3

AFRICA'S INFRASTRUCTURE: GREAT POTENTIAL BUT LITTLE IMPACT ON INCLUSIVE GROWTH

KEY MESSAGES

Africa must industrialize to end poverty and to generate employment for the 12 million young people who join its labor force every year.

One of the key factors retarding industrialization has been the insufficient stock of productive infrastructure in power, water, and transport services that would allow firms to thrive in industries with strong comparative advantages.

New estimates by the African Development Bank suggest that the continent's infrastructure needs amount to $130–170 billion a year, with a financing gap in the range $68–$108 billion.

Those figures are far higher than previous estimates of $93 billion in annual needs and annual financing gaps of $31 billion published by Agence Française de Développement and the World Bank.

Institutional investors such as insurance companies, pension funds, and sovereign wealth funds have more than $100 trillion in assets under management globally. A small fraction of the excess global savings and low-yield resources would be enough to plug Africa's financing gap and finance productive and profitable infrastructure.

Africa must industrialize to end poverty and to generate employment for the 12 million young people who join its labor force every year. One of the key factors retarding industrialization has been the insufficient stock of productive infrastructure in power, water, and transport services that would allow firms to thrive in industries with strong comparative advantages.

Despite the potential long-term benefits, the share of resources allocated to infrastructure was cut sharply by African governments and their development partners in the 1980s and 1990s, thanks to the structural adjustment programs most African countries adopted under the so-called Washington Consensus. That partly explains Africa's current lag in infrastructure relative to other regions. And while capital accumulation started to pick up again in the early 2000s, the pace has been too slow to close Africa's infrastructure gap. New estimates by the African Development Bank (AfDB) suggest that the continent's infrastructure needs amount to $130–$170 billion a year, with a financing gap in the range $67.6–$107.5 billion.[1] But African countries do not need to fill these gaps before proceeding with their economic transformations.

African countries need to accelerate their investments in infrastructure, but in a smarter way

The economic costs of Africa's insufficient stock and poor quality of infrastructure are as big for the continent as the size of the potential impacts of resolving the problem. Funding infrastructure in Africa and around the world should not be an issue of financial resources. Beyond the seemingly unlimited resources from the public sector in advanced economies and central banks, institutional investors such as insurance companies, pension funds, and sovereign wealth funds have around $100 trillion in assets under management globally.[2]

A small fraction of the excess global savings and low-yield resources would be enough to plug the financing gap and finance productive and profitable infrastructure in the developing world. That would boost aggregate demand, create employment in poor and rich countries alike, and move the world toward peace and prosperity. In ideal political circumstances, a global pact between rich and poor nations would codify a "grand bargain" based on infrastructure financing. But the world does not have ideal political circumstances. Economic decisions are rarely rational in the realm of dreams, and without the interference of political subjectivities and irrationalities.

So, African countries facing mammoth infrastructure needs have to change their focus and strategy. In fact, even if the continent had the resources, it should not devote them to financing infrastructure. No country or region in world history has ever had to fill its entire infrastructure deficit before igniting and sustaining high rates of growth. Indeed, in the 19th century's industrial revolution and the 20th century's miracle economies, countries from several global regions grew at high rates for long periods, while having wide infrastructure deficits.

With an estimated infrastructure gap up to $107.5 billion a year, and urgent needs in health, education, administrative capacity, and security, Africa has to attract private capital to accelerate the building of critical infrastructure needed to unleash its potential.

African countries need to accelerate their investments in infrastructure, but in a smarter way. And they need to find new mechanisms and instruments to fund their most urgent needs—infrastructure and otherwise. African countries can jump directly into the global economy by building well-targeted infrastructure to support competitive industries and sectors in industrial parks and export-processing zones linked to global markets. Using their limited resources for infrastructure more wisely for new investments and maintenance, all African countries can leverage these zones to attract light manufacturing from more advanced economies, as East Asian economies did in the 1960s and China in the 1980s.

By attracting foreign investment and firms, even the poorest African countries can improve their trade logistics, increase the knowledge and skills of local entrepreneurs, gain the confidence of international buyers, and gradually make local firms competitive. This strategy is already being used with great success in Bangladesh, Cambodia, Ethiopia, Mauritius, Rwanda, and Vietnam. The strategy need not be limited to traditional manufacturing but can also cover agriculture, services, and other activities. Africa is well placed to help boost the global economy. It is up to world leaders to put forth the policy framework to make it happen.

INFRASTRUCTURE IS CRITICAL FOR SUSTAINABLE GROWTH AND INCLUSIVE DEVELOPMENT

The positive impact of infrastructure on economic growth and inclusive social development has been well documented by researchers in several social science disciplines.[3] Infrastructure affects productivity and output directly as part of GDP formation and as an input to the production function of other sectors. And it does so indirectly by reducing transaction and other costs, thus allowing a more efficient use of conventional productive inputs.[4] Poor energy quality, for example, can impose additional costs on firms such as idle workers, lost production, or damaged equipment. But modern transport systems could increase manufacturing competitiveness cheaply and quickly, moving raw materials to producers and manufactured goods to consumers.

High-quality infrastructure is essential for Africa to achieve the Sustainable Development Goals (SDGs) of the United Nations (UN), Agenda 2063 of the African Union (AU), and the High Five Goals of the African Development Bank (AfDB). It is needed for raising economic productivity and sustaining economic growth. Good infrastructure has an impact on growth directly and indirectly. It increases total factor productivity (TFP) directly because infrastructure services enter production as an input and have an immediate impact on the productivity of enterprises. It thus fosters aggregate economic output given its contribution, on its own, to GDP.

Good infrastructure can also raise TFP indirectly by reducing transaction and other costs, allowing a more efficient use of conventional productive inputs. It does this by being a factor of production for virtually all goods and services generated by other sectors.[5] In addition, it can affect the adjustment costs of investment, the durability of private capital, and the demand for—and supply of—health and education services. If transport, electricity, or telecom services are absent or unreliable, firms face additional costs (buying power generators, for instance) and struggle to adopt new technologies. Better transport increases the effective size of labor markets.[6]

And in lowering transaction costs, infrastructure fosters more efficient use of productive inputs such as land, labor, and physical capital assets, which translates into higher TFP, and expands the production frontier and profitable investment opportunities.[7] For example, reducing the cost of broadband internet could foster the development of e-commerce and a digital economy. And the greater availability and reliability of infrastructure is poised to develop human capital through improved education and health services, which should foster greater economic prosperity. Other transmission channels include facilitating trade flows, stimulating aggregate demand, and improving a country's attractiveness as an investment destination.[8] And over the short term, infrastructure projects create jobs during construction, also contributing to growth.[9]

Africa has a compelling case for accelerating infrastructure development. First, it is a continent of small, open economies that will rely on trade as the main engine of growth for the foreseeable future. For much of the period since World War II, there has been an intellectual consensus that barriers to market access—tariffs, quotas, and nontariff measures disadvantaging foreign firms; safety and sanitary requirements; local content and the like—were the main barriers to trade and to foreign direct investment in Africa. That view still has some validity, but the global landscape for production and trade has changed considerably in recent decades.

Tariff barriers have declined steadily in advanced and developing countries, while nontariff measures have become more prevalent. But another tectonic shift has occurred in global commerce, making infrastructure an even bigger factor in economic growth in Africa. Empirical research by the OECD and the WTO (complemented by a recent WEF-Bain & Co.–WB report) shows that tariff reductions and market access have become much less relevant for economic growth than a generation ago. International trade is no longer about manufacturing a product in one country and selling it in another. It is about cooperating across boundaries and time zones to minimize production costs and maximize market coverage. Value chains (the networks of activities for producing and getting a product to consumers, spanning the manufacturing process and transport and

Infrastructure affects productivity and output directly as part of GDP formation and as an input to the production of other sectors

distribution services) are the dominant framework for trade.

Reducing supply chain barriers could increase global GDP up to six times more than removing all import tariffs. Poor quality infrastructure services can increase the input material costs of consumer goods by up to 200 percent in certain African countries.[10] In Madagascar for instance, supply chain barriers can account for about 4 percent of total revenues of a textile producer (through higher freight costs and increased inventories), eroding the benefits of duty-free access to export markets. Small and medium enterprises (SMEs) tend to face proportionally higher supply chain barriers and costs. Having all countries in the world reduce just two key bottlenecks to supply chains (border administration and transport and communications infrastructure) halfway to those in Singapore would increase global GDP $2.7 trillion (4.7 percent) and global exports $1.6 trillion (14.5 percent). These massive numbers compare with much smaller gains from complete tariff elimination worldwide, which would lead to gains of "only" $400 billion (0.7 percent) in global GDP and $1.1 trillion (10.1 percent) in global exports. Even a less ambitious set of reforms that moves countries halfway to regional best practice could increase global GDP by 2.6 percent and world trade by 9.4 percent. The main implication of this huge paradigm shift in global trade is that African policy makers should devote more time and resources to building some well-targeted infrastructure that can connect their economies to global value chains.

The economic benefits that Africa could draw from improved infrastructure are higher than those for other regions

Second, because the continent is a latecomer to the economic development process and many of its countries are still at low or lower middle incomes, the economic benefits that Africa could draw from improved infrastructure are higher than those for other regions, based on the underlying diminishing returns to capital. Indeed, supplying critical exogenous factors to low-income countries, where most African countries rank, should allow them to draw exceptionally higher returns to capital as they catch up.[11] Table 3.1 summarizes research findings supporting this; figure 3.1 shows that the growth benefits drawn from infrastructure development are inclusive, given that they reduce inequality of opportunity; and box 3.1 reviews some of the empirical quandaries of infrastructure and growth.

THE LOW INFRASTRUCTURE STOCK IN AFRICA REFLECTS THE LOW DEVELOPMENT OF MANY COUNTRIES ON THE CONTINENT

Africa's infrastructure stock is low, particularly in power (box 3.2).[12] More than 640 million Africans have no access to energy, giving an electricity access rate for African countries at just over 40 percent—the world's lowest. Per capita consumption of energy in Sub-Saharan Africa (excluding South Africa) is 180 kWh, against 13,000 kWh per capita in the United States and 6,500 kWh in Europe.

Access to energy is crucial not only for attaining health and education outcomes, but also for reducing the cost of doing business and unlocking economic potential, creating jobs. Insufficient access to modern energy causes hundreds of thousands of deaths each year due to the use of wood-burning stoves for cooking; handicaps the operations of hospitals and emergency services; compromises educational attainment; and drives up the cost of doing business. So, energy access for all is one of the key drivers of inclusive growth, because it creates opportunities for women, youth, and children in urban and rural areas.

Africa's energy potential, especially renewable energy, is enormous, yet only a fraction is employed. Hydropower provides around a fifth of current capacity, but not even a tenth of its potential is utilized. Similarly, the technical potential of solar, biomass, wind, and geothermal energy is huge. Based on preliminary results, it is expected that Africa's investment needs for infrastructure overall will be in the range of $130–$170 billion a year (table 3.2)—see annex 3.1 for the methodology.

