding-Fecher, Randall, Arthur Chapman, Francis Yamba, Hartley Walimwipi, Harald Kling, Bernard Tembo, Imasiku Nyambe and Boaventura Cuamba. 2014. "The vulnerability of hydropower production in the Zambezi River Basin to the impacts of climate change and irrigation development." *Mitigation and Adaptation Strategies for Global Change*, pp. 1573–1596. doi:10.1007/s11027-014-9619-7.

United Nations (UN) Department of Economic and Social Affairs, Population Division (DESA). 2015. *World population prospects: the 2015 revision*. UNDESA Working Paper No. ESA/P/WP.241. New York.

United Nations Environment Programme (UNEP). 2006. *African regional implementation review for the 14th session of the Commission on Sustainable Development* (CSD-14): Report on climate change. Available fromhttp://www.un.org/esa/sustdev/csd/csd14/ecaRIM_bp1.pdf.

United Nations Environment Programme (UNEP). 2007. *The Fourth Global Environment Outlook – Environment for Development Report*. Available from http://www.unep.org/geo/geo4/report/geo-4_report_full_en.pdf

———. 2010. *Africa Water Atlas*. *UNEP Division of Early Warning and Awareness, Nairobi, Kenya*. Available from-http://www.unep.org/pdf/africa_water_atlas.pdf.

———. 2011. *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication*. Nairobi, Kenya. Available fromhttp://www.unep.org/greeneconomy/Portals/88/documents/ger/ger_final_dec_2011/Green%20EconomyReport_Final_Dec2011.pdf.

———. 2013. *Green economy modelling report of South Africa: focus on natural resource management, agriculture, transport and energy sectors. Nairobi, Kenya*. Available from https://www.environment.gov.za/sites/default/files/docs/greeneconomy_modellingreport.pdf.

———. 2014a. *Green economy assessment report: Kenya. Nairobi, Kenya*. Available from http://www.unep.org/greeneconomy/portals/88/documents/KenyaGEassessment.pdf.

———. 2014b. *Green economy assessment study : Senegal. Nairobi, Kenya*. Available from http://www.un-page.org/files/public/content-page/green_economy_assessment_study_senegal_unep.pdf.

———. 2014c. Integrated assessment of the impacts of green investment and policy reforms in Burkina Faso.

———. 2015. *Building inclusive green economies in Africa: experiences and lessons Learned 2010–2015*. Nairobi, Kenya. Available fromhttp://www.unep.org/greeneconomy/Portals/88/documents/GEI%20Highlights/EC_AFRICA_SYNT-REPORT_FINAL_10FEB-c.pdf.