The Africa Infrastructure Development Index (AIDI), produced by the African Development Bank, serves three main objectives: To monitor and evaluate the status and progress of infrastructure development across the continent; to assist in resource allocation within the framework of African Development Bank replenishments; and to contribute to policy dialogue within and outside of the Bank. The AIDI also serves as a key

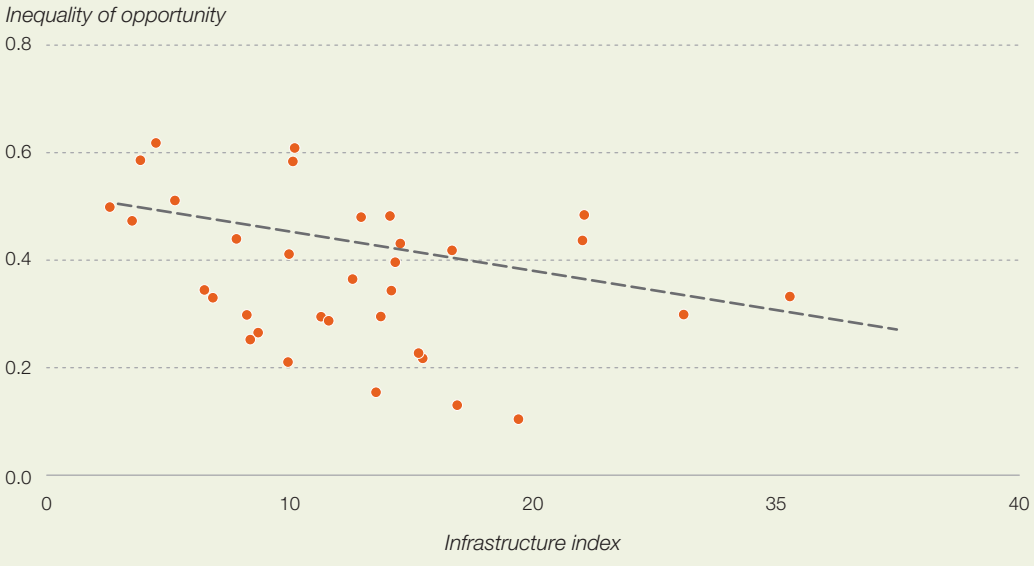
TABLE 3.1 Selected evidence on the growth benefits of infrastructure development

Coverage	Study period	Sector(s)	Infrastructure indicator	Growth effects	Source
Global	Meta-analysis of studies up to 2006	Multiple	1% increase in public investment	Direct increase of at least 0.08% in GDP excluding multiplier effects	Bom and Lighthart 2008
Global	Meta-evaluation of studies conducted between 1999 and 2009	Multiple	1% increase in public investment	Direct increases of between 0.05% and 0.45%	Estache et al. 2005; Calderón and Servén 2004; Hurlin 2006
Africa	1988–2007	ICT	10 percentage point increase in telephone subscriptions	16 percentage point increase in real GDP growth	Andrianaivo and Kpodar 2011
39 African countries	1960–2005	ICT, roads, electricity	Infrastructure stock accumulation and quality improvement	0.99 percentage point increase in GDP growth	Calderón 2009

Source: Faye and Mutambasere 2018.

The growth benefits drawn from infrastructure development are inclusive

FIGURE 3.1 Inequality of opportunity and infrastructure development in selected African countries



Source: Shimeles and Nabasaga 2015.

Note: The index is aggregated from access to electricity, ICT penetration, road density, and access to water and sanitation.

BOX 3.1 The challenging empirics of infrastructure and growth

Despite a large body of theoretical work on the relationship between infrastructure and growth, empirical analyses in Africa have not yet offered a strong consensus. Researchers agree that the relationship is heterogeneous and heavily dependent on the countries, infrastructure types, and periods under study.

Several studies report a positive relationship between infrastructure measures and indicators of socioeconomic development such as gross national product (GNP), GDP growth, GDP per capita, employment, and poverty headcount.[2] Most use co-integration and causality tests. One set of studies finds a positive bidirectional relation.[2] Another set of papers finds a unidirectional positive causality running from infrastructure to economic growth.[3] Interestingly, another strand of the literature finds a lack of relationship between infrastructure and growth.[4]

What explains these inconsistencies in empirical evidence? One argument is that the absence of causality reflects a "type II" error (also known as a "false negative," when one fails to observe a difference when there is one) caused by flaws in data such as relying on connections to the grid to measure access when, in fact, a large share of the population meets its energy needs through off-grid sources such as generators and traditional biomass.[5] Another explanation is that studies using public investment in infrastructure may not reflect the market value of services provided by these investments, and thus the full benefits of access to infrastructure, because project costs in developing countries are often inflated by governmental inefficiencies or institutional weaknesses.[6] The absence of causality between growth and infrastructure may also reflect the presence of other binding constraints to growth. For instance, benefits from rural electrification can be neutralized by poor access to other factors of agricultural production such as irrigation, access to markets, and access to finance.

Improving quality is unlikely to help African countries reap strong economic benefits from infrastructure development

Should funding to infrastructure be targeted to achieve particular objectives or project types? Evidence suggests that the growth benefits from enhanced access to or quality of infrastructure depend highly on the country context. In an attempt to test this hypothesis while capturing the multidimensional aspect of infrastructure, Kodongo and Ojah (2016) use two indexes measuring the access and quality of various infrastructure types, in addition to gross fixed capital formation to control for public spending. Their results, drawn from 45 African countries, show that neither the stock/access nor the quality of infrastructure drives economic growth in a low basic infrastructure endowment—but that the spending on infrastructure and the increments (gains) in access do. From a policy perspective, such a finding suggests that improving quality is unlikely to help African countries reap strong economic benefits from infrastructure development, unless the countries have reached a certain infrastructure endowment necessary to foster incremental aggregate economic activity. Efforts should, therefore, focus on incremental access.

Notes

1. Number of people living below the poverty line.
2. Kularatne 2006 for economic infrastructure and social spending in South Africa and Jumbe 2004 for access to energy in Malawi.
3. Wolde-Rufael 2006 for energy spending in Benin and Democratic Republic of Congo.
4. Wolde-Rufael 2006 for energy in Congo, Democratic Republic of Congo, Kenya, South Africa, and Sudan.
5. Wolde-Rufael 2006.
6. Straub 2008.

BOX 3.2 Infrastructure stocks, needs, and gaps: A practical lexicon

Infrastructure includes all main networks (systems of public facilities, sets of fixed assets or structures) that support economic and social activity, including those associated with water, power, sanitation, ICT, and transport (roads, railways, maritime, and air). This definition is based on the Classification of Function of Government in the Government Finance Statistics Manual of the International Monetary Fund. This functional classification allows defining infrastructure as asset types classified by purpose in the economy. As such, infrastructure assets are by nature long-lived capital assets.

Infrastructure stock (or capital stock)

Capital stock is a measure of the amount of capital in existence at a point in time, *t*. Investment, a flow concept, is a measure of the additions to capital stock over a time period, such as a year.

Infrastructure capital stock is calculated using gross fixed capital formation (investment flow) on infrastructure and the perpetual inventory method or equation:

$$K_{t+1} = (1 - \delta_t).K_t + (1 - \delta_t/2).I_t$$

where for each country *i*, K_{t+1} is the stock of capital at the beginning of period $t + 1$; δ_t is a time-varying depreciation rate; and I_t is gross fixed capital formation on infrastructure in period *t*, assuming that new investment is operational in the middle of the period.

The inputs required to apply this method are the investment flow series, the initial capital stock, and the size and time profile of the depreciation rate.

Infrastructure gap or deficit

A few definitions are used for the infrastructure gap or deficit.

- The infrastructure gap (or deficit) is generally defined as the difference between supply and demand for infrastructure services (assets).
- It is also defined as the difference between a target level of infrastructure development and the actual level. Either level is generally measured by specific indicators. In the power sector, for instance, the percentage of population with access to electricity can be the indicator and universal access the target (as with the New Deal on Energy). The deficit is then the percentage of the population with no access to electricity.
- The infrastructure deficit (also called infrastructure requirements or infrastructure investment needs) can also refer to the amount of investment needed to bridge the gap (as just defined). In the power sector, it is the amount of investment needed to achieve universal access for electricity from the actual level of access.

  Depending on the context, any of the above definitions is used.

Infrastructure investment needs

The amount of investment (the cost) to bridge the infrastructure gap (as defined previously) is also called infrastructure requirements or infrastructure investment needs. In the above example on power, it is the amount of investment needed to achieve universal access to electricity from the current actual level of access.

Infrastructure financing gap

This is defined as the infrastructure investment needs minus the total amount of financing commitment by national governments and all donors to resolve the infrastructure deficit.

Infrastructure includes all main networks that support economic and social activity

TABLE 3.2 Preliminary figures on investment needs ($ billions)

Infrastructure subsector	Target by 2025	Annual cost	Notes
Power	100% urban electrification 95% rural electrification	35–50	New Deal on Energy target by 2025
Water supply and sanitation	100% access in urban area 100% access in rural area	56–66	Water access includes: Piped water, public tap/standpost, safe wells/boreholes Sanitation access includes: Improved latrines, safe pit latrines, septic tank, sewer
Information and communication technology	Mobile universal coverage 50% of population within 25 km of a fiber backbone Fiber to home/premises internet penetration rate (10%)	4–7	
Road and other transport sectors (air, rail, and port)	80% preservation; 20% development	35–47	Preservation: Maintenance and rehabilitation Development: Upgrading and new construction
Total		**130–170**	**Preliminary figures**

BOX 3.3 Infrastructure needs: From $93 billion a year to $130–$170 billion

Prior to the new AfDB estimate of Africa's infrastructure needs, the most widely quoted number on Africa's infrastructure needs was $93 billion, from the 2006 Africa Infrastructure Country Diagnostic (AICD) study (quoted in Foster and Briceño-Garmendia 2010). The calculations were based on the following objectives:

- Develop an additional 7,000 megawatts a year of new power generation capacity (about half through multipurpose water storage schemes).
- Enable regional power trade by laying 22,000 megawatts of cross-border transmission lines.
- Complete the intraregional fiber-optic backbone network and continental submarine cable loop.
- Interconnect capitals, ports, border crossings, and secondary cities with a good-quality road network.
- Provide all-season road access to Africa's high-value agricultural land.
- More than double Africa's irrigated area.
- Meet the MDGs for water and sanitation.
- Raise household electrification rates by 10 percentage points.
- Provide global systems mobile voice signal and public access broadband to 100 percent of the population.

It was estimated that the implementation costs for such a program would amount to $93 billion a year, with about two-thirds of the total relating to capital expenditure, and the remaining one-third to operation and maintenance requirements.

But that estimate of total investment costs was not meant to bring Africa to the path of universal access in the power sector or in the water and sanitation sectors. It was the best to reduce the gap between Africa and developed countries. At the time, the access rate for electricity in Africa was estimated around 40 percent and for developed countries around 75 percent. With AfDB's New Deal on Energy (and the High 5s), Africa would be on the way to universal access. It will cost more to get there in a shorter period of time (less than 10 years) than envisaged in the $93 billion simulations.

Source: Foster and Briceño-Garmendia 2010.

tool in evaluating and monitoring the continent's progress toward attainment of the "High 5s," the number one priority being to "light up and power Africa." The indicators produced by the AIDI also generate other indices relating to High 5s, namely the "Feed Africa Index," "Industrialize Africa Index," and "Integrate Africa Index."

The AIDI has four main components: transport, electricity, ICT, and water and sanitation. These components are disaggregated into nine indicators that have a direct or indirect impact on productivity and economic growth.[13] A data reduction method generates a single index, normalized to lie between 0 and 100. Thus, the higher the value of the index, the better a country's readiness in meeting its infrastructure needs for development.

In the updated version, there is a wide variation among African countries in their infrastructure gap, with a range of more than 90 percent between the country at the top of having good infrastructure (Seychelles) and the country at the bottom (Somalia) (figure 3.2). The countries at the top are mostly from North Africa, with a few from Southern Africa. The rest of the continent is in very bad shape. There is a high correlation between inequality in assets and the infrastructure index, suggesting that improving infrastructure leads to inclusive growth as well.

Although Africa, Asia, and Latin America started at similar levels in 1960, fixed capital formation (a proxy for infrastructure) declined in the 1980s and 1990s in Africa, partly due to Washington Consensus policies (figure 3.3).[14] While capital accumulation started to rise again from 2002, the pace is still much slower than in other developing regions.

Partly due to this lack of investment in infrastructure building, Africa's infrastructure lags that of other regions on quantity, affordability, and quality. For example, at the same level of GDP per capita, China and India both had higher access to electricity and water than most African countries (figure 3.4).

In 2014, the share of population in Africa with access to electricity was estimated 47 percent, around half the 97 percent in Latin America and 89 percent in Asia (figure 3.5). There are also stark regional differences, with access in North Africa around 98 percent (the highest) and 26 percent in East Africa (the lowest). Electricity access also varies greatly within countries: Urban consumers are typically better served than rural consumers, and across Africa in 2014, average electricity access was about 72 percent in urban areas, more than double rural Africa's 33 percent. The largest difference was in East Africa, where urban access was about 73 percent, nearly seven times the 11 percent in rural areas.

Access to improved sanitation also tends to be higher—though less starkly than for electricity—in urban Africa (47 percent) than in rural Africa (34 percent). For Africa as a whole, access to improved sanitation was 36 percent in 2015, far lower than in Latin America (83 percent) and Asia (62 percent). This rate was lowest in West Africa (25 percent). The share of population using improved water sources (70 percent) or using basic drinking water services (63 percent) was the lowest in Africa, against more than 90 percent in Asia and Latin America.

Despite rapid expansion in the use of mobile phones and mobile technology applications in Africa, internet penetration—a lifeline for modern trade, communications, and technology applications in almost all sectors—has been progressing extremely slowly in the past decade (figure 3.6). Table 3.3 presents summary data on access to infrastructure for selected regions worldwide.

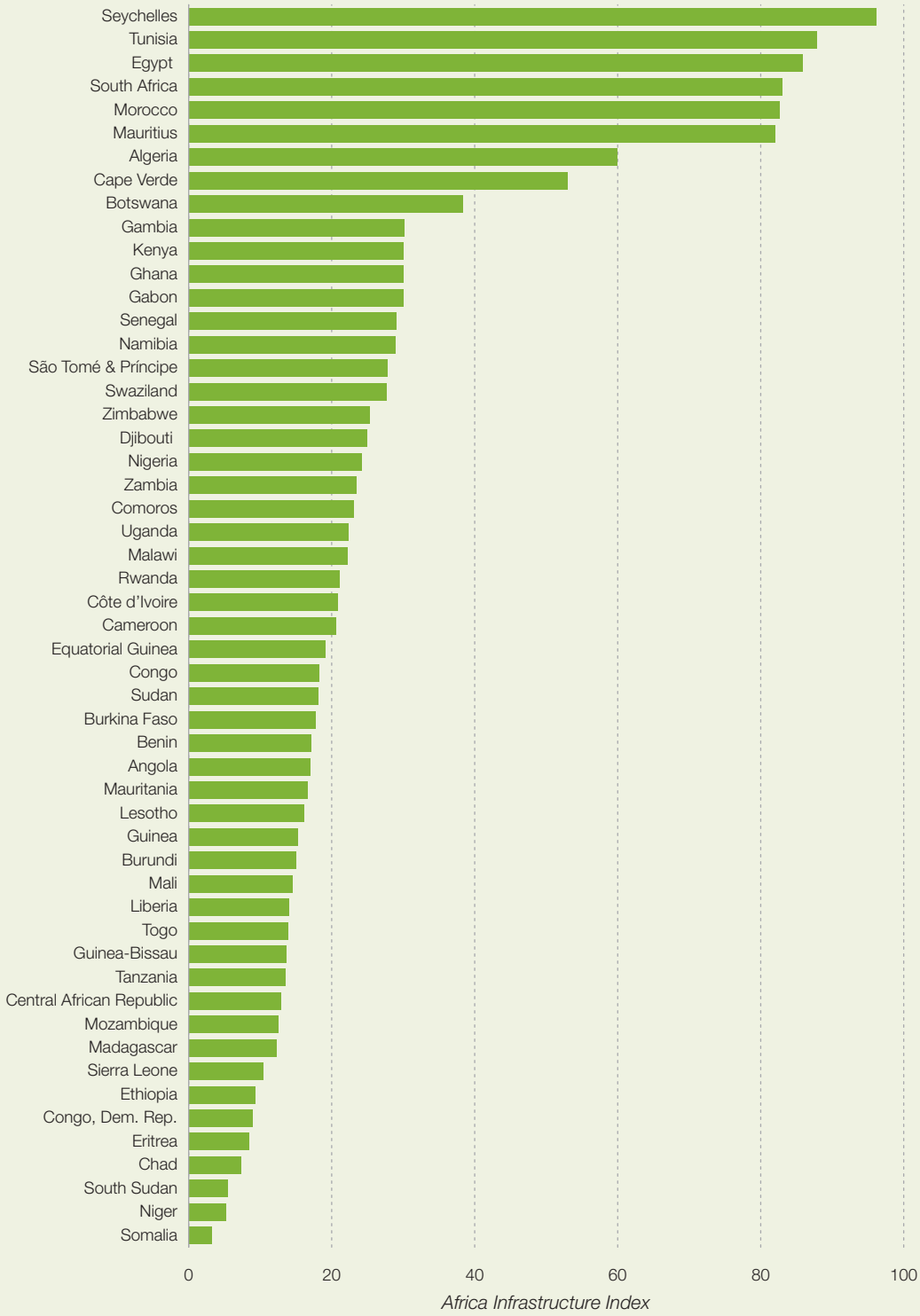
Affordability is also a challenge. Infrastructure service costs in Africa are several multiples higher than in other developing regions, whether for power, water, transport, or ICT.[15] Energy is particularly expensive, notably for countries running small or isolated electricity grids and for net fuel importers. The average effective cost of electricity to manufacturing enterprises in Africa is close to $0.20 per kWh, around four times higher than industrial rates elsewhere in the world. This reflects both high-cost utility power (of around $0.10 per kWh), and heavy reliance on emergency back-up generation during frequent power outages (around $0.40 per kWh). Road freight tariffs in Africa are two to four times higher per kilometer than those in the United States, and travel times along key export corridors two to three times higher than those in Asia.

Africa's telecommunications costs have been falling sharply in recent years, but are still higher

The countries at the top are mostly from North Africa, with a few from Southern Africa

Infrastructure service costs in Africa are several multiples higher than in other developing regions

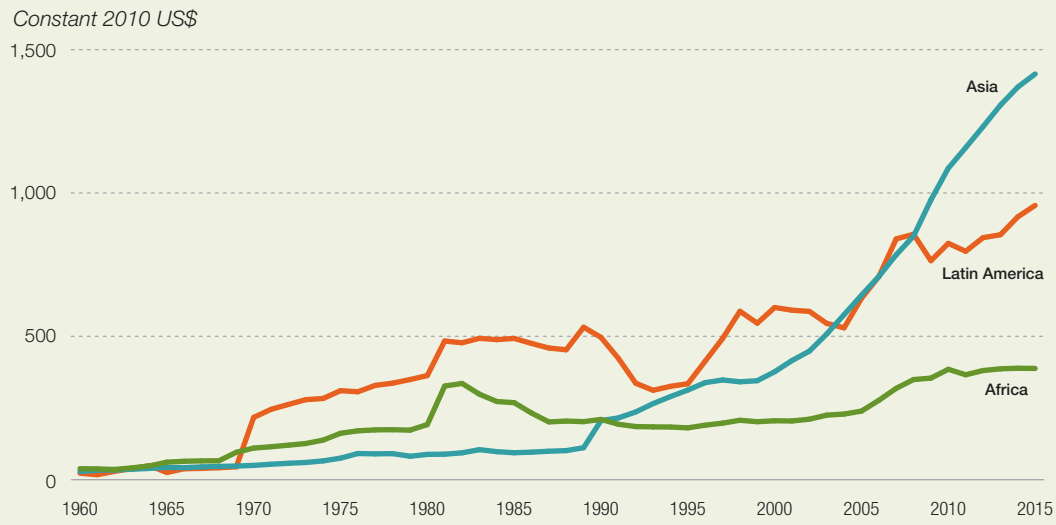
FIGURE 3.2 Africa Infrastructure Index 2018



Source: AfDB statistics.

Note: Libya, not listed in this chart, used to be one of the top-ranked African countries for its infrastructure. But since the 2011 crisis and ensuing political instability and civil conflict, the country's infrastructure stock has eroded.

FIGURE 3.3 Gross fixed capital formation per capita in selected global regions, 1960–2015



than those in other developing regions. Mobile and internet telephone charges in Africa are about four times higher than those in South Asia, and international call prices are more than twice as high. Connectivity of African countries to international broadband networks is nearly complete, but cost is a key factor affecting adoption. In Africa 1GB of data costs an average citizen nearly 18 percent of average income in 2016, against only 3 percent in Asia.[16] Uncompetitive pricing policies of mobile telephone operators, such as charging more for calls to competitor networks, also make ICT relatively expensive.

Besides access, adequacy, and cost, the quality of infrastructure services is crucial for productivity and economic growth. Compared with other developing regions, electricity in Africa is not only scarce and expensive but also unreliable. Between 2006 and 2016, 79 percent of firms in Sub-Saharan Africa experienced power outages —on average 8.6 power outages a month, with an average duration of 5.7 hours.[17] Although roads are the predominant mode of transport, much of Africa's road network is unpaved, isolating people from basic education, health services, transport corridors, trade hubs, and economic opportunities —particularly in regions with high rainfall. Road safety is worrisome, with the region recording the highest rate of fatalities from road traffic injuries worldwide, at 26.6 per 100,000 population for 2013.[18]

Similar quality constraints are seen in port infrastructure where—in addition to limited capacity in terminal storage, operation, and maintenance—many ports lack the capacity even to handle large vessels. And they are hamstrung by inadequate infrastructure networks in the hinterland, such as railway lines and roads linked to ports, often leading to long delays at the ports.[19] In 45 African countries, neither the current stock nor the access nor the quality of infrastructure drives economic growth in a context of low basic infrastructure endowment.[20]

Poor infrastructure shaves up to 2 percent off Africa's average per capita growth rates.[21] Only firms that have very high returns and engage in well-controlled markets can make a profit by operating in Africa, notably extractive industries in mining, oil production, and allied activities. Firms with high value addition, broad job opportunities, and wide sectoral linkages face serious setbacks.