5.6 ENDNOTES

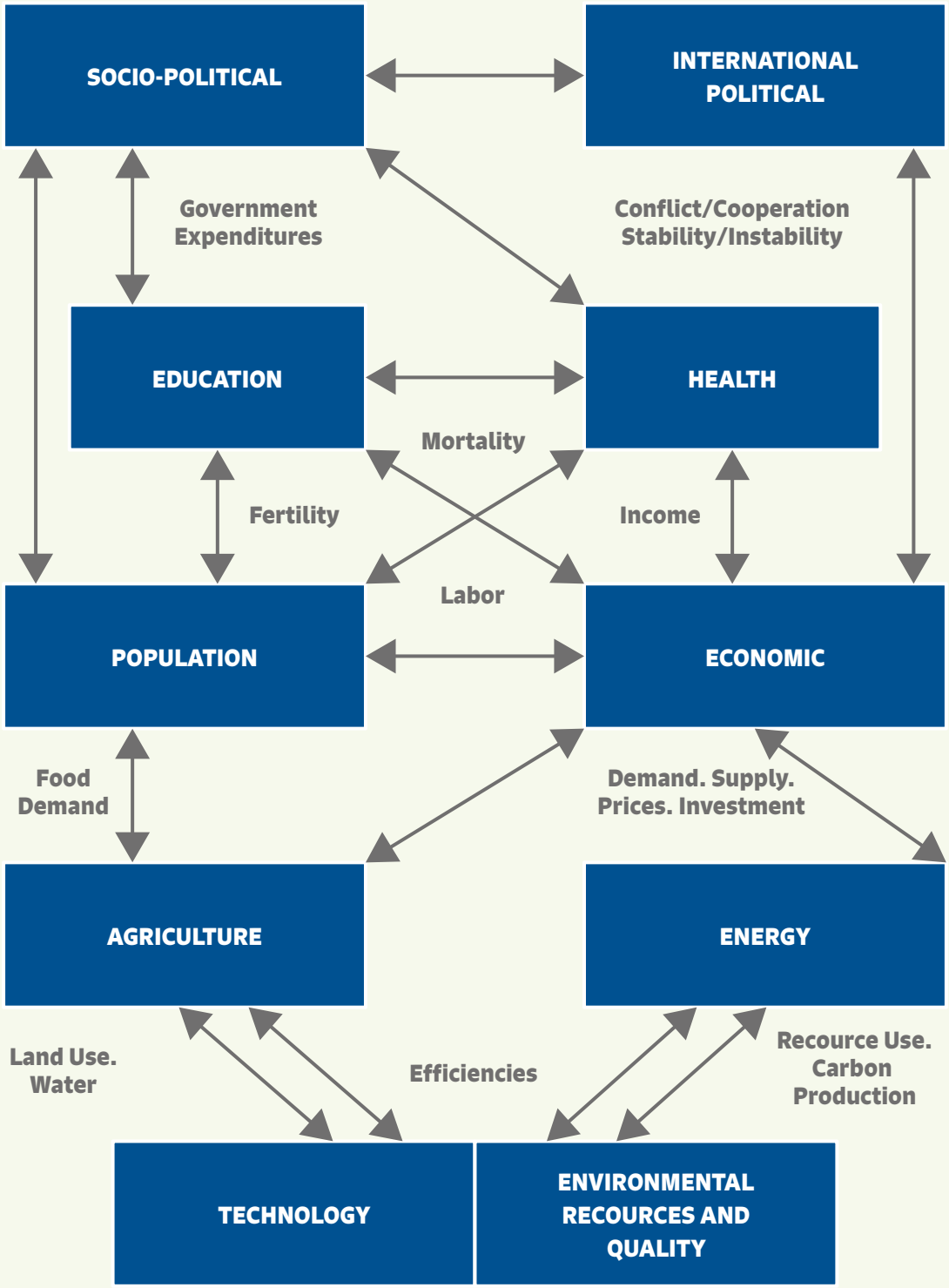
1 In these scenarios the focus is primarily on water because water is the resource on which every other sector depends, to a greater or lesser extent. Water scarcity, even in subregions with good rainfall, is set to continue across Africa, largely because of weak infrastructure. Average water availability per person in Africa is 5,720 cubic metres a year, compared with a global average of 7,600.

2 This is because urban centres connect people to economic opportunity and the kind of jobs that can provide them with a pathway out of poverty.

3 Causality works in both directions. Improved socioeconomic indicators beget lower birth rates, which will amplify progress in other sectors, creating a virtuous circle that can shift the development trajectory even further beyond the GA scenario. That scenario illustrates the effect of slower population growth as it flows through the International Futures (Ifs) system model. Nowhere is this more evident than within the economic and development indicators and environmental indicators, as declining fertility rates relieve some of the pressure on natural resources and service provision.

ANNEX 1

FIGURE 1 THE MODULES AND HIGH-LEVEL CHARACTERIZATION OF LINKAGES BETWEEN MODULE COMPONENTS IN THE IFS



Links shown are examples from much larger set. Januari 2010

SOURCE: HUGHES (2006).

SCENARIO DEVELOPMENT METHODOLOGY

The numerous linkages in a model like IFs, which is only an abstraction of a much larger set of interlinkages, evolves over time as economists better understand the linkages in the real economies of countries. Typically, those linkages focus on distinguishing the proximal and distal drivers of an outcome (for example, poverty).

CAUTION WITH IFS MODELLING

Models are huge abstractions and simplifications of reality, and all models, by definition, are wrong. Projections by IFs of the future are wrong in that they should not be used as accurate statements of how an issue, country or region will evolve into the future. No one can predict the future. Nevertheless, because of its rich specification and long history of development with well-accepted socioeconomic and environmental relationships, a model can be used as a tool to help think about the future. IFs is used in this context to undertake forecasts using known relationships, with confidence levels surrounding the exact nature of these relationships varying dependant on the quality and quantity of data and the extent to which the model accommodates for context-specific issues.