Firms in Africa face adversities due to difficulties in powering their production operations (table 3.4). On average, power outages occur a quarter of the year, significantly increasing down time or exposing firms to costly energy substitute such as private generators. Progress thus far in this area

Poor infrastructure shaves up to 2 percent off Africa's average per capita growth rates

FIGURE 3.4 Electricity and water access in African countries compared with that in China and India

has been very slow. Close to 60 percent of firms operating in Africa consider infrastructure (power shortages and costs and transport bottlenecks) as the most binding constraint they face in their daily operation. Even if most African countries have enhanced their electricity generation capacity, their progress in power distribution has been painfully slow, making the generated electricity unusable for productive purposes.[22]

The consequences of poor infrastructure are not just the opportunity costs of lost growth. They also include retarded human development. Higher child mortality is driven by low access to basic services, such as electricity and clean water. [23]

The productivity loss and the cost to human development brought about by poor infrastructure will not go away without commitments by policy makers and leaders to embark on ambitious

FIGURE 3.5 Access to electricity and GDP per capita, 2014

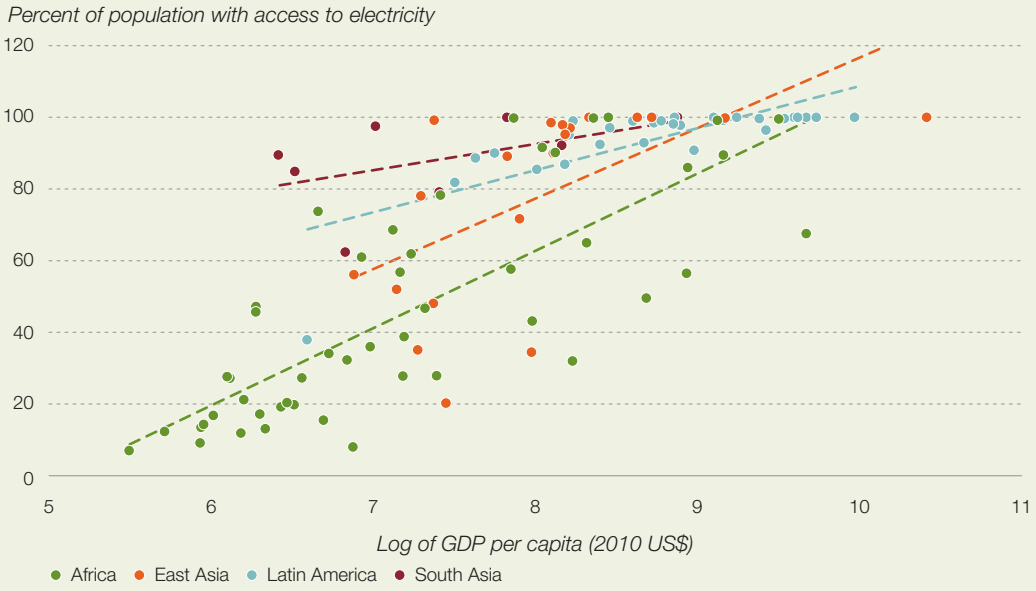
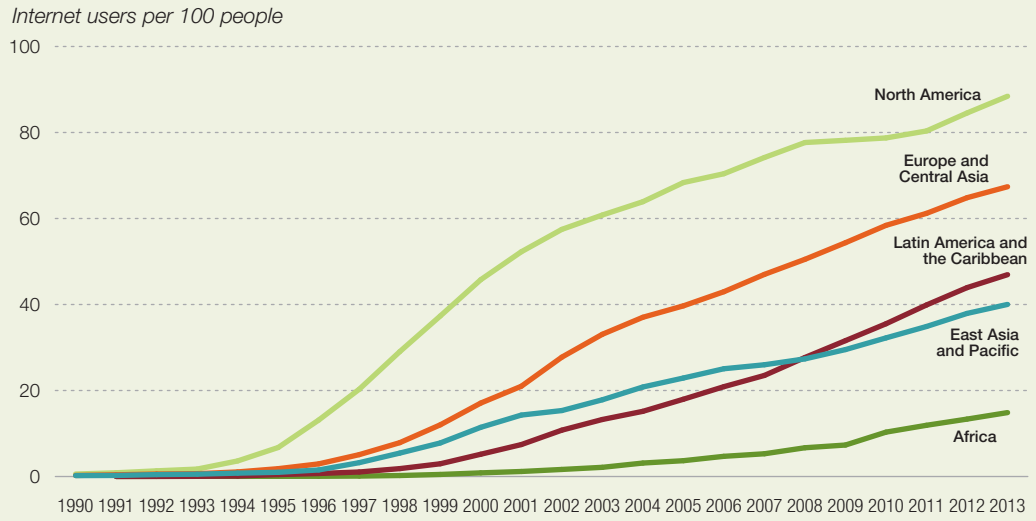


FIGURE 3.6 Internet penetration in selected regions of the world



Source: Computations based on AfDB Data Portal.

The consequences of poor infrastructure also include retarded human development

investments in the sector. First, African countries on average had lower access to electricity irrespective of the level of development, suggesting that what really matters is the political will and committed determination of countries to invest in power generation rather than their ability to afford it (which is still important, however) (see figure 3.5). Second and strengthening this point, some African countries provided access to electricity for large segments of their population, almost close to the East Asia average, while being relatively poorer.

TABLE 3.3 Infrastructure access data for selected global regions

Indicator	Africa	Asia	Europe	Latin America
Transport				
Paved road density (km of paved road per 100 km^2 of land area)	2	25	122	3
Railway lines (km)	46,380	197,610	85,986	89,002
Information and communication technology				
Fixed broadband subscriptions per 100 population	1	6	15	9
Mobile cellular subscriptions per 100 population	73	85	119	115
Power				
Electricity production per capita (kWh)	572	1,930	3,355	2,116
Electricity access (% of total population)	46	88	100	97
Water supply and sanitation				
Improved water (% of total population)	69	90	99	94
Improved sanitation (% of total population)	39	61	93	82

Source: AfDB statistics and World Bank WDI database.
Note: Data are for 2013.

What really matters is the political will and committed determination of countries to invest in power generation

TABLE 3.4 Impact of unreliable infrastructure services on the productive sector

Service problem	Sub-Saharan Africa	Developing countries
Electricity		
Delay in obtaining electricity connection (days)	79.9	27.5
Electrical outages (days a year)	90.9	28.7
Value of lost output due to electrical outages (percent of turnover)	6.1	4.4
Firms maintaining own generation equipment (percent of total)	47.5	31.8
Telecommunications		
Delay in obtaining telephone line (days)	96.6	43.0
Telephone outages (days a year)	28.1	9.1

Source: World Bank 2014.

FACTORS EXPLAINING THE LOW INFRASTRUCTURE PROVISION IN AFRICA

Weak legal, regulatory, and institutional frameworks

Africa's legal, regulatory, and institutional frameworks are major constraints to attracting private capital to infrastructure. Ineffective or nonexistent institutions also pose a challenge. Even when laws are enacted, they may not be implemented or may lack the implementation decrees. In the energy sector for instance, strong and credible financial institutions are required for the sector to work. Private sector players tend to participate in power generation as independent power producers (IPPs) and in the distribution to final consumers (DISCOs). Between the two, a public company

often owns the transmission lines and purchase the power produced by IPPs (off-taker) to sell it to DISCOs. The off-taker typically guarantees the payment of the IPPs production at a pre-agreed rate. The lack of a financially credible off-taker is often a major constraint for IPPs to negotiate and sign power purchase agreements, which can be mitigated through government guarantees backed by guarantee schemes from development finance institutions. This increases project costs and off-take tariffs.

The often inappropriate regulatory framework also limits private sector participation in infrastructure funding. For example, a large number of pension funds in Africa are not allowed to invest in infrastructure projects, even less so outside their countries. Given the small size of most economies, and the cross-border nature of many infrastructure projects, this obstacle is crucial. When allowed, institutional investors may find it difficult to invest as they are often subject to stringent guidelines, such as those for the credit ratings of facilities they invest in, except in Botswana, Mauritius, Seychelles, and South Africa. Most pension funds lack the technical skills to assess complicated infrastructure projects, and there is no incentive for them to assume the extra risk of investing in infrastructure. Fixing these failures would allow African pension funds to allocate up to $4.6 billion a year to infrastructure.[24]

Another area that requires strong institutional intervention is the PPP framework. PPP agreements are often poorly structured and drafted due to a lack of skills or experience in government departments. Lacking actual PPP laws, each project is then subject to individual workaround existing public investment laws and procurement regulations case by case. In the worst case, all project elements have to be developed with all levels of government, adding to uncertainty and extending project development times and complications in procurement. Overall, however, interest is growing for PPPs to support infrastructure in Africa, as reflected in the development of regulatory and institutional frameworks, with many African countries passing laws, national policies, regulations, and PPP units for implementation over the years.

Weaknesses in infrastructure planning and project preparation

The absence of well-defined infrastructure programs and bankable project pipelines is also a major issue in many African countries. At the core of the challenge: The private sector is not prepared to assess, develop, and prepare infrastructure projects, given the costs, risks, and long-time horizons. That means governments, donors, and international financial institutions (IFIs) need to take action through long-term infrastructure planning based on population growth and development objectives and taking into account the economic importance of different regions of a country.

A lack of planning may also prevent a government from taking a programmatic approach to building infrastructure and implementing complementary projects to maximize benefits. For instance, a national highway passing through an agricultural region can be built or upgraded along with rural roads to ensure that farmers benefit from the highway.

The absence of well-defined infrastructure programs and bankable project pipelines is a major issue in many African countries

Even with infrastructure plans, individual projects need preparation to demonstrate their bankability and reach financial viability. Project preparation includes project identification, prefeasibility and feasibility studies (proof of concept), detailed studies (feasibility, environmental and social impact, design), project structuring, and procurement and concession agreements (including contract negotiation). Strong administrative capacity may also be required for setting up the laws, regulations, and institutions necessary for a specific project. This step can be challenging for African countries due to their lack of capacity and financing. Sometimes, an African country may lack the human capital in the public sector to undertake infrastructure project preparation, which can require highly skilled professionals, so many must seek external expertise.

The more complex the PPP structure, the more extensive the advisory services required. Even if a sufficiently skilled workforce exists in the public bureaucracy, it may be dispersed among multiple ministries and agencies, and unable to work well together. Poor coordination between ministries can make this process complex and time consuming, discouraging investors. But some countries have good models that other countries can

adapt, including the Bureau National d'Etudes Techniques et de Développement in Côte d'Ivoire and the Presidential Infrastructure Coordinating Committee in South Africa (box 3.4).

Another constraining issue in infrastructure development is the lack of funding for project preparation. In general, the preparation phase can be very risky for private entrepreneurs if they are not compensated when projects do not reach financial completion; this may happen with relatively high probability due to various obstacles. According to the NEPAD Infrastructure Project Preparation Facility (IPPF), project development costs in Africa average 10–12 percent of total project cost. At that rate, the cost of preparing the PIDA projects alone could be as high as $2.5 billion a year, far more than the $91.8 million currently available in the IPPF or $126 million for InfraCo Africa.[25] Given the estimated infrastructure funding need of $95 billion, project preparation costs can range from $9.5 billion to $11.4 billion, so the funding facilities are well below the needs.

During the operational phase, pricing of user charges by a regulator is often compromised by political motives, without taking into consideration the real cost of infrastructure services and the market pricing of the associated risks. Indeed, African countries have followed a distinct trend when pricing infrastructure services. Services are considered basic rights, and those with strong public-good characteristics have been provided below costs, including water, roads, commuter rail services, and to a varying degree, electricity. Road infrastructure services, for instance, have traditionally been provided toll-free. And in the power and water sectors, illegal connections and undercollection of bills add to losses that undermine the financial stability of utilities.

Poor governance and political economy issues can be major bottlenecks for infrastructure development

Governance and corruption

Poor governance and political economy issues can be major bottlenecks for infrastructure development in Africa, frequently because these projects are complex. They require heavy, long-term investment, have strong public-good characteristics, a long-life, and high sunk costs. And they are very sensitive to local political conditions. These issues naturally affect private investors'

BOX 3.4 Presidential Infrastructure Coordinating Committee terms of reference

The PICC's mandate is to ensure systematic selection, planning, and monitoring of large projects, and its terms of reference include the following:

- Identify 5-year priorities.
- Develop a 20-year project pipeline.
- Achieve development objectives: Skills, industrialization, empowerment, research and development.
- Expand maintenance: New and existing infrastructure.
- Improve infrastructure links: Rural areas and poorest provinces.
- Address capacity constraints and improve coordination and integration.
- Scale-up investment in infrastructure.
- Address impact of prices.
- Support African development and integration.

Overall approach

- An infrastructure book has been compiled, which contains more than 645 infrastructure projects across the country.
- A national infrastructure plan with 18 identified strategic integrated projects has been developed and adopted by the cabinet and the PICC.

Source: PICC 2012.

risk perceptions of infrastructure funding in Africa.

Political rather than economic and social considerations may dictate where infrastructure projects are executed.[26] In many African countries, airports, paved roads, and power plants are built to yield political benefits in the regions of powerful politicians, and end up as "white elephants." This was particularly common in the 1980s.[27] Political bias in project selection also leads to a large number of unfinished projects as new governments fail to complete old projects given their lack of economic returns or their perceived benefits favoring constituencies that may not support them.

Elections and political considerations can shift the composition of public spending toward "more visible" current expenditures instead of capital expenditures.[28] A major infrastructure project can easily take more than five years from inception to commissioning. So, governments might prefer not to undertake such projects in one or two years since they won't be able to show outcomes ahead of the next election. In addition, political considerations may favor constructing new infrastructure as opposed to optimizing the use of what is already there.

The negative consequences of political considerations are often worsened by rent-seeking and corruption, lowering the quantity of productive public investment.[29] Corruption also reduces the efficiency of public investment as corrupt officials give priority to projects that generate higher private material and political gains over projects with higher social returns. In such circumstances, projects take a long time to develop and involve multiple stakeholders. Civil servants at various levels of responsibility play critical roles at various stages in the project development cycle, which increases their opportunities to seek bribes. Projects involve large sums of money and cumbersome regulatory systems with ambiguous rules, leaving room for subjective interpretations, weak accountability, and ineffective transparency mechanisms.[30]

Widespread corruption in infrastructure increases project costs, lengthens delivery times, reduces output quality, and thus lowers benefits.[31] It also undermines infrastructure maintenance and sustainability of benefits. In many countries, not only is there an infrastructure deficit, but the existing infrastructure, such as power plants and paved roads, is not regularly maintained. Bureaucrats may let the infrastructure deteriorate so that renovation and redevelopment will require more funds to siphon off. Vested interested may also stall critical infrastructure projects that displace rent-seeking activities. Strong political will and leadership at the highest level of government is necessary to overcome the powerful forces trying to keep the status quo.

Political considerations and weak management capabilities can also lead to soft but pervasive forms of populism where households and firms do not pay bills, starving public utilities of revenue. Power and water infrastructure tend to record significant wastage. Transmission and distribution losses can be as high as 50 percent of the power output in many Sub-Saharan African countries.[32] In addition to those losses, illegal connections and undercollection of bills hamper the financial stability of utilities in Africa. Utilities typically collect only 70 to 90 percent of billings, and distribution losses can easily be twice as high as technical best practice. It is not unusual for revenues lost as a result of these inefficiencies to exceed the current turnover of the utilities. In the power sector, these losses have been estimated on average at 1.9 percent of GDP.[33] For water utilities, the absolute value of the inefficiencies is smaller, with the average at 0.6 percent of GDP.

These quasi-fiscal costs represent a real financial burden on the public budget, since utilities that incur such deficits must ultimately resort to the state for investment finance and periodic bailouts. They may also represent a real economic burden for the country, as underfunded utilities tend to run down their assets and provide low quality services. The revenues lost as a result of undercollection, distribution losses, and other inefficiencies amount to $6 billion a year.[34]

Widespread corruption also undermines infrastructure maintenance and sustainability of benefits

Infrastructure deficits are not unique to Africa

Despite the fact that good infrastructure investments offer long-term returns immune to the volatility of stock and bond markets, excess global savings are not being channeled into profitable

opportunities. In all world regions, projects are shovel-ready in many countries, which could boost global productivity, global demand, and global growth. But institutional investors seem incapable of finding these potentially profitable investments, or finding the appropriate financial instruments to carry out the necessary intermediation.

Assessing infrastructure finance needs is complex and necessarily inexact, varying with the assumptions. Global infrastructure needs amount to an estimated $5–$6 trillion of investments each year in cities, transport systems, energy systems, water and sanitation, and telecommunications,[35] resulting in a yearly gap of $2–$3 trillion.[36] This gap applies both to developed and developing countries (figure 3.7).

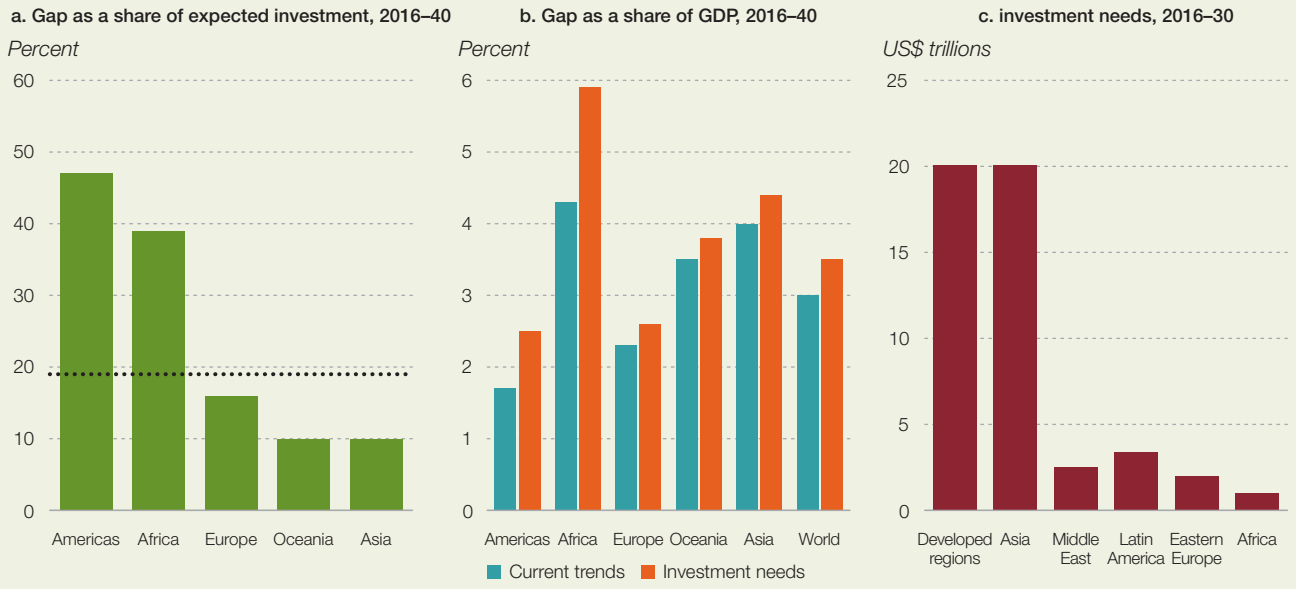
The world needs to invest an average of $3.3 trillion annually just to support currently expected rates of growth…

A comprehensive McKinsey study on transport, power, water, and telecommunications systems finds that the world needs to invest an average of $3.3 trillion annually just to support currently expected rates of growth, with emerging economies to account for some 60 percent of that (figure 3.8).[37] With the world investing about $2.5 trillion a year in these infrastructure areas, McKinsey estimated a global infrastructure gap of about $800 billion a year.

A third study by the World Economic Forum broadening the scope of infrastructure estimates a global need for $3.7 trillion in infrastructure investment each year, while only $2.7 trillion is invested, mostly by governments, suggesting an infrastructure investment gap of about $1 trillion a year. A similar story emerges from a study by McKinsey, which estimates that the G20 nations' need for infrastructure projects will amount to $60 trillion in the next 15 years. This would leave the financing envelop for infrastructure projects and programs in G20 countries short by at least $20 trillion.

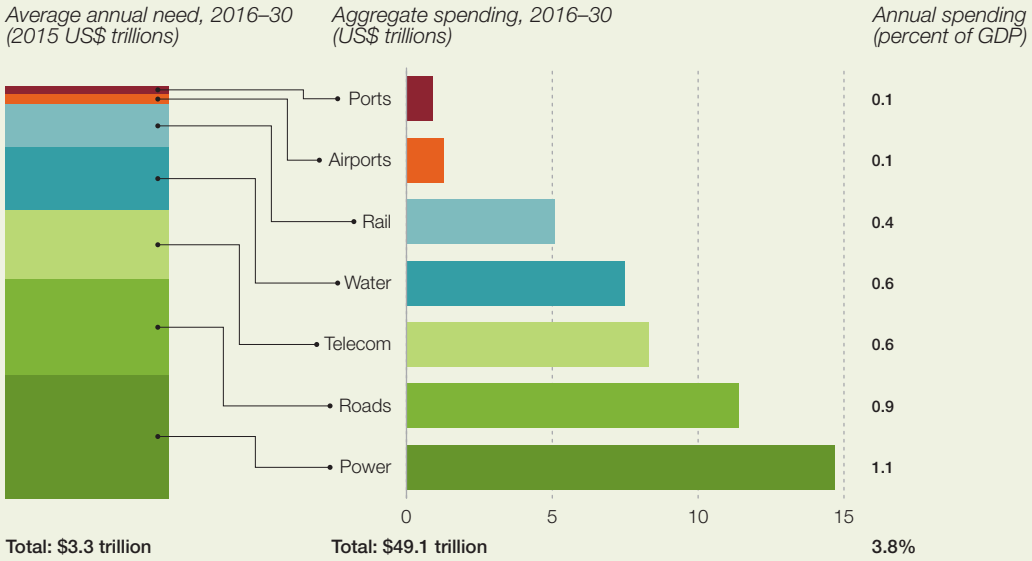
In the United States, the American Society of Civil Engineers (ASCE) has compiled regular "report cards" on the state of the country's infrastructure since the 1980s. In its 2017 report, it grades infrastructure as a "D" on average, meaning that conditions are "mostly below standard," exhibiting "significant deterioration," with a "strong risk of failure." It estimates a total "infrastructure gap" of nearly $1.5 trillion by 2025. The U.S. Department of Transportation estimates that more than $800 billion is required just to shore up the nation's roads and bridges. McKinsey calculates that $150 billion a year will be required between

FIGURE 3.7 Infrastructure financing gaps to 2040 and investment needs to 2030 in selected regions



Source: Calculations based on Global Infrastructure Hub (2017) and UN (online).

FIGURE 3.8 How much should the world invest in infrastructure?



Source: https://mckinsey.com/industries/capital-projects-and-infrastructure/our-insights/infrastructure-productivity.

Note: The estimate of total demand is lower than the $57 trillion projection in previous MGI research. It has been adjusted for the following reasons: This projection covers a 15-year period (2016–30) rather than an 18-year period (2013–30); water numbers have been reduced by 40%, as Global Water Intelligence adjusted its water capital-expenditure definition to exclude equipment spending; base-year prices have been revised from 2010 to 2015; and GDP growth forecasts have been revised downward by IHS.

…and emerging economies account for some 60 percent of that figure

2017 and 2030 to keep abreast of all infrastructure needs in the United States.[38]

Infrastructure problems are similar in Canada. A 2016 Infrastructure Report Card, generated from surveys of more than 100 municipalities representing 20 million Canadians, found that 60 per cent of municipal infrastructure ranked as less than "fair" quality. Just under two-thirds of Canada's bridges, roads, transit lines, water structures, and government buildings are either in need of repair or will be in the near future—at substantial costs.

The situation is also far from ideal even in Europe, where government reports on infrastructure point to crumbling bridges and traffic jams in many places. In Germany for instance, an estimated 15 percent of municipal road bridges need to be completely rebuilt.

Asia will need to invest an estimated $26 trillion from 2016 to 2030, or $1.7 trillion a year, if it is to maintain its growth momentum, eradicate poverty, and respond to climate change (in the climate-adjusted estimate). Without the adjusted mitigation and adaptation costs, $22.6 trillion will be needed, or $1.5 trillion a year. In India, infrastructure needs for the next decade are estimated at between $1 trillion and $2 trillion.[39]

Despite upgrades over the past decades, the level and quality of infrastructure in Latin America and the Caribbean are inadequate and identified as important barriers to growth and development.[40] There have been improvements in some areas of transportation (for the most part in highways), electric energy (electricity supply and generation), but progress in water and sanitation and urban transportation is still viewed as insufficient. In fact, many countries in the region score lower in infrastructure quality—measured by indicators such as reductions in electricity distribution losses, unpaved roads, and telephone faults—than one would expect given their income per capita. Indeed, countries in the region have

lower quality infrastructure than countries with similar incomes in other regions.[41] It is estimated that Latin America should increase investments by 3 percentage points of GDP if it intends to enter the league of developed regions, and everything indicates that the public sector cannot, by itself, mobilize the necessary funds.[42]

INFRASTRUCTURE FINANCE IN AFRICA DECLINED IN RECENT YEARS

With investment needs estimated at $130–$170 billion a year, and commitments from all sources at $62.5 billion in 2016…

Between 2012 and 2016, commitments to Africa's infrastructure from all reported sources averaged $75 billion, with 2013 recording the highest commitment at $83.3 billion.[43] Commitments declined to $62.5 billion in 2016, the lowest level in five years (table 3.5). Overall commitments fell by $16.4 billion from 2015 to 2016. This was mainly due to a large reduction of $14.5 billion of reported funding from China, and a $4.9 billion decline in private sector investment. African governments, whose contributions to infrastructure financing were sharply curtailed in 2014 after the commodity price shock, increased their share slightly from $24 billion in 2015 to $26.3 billion in 2016 (down from the peak of $43.6 billion in 2014).

With investment needs estimated at $130–$170 billion a year, and commitments from all sources at $62.5 billion in 2016, the financing gap for Africa's infrastructure is in the range of $67.6–$107.5 billion. These numbers are all flow variables, not stocks. The value of the infrastructure stock in Africa for 2016 is difficult to calculate rigorously using the inventory method. Few African countries publish estimates of their infrastructure stock. Most of them have a public infrastructure asset management system, especially if they have a ministry of infrastructure, and ministries of finance typically compute figures on public infrastructure assets. But most countries define those assets to include public buildings hosting social services (hospitals, schools, and so on) which we do not include in the definition of infrastructure as per the IMF functional classification used in this report as noted in box 3.2.

For Africa, the share of infrastructure investments in transport is the largest, at around 39 percent, followed closely by the energy sector at 32 percent and water and sanitation at 17 percent. The increasingly important ICT sector is under 3 percent (table 3.6). Digging deeper into sectoral allocations, commitments to the transport sector fell sharply in 2016 to $24.5 billion, down from $34.4 billion in 2014 and $32.4 billion in 2015. The sector benefited from strong Chinese support in 2015 while budget allocations to transport from national governments peaked at $17.6 billion in 2014 before they were depressed by weak oil and commodity prices in the two following years. African national governments nevertheless continued to be the main funders of the continent's transport infrastructure in 2016, providing $14.6 billion (59.6 percent) of the $24.5 billion committed that year. West Africa received the highest transport commitments in 2016 ($6.6 billion or 26.9 percent of the total), and East Africa the highest in

TABLE 3.5 Trends in infrastructure finance in Africa, by source ($ billion)

Source	2012	2013	2014	2015	2016	Average
African governments	26.3	30.5	43.6	24	26.3	30.1
Donors (ICA members)	18.7	25.3	18.8	19.8	18.6	20.2
MDBs and other bilaterals	1.7	2	3.5	2.4	3.1	2.5
China	13.7	13.4	3.1	20.9	6.4	11.5
Arab countries	5.2	3.3	3.4	4.4	5.5	4.4
Private sector	9.5	8.8	2.9	7.4	2.6	6.2
Total	75.1	83.3	75.4	78.9	62.5	75.0

Source: ICA 2017.

TABLE 3.6 Infrastructure disbursements of $62.5 billion by sector in Africa, 2016

Sector	Disbursements (%)
Total disbursed	
Transport	39.2
Water and sanitation	16.9
Energy	31.9
ICT	2.6
Multisector	4.4
Other unallocated	5.1

TABLE 3.7 Infrastructure disbursements in Africa by region, 2016

Region	Share (%)
North Africa	20.7
West Africa	26.1
Central Africa	10.1
East Africa	21.0
Southern Africa (excluding South Africa)	10.4
South Africa	9.4
Pan-African	2.3

… the financing gap for Africa's infrastructure is in the range of $67.6–$107.5 billion

2015 ($11.8 billion, or more than one-third of commitments).

Commitments to the water sector increased substantially from $7.5 billion in 2015 to $10.5 billion in 2016, and surpassing the $9.7 billion reported in 2014. African national governments again provided substantial funding to the sector, with $4.4 billion allocated, while bilateral and multilateral agencies committed $1.5 billion. In keeping with previous years, North Africa ($2.6 billion) and East Africa ($2.5 billion) accounted for almost half of the total commitments to water in 2016. West Africa received $2.1 billion in water sector financing in 2016, a substantial increase on 2015 ($1.1 billion). Financing for projects in Southern Africa stood at $1.9 billion (18 percent), while Central Africa received $851 million and South Africa $528 million.

Financing of energy projects in Africa fell to $20 billion in 2016, from the peak of $33.5 billion reported in 2015, which included African national government allocations of $6 billion. Chinese commitments, almost halved to $4.6 billion, though this still accounted for 23 percent of total commitments to the sector. The relative lack of renewable energy projects reaching financial closing in South Africa, compared with previous years, was a major factor in the overall decline, with the private sector investing just $1.3 billion in 2016.

Southern Africa, historically a primary destination for investment in energy, received only 18.3 percent of total commitments in 2016, down from 50 percent in 2015. By contrast, West and East Africa accounted for more than half of total commitments, receiving $5.6 billion and $5.2 billion, respectively. Commitments to North Africa fell from $4.5 billion to $3.3 billion, while those to Central Africa rose from $1.2 billion to $1.4 billion.

ICT sector commitments stood at $1.6 billion in 2016, less than the $2.4 billion reported in 2015. African national government allocations increased to $853 million, but Chinese investments declined from just over $1 billion in 2015 to $300 million.

Chinese funding in 2016 reached just one project, the second and third phases of Zambia's digital migration. Southern Africa (excluding South Africa) was the largest recipient of ICT commitments from all sources, attracting 44 percent of the total ($715 million).

Overall commitments to Africa's infrastructure from all reported sources declined to $62.5 billion in 2016, the lowest in five years, due mainly to a large reduction of $14.5 billion of reported Chinese funding and a $4.9 billion reduction of private investment.

NATIONAL GOVERNMENTS REMAIN THE MAIN SOURCES OF INFRASTRUCTURE FINANCE IN AFRICA

Internally funded national budget allocations remained depressed in 2015 and 2016 ($24 billion and $26 billion)

Internally funded national budget allocations, on the rise until 2014, remained depressed in 2015 and 2016 ($24 billion and $26 billion). National government capabilities for investment in infrastructure are limited by national fiscal and economic constraints.

Commitments by the European Commission (EC) amounted to $1.4 billion in 2016. The EC manages the European Development Fund (EDF, for Sub-Saharan Africa countries) and the Development Co-operation Instrument for North African countries. Data for 2016 includes the EDF contribution to the EU-Africa Infrastructure Trust Fund (ITF) and Africa Investment Facility (AfIF), but does not reflect the projects approved and implemented with a contribution of the ITF or AfIF, since loans for such projects are provided by other institutions and should thus be reported by these institutions.

The EU-AITF committed $64 million in 2016, down from $156 million in 2015. Most of the 2016 commitments ($58 million) were directed at energy projects, while transport projects received $5 million. Disbursements in 2016 amounted to $38 million, with most for energy ($28 million) followed by transport ($8 million) and water ($4 million). The fund blends long-term loans from participating financiers with grant resources from donors. It provides technical assistance for preparatory work, project supervision and targeted capacity building. It also provides interest rate subsidies and thus reduces the total amount of debt. And it also provides financial instruments to guarantee cost financing, equity or quasi-equity investments or participations, and risk-sharing instruments.

France reported commitments and disbursements through Agence Française de Développement (AFD), its Proparco subsidiary dedicated to the private sector, and Fonds Français pour l'Environnement Mondial (FFEM–French Fund for the Global Environment). Commitments in 2016 totaled $2.8 billion, a bit higher than the $2.5 billion reported in 2015 and $2.4 billion in 2014.

Germany reported $1.1 billion of commitments in 2016 (including DEG, GIZ, and KfW), the same level as in 2015. Most 2016 commitments targeted energy ($778.7 million), followed by water ($330.9 million) and transport ($17.1 million).

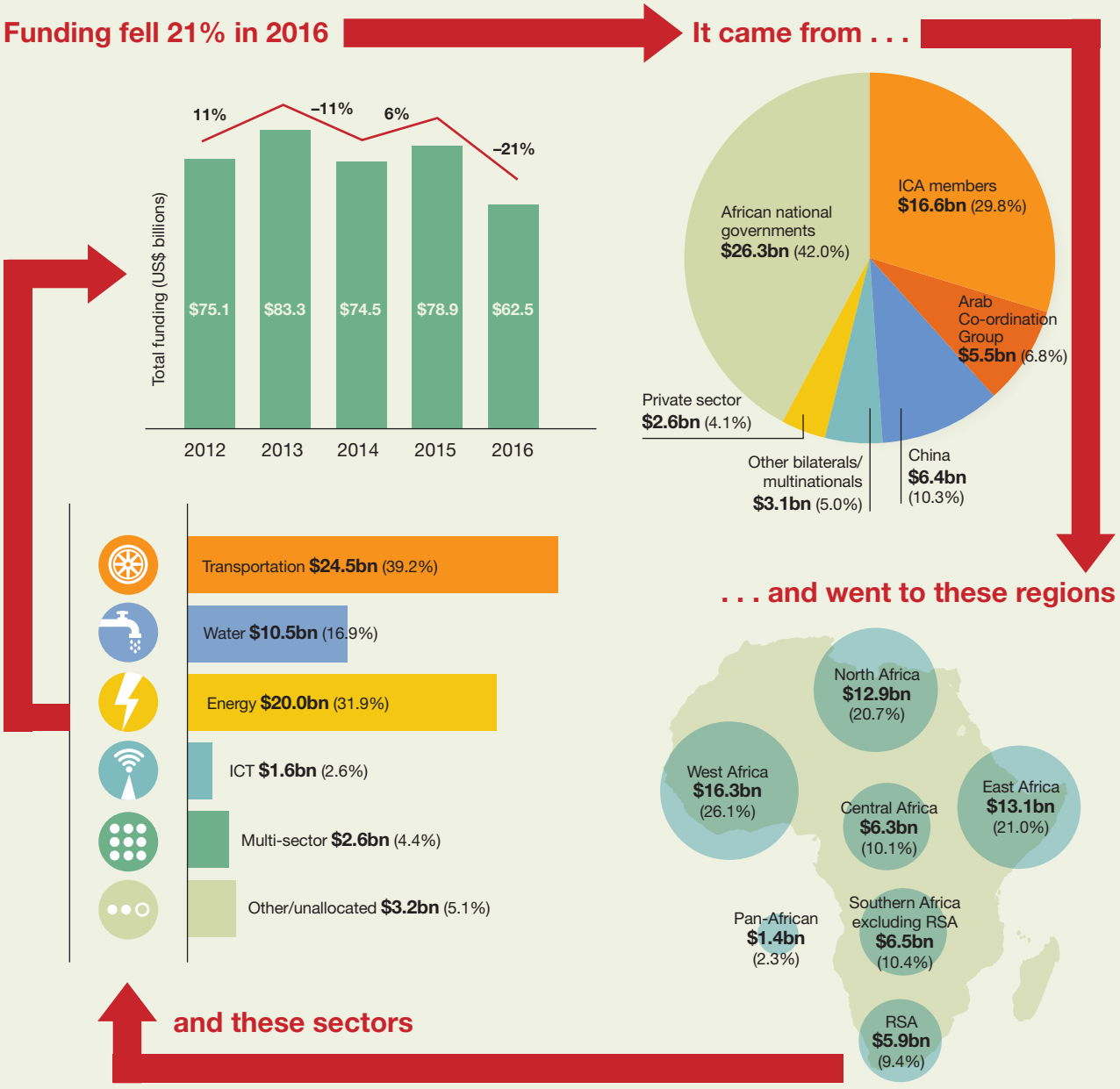
For the UK, direct grant funding from DfID and equity investments by CDC totaled $537 million in 2016 compared with $288 million in 2015. DfID committed $281.7 million in 2016, with most for water ($103.8 million), followed by transport ($78.6 million), multisector ($57.9 million), energy ($33.7 million), and ICT ($7.7 million). CDC committed $287.7 million, with $251 million for the energy sector and $36.7 million for multisector projects. In the same year, DfID disbursed $291 million, with most for water ($109 million), followed by transport ($78 million), multisector ($57 million), energy ($41 million), and ICT ($6 million).

Italy reported commitments and disbursements through Cassa Depositi e Prestiti (CDP), which assumed the role of the National Financial Institution for Development Co-operation in January 2016. Italy, as Chair of the G7, is hosting the 2017 ICA Annual Meeting in Rome. In 2016, it committed $28.8 million to the infrastructure sector, most for water and sanitation projects. Total Italian disbursements that year amounted to $19.7 million, $1.7 million of it as grant money for multisector projects.

China has become a significant player in Africa's infrastructure scene, but commitments vary from 16.1 percent of total funds in 2013 to 4.1 percent in 2014, 26.5 percent in 2015, and 10.2 percent in 2016. The fall in Chinese funding particularly hit the energy sector, with overall sector commitments falling by $14.7 billion (42 percent) between 2015 and 2016. China's $1 billion funding for transport in 2016, compared with nearly

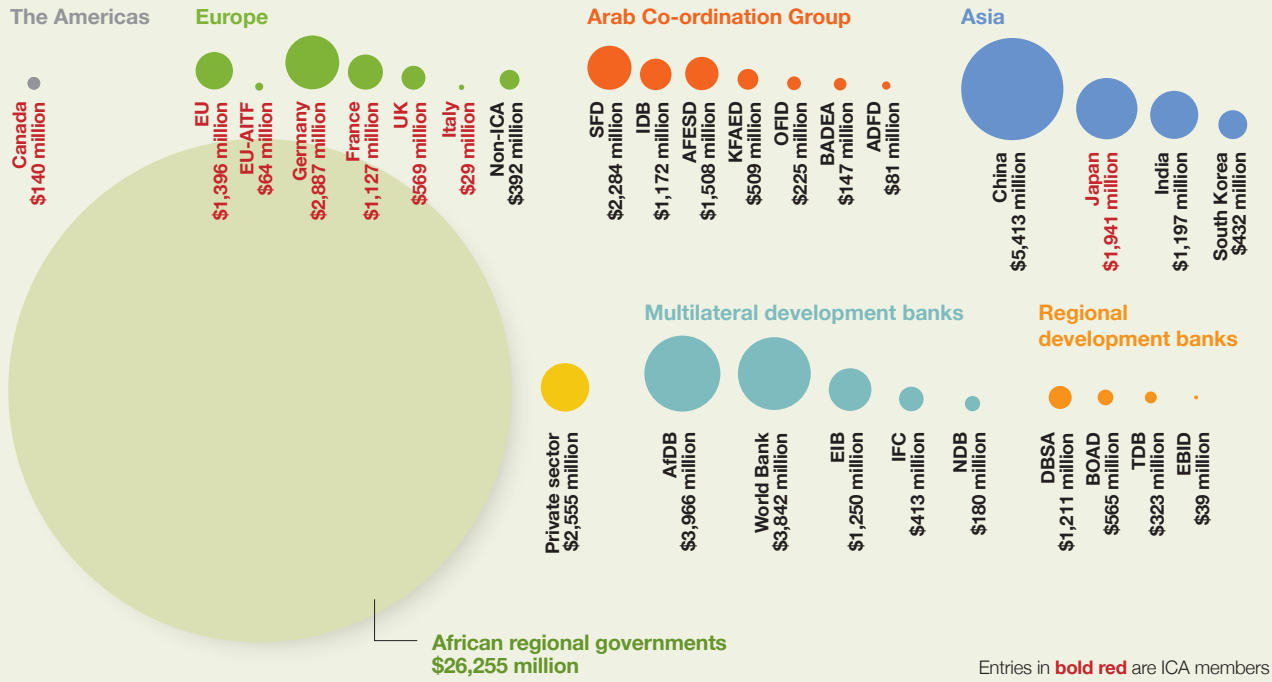
INFOGRAPHIC 3.1 **Overall commitments to Africa's infrastructure from all reported sources fell to $62.5 billion in 2016, the lowest in five years**

Falling commitments in 2016 are substantially due to a large reduction of $14.5 billion in reported Chinese funding and a $4.9 billion reduction in private sector investment



$10 billion the previous year, explains most of the overall decline in funding of 29 percent (or $10.2 billion) for the sector. India's commitments more than doubled in 2016 to $1.2 billion, from $524 million in 2015. South Korea committed $432 million to four projects in 2016 compared with a single commitment of $81 million in 2015. Brazil announced no new commitments in 2016.

INFOGRAPHIC 3.2 Funding for infrastructure relies heavily on external funding, which roughly matches the funding by national governments



The Arab Co-ordination Group (ACG) reported commitments of $5.5 billion in 2016, the third consecutive annual increase and the highest in the last eight years, with average annual commitments of $3.8 billion over those years.

Bilateral and multilateral institutions such as AfDB and the World Bank Group are also supporting infrastructure investment, particularly in projects with public-private participation. Together, they contributed more than 50 percent to infrastructure financing in Africa. AfDB has devoted 60 percent of its portfolio to infrastructure projects since 2009. In the last five years alone, it has allocated $6 billion to power Africa. Recently AfDB also launched a New Deal on Energy to increase access to electricity from about 25 percent of its current level to almost 100 percent by 2025. IFC committed $413.3 million in 2016 compared with $246 million in 2015 and $621 million in 2014. Disbursements of $203 million in 2016 fell from $747 million in 2014 and $292 million in 2015. Completed projects in 2016 included two final debt financings for Umeme, Uganda's privately-owned electricity distributor, and financing for developers of mobile telecoms towers. IFC also signed off the 134MW Amakhala wind farm completed on South Africa's Eastern Cape. It is part of the country's Renewable Energy Independent Power Producer Procurement Programme (REIPPP), which IFC also supported through several other renewable energy projects.

Regional Development Banks (RDBs) provide significant support to infrastructure development through provision of loans. As an example, DBSA in 2016 had disbursement and commitment of $1.2 billion (see infographic 3.2). By contrast four major RDBs (BOAD, EBID, TDB and EADB) together committed a total of $924 million in 2016, almost twice the previous year, with about 90 percent to energy and transport projects.

Private sector mobilization with the public sector

The funding mobilized by the private sector (about 4 percent) is a useful contribution to the funding mix, though not on the same level as

governments and development finance institutions (DFIs). Cooperation with the private sector has the potential to give access to additional resources triggered. Development plans of the major DFIs and most national plans include access to private sector funding. In addition to general constraints and risks related to infrastructure funding, the private sector is particularly concerned. The continuing success or increase of provision of these funds depends not only on market conditions but suitable risk mitigation for commercial risk and constraints.

The good news is that Africa could achieve the 2030 Sustainable Development Goals and the High Five Agenda by adopting new and emerging technologies, materials, and processes that would accelerate economic growth.[44] The continent does not have to repeat the technological mistakes that other world regions made when developing new infrastructure. Instead, it could "leapfrog" to new technologies, including green and digital technologies.

GREATER FINANCING OF HIGH-QUALITY INFRASTRUCTURE WOULD CONTRIBUTE TO GLOBAL PUBLIC GOODS AND ADDRESS SOME OF THE WORLD'S BIGGEST CHALLENGES

The global economic recovery is under way, and new sources for growth are emerging, especially in developing countries. But global growth, still below potential, is insufficient to provide the employment opportunities needed to mitigate the effects of climate change, social conflicts, and refugee flows—and to slow the migration of unskilled labor out of Africa. Downside risks remain due to the potential volatility in financial markets, fluctuations of commodity prices, sluggish trade and investment, and slow productivity and employment growth in some countries.

The international community acknowledges that global growth can be boosted to create more jobs only if it is "powered by new driving forces."[45] After adopting the Sustainable Development Goals (SDGs) in 2015 (box 3.5), the United Nations General Assembly recently adopted a resolution declaring 2016–25 the Third Industrial Development Decade for Africa. While reaffirming the importance of addressing shortfalls in global demand to support short-term growth, G20 countries have indicated that it is also imperative to address supply-side constraints to raise productivity sustainably, to expand the frontier of production, and to unleash the potential for mid- to long-term growth.

The G20's New Industrial Revolution Action Plan is a blueprint to support industrialization in developing countries, especially in Africa.

Industrial production creates job opportunities at higher skill levels. It also facilitates denser links with the service and agricultural sectors, between rural and urban economies, and between consumer, intermediates, and capital goods industries. Manufactured exports are less volatile and less susceptible to long-term price deteriorations than those of primary goods. Furthermore, industrialization is a critical tool in employment generation, poverty eradication, and regional development policies. Industrialization can also spur technological advancement and innovation as well as productivity gains. Indeed, virtually all the successful countries recognized the critical role of industrialization and actively supported their industries through targeted policies and institutional development.

The manufacturing sector typically has higher productivity than other sectors. It provides special opportunities for capital accumulation, spatial concentration, agglomeration economies and dynamic economies of scale. It drives technological change and presents many opportunities for learning and upgrading, and its positive spillovers and linkages to the economy are typically stronger. Compared with other sectors, manufacturing is particularly well suited to create direct and indirect jobs, better paid than in other sectors and typically with better working conditions. The generation of direct and indirect jobs in manufacturing and manufacturing-related services includes more people in the growth process. It also increases productivity, wages, and family incomes, thus reducing poverty.

Seventy percent of Africa's population is under the age of 30, and more than 80 percent of the

The global economic recovery is under way, and new sources for growth are emerging

BOX 3.5 Employment, industrialization, and the Sustainable Development Goals

Strong progress in employment generation in Africa, preferably in the formal sector, would improve the conditions for global prosperity and social peace. It requires integrating skilled and unskilled—and low-skilled people unemployed or underemployed—into the active labor force. Only inclusive and sustainable industrialization can provide employment in low-income countries dominated by low-skilled labor. Virtually no country was able to end poverty, build human capital, and establish well-functioning institutions, move from low income to high income, and achieve economic prosperity and social stability without industrializing, which enriches the stocks of physical and human capital and stimulates knowledge generation and diffusion.

Employment generation is the key to success for all the Sustainable Development Goals adopted by the world community in 2015. It is the single most important tool for eradicating poverty (Goals 1 and 2) and helping people everywhere develop human capital and soft skills (Goal 4), which eventually give them the means for improving their health (Goal 3). Decent employment converts excluded women into empowered and active citizens (Goal 5). It also converts even the least skilled people in the labor force into productive agents and taxpayers, generating sustainable growth (Goal 8). And it gives governments the financial resources to build infrastructure and provide public services and utilities (Goals 6 and 7).

By helping working families gain new and stable sources of income, inclusive and sustainable industrialization is the most effective route to end hunger, achieve food security and ensure adequate nutrition for all (Goal 2). It also offers equality of opportunities to people across social groups and geographical areas, and good possibilities to reduce inequality (Goal 10). It is also the best way of promoting sustainable consumption and production patterns (Goal 12) of building inclusive, safe, and sustainable cities and human settlements (Goal 11).

Inclusive and sustainable industrialization is the appropriate platform for establishing mutually beneficial partnerships between low-, middle-, and high-income countries (Goal 17). By offering government and corporate interests in poor and rich countries the incentives to design and implement profitable new models of cooperation and durable productive ventures, it gives all parties incentives to search for environmentally sensible deals. It thus helps in addressing climate change and other environmental concerns (Goals 13, 14, and 15) while creating the conditions for building peaceful and inclusive societies, the rule of law, and effective and capable institutions (Goal 16).

With the right policies, industrialization in Africa would spur growth and contribute to global demand

workforce is either unemployed or engaged in informal and subsistence activities. Unless rapid and sustained industrial development takes place across the continent, unemployment and underemployment there are likely to worsen, pushing workers to migrate to other regions of the world, especially Europe.

But with the right policies, industrialization in Africa would spur growth and contribute to global demand. By raising productivity and creating formal sector employment, it would boost average incomes, raise domestic consumption, support a rapidly growing middle class, and boost demand for imported capital equipment. According to UNIDO research, for every percentage point increase in the share of manufacturing in African GDP,[46] per capita investment would increase $66 and per capita consumption would increase $190. This boost in investment and consumption would increase their requirements for imported capital and consumer goods from other regions of the world, notably the G20 economies, the source of most of Africa's imports.

Increased production of capital and consumer goods in G20 economies and in Africa would also put into motion several multiplier effects, generating further demand for intermediate inputs, augmenting incomes, and increasing employment.

TABLE 3.8 **Projected increase in production and employment in G20 countries due to industrialization in Africa and least developed countries** *($ millions)*

	Investment	Consumption	Total
Direct exports from G20	28,538	63,586	92,123
Indirect effects of exports	45,805	85,841	131,647
Indirect effects of production increase in Africa and LDCs	109,478	204,026	313,504
Total increase in production	183,821	353,453	537,274
Total increase in employment (thousands of workers)	2,171	5,332	7,503

Source: Simulations based on Eora Multi-Regional Input Output Table, 2013.

Note: Employment figures were calculated using sectoral employment data from ILO WESO 2015. Direct employment requirement coefficients were calculated dividing sectoral employment of 2013 (as published in ILO WESO 2015) by sectoral output of 2013 (as published in Eora). Employment increase in the last row of the table was then calculated multiplying these direct employment coefficients by the corresponding change in production, by sector and by G20 country.

UNIDO estimates that increasing the share of manufacturing in GDP in Africa (and other LDCs) could boost investment in the G20 by about $485 billion and in household consumption by about $1.4 trillion.

Using the same method it is also possible to estimate: a) the direct increase in G20 exports of consumer and capital goods to Africa and LDCs triggered by their industrialization; b) the indirect increase in production in G20 countries triggered by these augmented exports; and c) the indirect increase in production in G20 countries triggered by the augmented production in Africa and LDCs needed for the domestic production of investment and consumer goods (table 3.8).

The impact of African (and other LDC) industrialization on G20 economies would also be large. Direct exports of capital and consumption goods would increase by more than $92 billion. And the indirect effects associated with this increase in exports—given the domestic linkages between G20 exporters and other domestic producers—would increase G20 production by $132 billion. The most important effect, however, is related to the increase in the domestic production of consumer and capital goods inside Africa (and other LDCs) and the multiplier effect on other parts of the world, particularly on the G20 countries. These multiplier effects would amount to almost $315 billion. All that would generate 7.5 million jobs in the G20 economies.

In the decades ahead, Africa could thus become a major contributor to and driver of global growth, just as Asia has been. New opportunities for decent jobs, especially for youth in the Arab world and in Sub-Saharan Africa, would alleviate socio-political tensions and mitigate the risks of seeing large numbers of disenfranchised youth joining radical militant groups and posing threats to global peace and security. Higher growth rates in Africa would yield additional global benefits. It would bring higher tax revenues to many low-income countries—and reduce their dependence on foreign aid. And it would help improve their domestic health systems and strengthen their capacity to prevent and handle disease outbreaks, such as Ebola and Zika.

To yield such potential global benefits, Africa's industrialization would have to be underpinned by a robust infrastructure financing program. This requires a global finance pact among advanced and developing countries, a shift in strategic approaches, and new models of financing, as chapter 4 details.

In the decades ahead, Africa could become a major contributor to and driver of global growth

ANNEX 3.1 AFRICA'S INVESTMENT NEEDS: A NOTE ON METHODOLOGY

The main data sources for calibrating the models used to estimate investment needs were the AfDB Socioeconomic Database, AIKP database and Power plant database for the power sector (both available through AfDB platform "Africa Information Highway – AIH"). Whenever data were not available from these sources, we used publically available sources.

Power: The model for estimating power sector investment needs per country is the Open Source Energy Modeling System (OSeMOSYS), an optimization model.[47] The models aim to support a more active and informed engagement of energy stakeholders in developing energy investment strategies. It was applied to 13 countries (Algeria, Burundi, Comoros, Djibouti, Egypt, Libya, Mali, Morocco, São Tomé and Príncipe, Seychelles, South Sudan, Swaziland, Togo, Tunisia, and Zimbabwe). It covers all or individual energy sectors, including heat, electricity, and transport. Used mainly for long-run energy planning, it has been written using the open source high-level programming language GNU Mathprog. It calculates power system investment needs and energy dispatched by minimizing the total discounted costs. The model is driven by exogenously defined demands for energy services. The parameters used as inputs to the models are GDP growth rate, urban target access rate, rural target access rate, cost of coal, cost of oil, discount rate, and climate-change sensitivity.

Roads: The model used for estimating road sector investment needs for Africa is the RONET (Road Network Evaluation Tool) model (Sub-Saharan Africa Transport Policy Program–SSATP Working Paper No. 89-A). RONET assesses the performance of the road network over time under different road maintenance standards. It determines, for example, the minimum cost for sustaining the network in its current condition and estimates the savings or the costs to the economy of maintaining the network at different levels of service. It determines the allocation of expenditures among recurrent maintenance, periodic maintenance, and rehabilitation road works. It is developed from the same principles underlying the Highway Development and Management Model (HDM-4). It uses simplified road user cost relationships, based on HDM-4 or other relationships, and simplifies the road deterioration equations derived from the HDM-4 research.

ICT: The estimate is based on an assessment of future investment needs in African telecom infrastructure across 45 countries. The current status and future needs were assessed in three broad categories:

- Coverage extension and capacity expansion driven investment in mobile networks.
- Investment need in fiber backbones including across borders.
- FTTP/H rough indicative estimate potential based on local affordability.

The estimates take into account the future waves of investment in the industry for 2016–25, characterized by an upgrade and modernization of mobile networks to support the shift to smartphones—and fiber broadband and fiber access as the major new emerging trend. For mobile investment, detailed GIS models focusing on coverage extension and capacity expansion were used. In recent years, more than $4 billion has been invested in African submarine cable systems connecting all coastal states to high capacity fiber. Cable technology advanced in this period with newer cables having much greater capacity than their immediate predecessors. Modern cable systems are designed to be upgradeable to at least double their capacity, so it seems unlikely that any major capacity investment will be needed before around 2020. Fiber to the premises (or home), known as FTTP/H, has started in several countries from Egypt to South Africa (where a classic fiber "landgrab" started recently). Conditions are highly variable across Africa, but where fiber backbone capacity is sold at a reasonable price, a middle class with money to spend and a liberal regulatory environment then there is clear rough indicative FTTH Potential growth. We have calculated a very rough indicator of potential for each

country at $12 billion of CAPEX to be invested in FTTH based on possible demand today.

Water and sanitation: The model used for estimating investment needs is based on three scenarios described in table A3.1.

The inputs to the model are population statistics (urban, rural and national population and population growth rates); population distributions across urban and rural areas, current access (access to water and sanitation by technology and location); and water unit costs (unit cost per capita of each water supply technology at various densities).

The outputs of the model are capital costs (costs of service expansion to serve the additional people that need to be covered by improved water supply and sanitation by 2025 in order to achieve SDG targets); rehabilitation costs (costs of maintaining new and existing access); and O&M costs (costs of rehabilitating existing access). The base scenario was used to generate the investment needs figures with universal access as the access target for year 2025.

Revision of the estimates

Using the above foregoing methodologies, total investment needs is estimated at $100 billion a year over 2016–25. But the estimate of the power sector investment data is under revision using a new model (called BALMOREL) that takes into account the current access rates, population density, poverty, and investment climates for each country to determine the pace and relative importance of grid, mini-grid and off-grid connections. We believe that Africa power investment needs will be in the range of $35–$50 billion a year (actual calculation based on 12 countries gives $7 billion). Road sector data are also under revision and may be estimated at $15–$20 billion. ICT data will be revised with a slight change at $4–$7 billion and water and sanitation at $56–$66 billion. The remaining transport subsectors (air, rail, and port) should account between $20–$27 billion (according to our rough estimates). In total, investment needs should range between $130–$170 billion.

TABLE A3.1 Three high-end scenarios

Scenario		Pragmatic scenario	Base scenario	High-end scenario
Water	Urban	Stand posts	2015 distribution across modalities is preserved	Piped water: if 2015 coverage < 20%, 2025 coverage increases to 30%; if 20% ≤ 2015 coverage < 40%, 2025 coverage increases to 50%; if 40% ≤ 2015 coverage < 70%, 2025 coverage increases to 70%; if 40% ≤ 2015 coverage < 70%, and selected target coverage < 70%, 2025 coverage increases to selected target coverage (universal or HG); the remaining additional customers are served by stand posts
	Rural	Safe boreholes		If 2025 rural density < 50 people/km^2, 2015 modality distribution is preserved. Otherwise: piped water: if 2015 coverage < 10%, 2025 coverage increases to 10%; if 10% ≤ 2015 coverage < 20%, 2025 coverage increases to 20%; otherwise 2025 coverage is the same as in 2015; standposts: if 2015 coverage < 10%, 2025 coverage increases to 20%; if 10% ≤ 2015 coverage < 30%, 2025 coverage increases to 30%; if 2015 coverage ≥ 30%, 2025 coverage increases to 60%; the remaining additional customers are served by boreholes
Sanitation	Urban	VIP latrines	2015 distribution across modalities is preserved	At least 5% of sewer coverage in all countries. In addition: in LIC countries, septic tanks coverage same as 2015. All the remaining additional customers served by VIP; in non-LIC countries VIP latrines coverage same as 2015, remaining additional customers all to be covered by septic tanks
	Rural	Traditional latrines		In all countries: sewer coverage same as in 2015; septic tanks coverage to be increased to 5% if currently < 5%, otherwise same as in 2015; VIP latrine coverage to be increased to 30% if currently < 30%, otherwise same as in 2015; all the remaining additional customers to be served by traditional latrines

NOTES

1. Defined as the infrastructure investment needs minus the total amount of financing commitment made by all donors to resorb the infrastructure deficit.
2. Arezki et al. 2017.
3. Infrastructure is a heterogeneous concept that typically includes both various types of physical assets that are used in an economy as inputs to the production of goods and services. This description encompasses "social infrastructure" (such as schools and hospitals) and "economic infrastructure" (such as energy, water, transport, and telecommunications). This chapter focuses on economic infrastructure.
4. Barro and Sala-i-Martin 2004.
5. Aschauer 1993; Gramlich 1994.
6. Dethier 2015.
7. Barro 1990.
8. Sanchez-Robles 1998; Sutherland et al. 2009.
9. MGI (2016) estimates that a one percentage point of GDP investment in infrastructure could generate up to 3.4 million jobs in India and 1.3 million in Brazil.
10. WEF, Bain and Co., and World Bank 2013.
11. Fagernäs and Roberts 2004.
12. Dethier 2015.
13. For details of the nine sub-components see AfDB (2013).
14. Gross fixed capital includes land improvements (fences, ditches, drains, and so on); plant, machinery, and equipment purchases; and the construction of roads, railways, and the like, including schools, offices, hospitals, private residential dwellings, and commercial and industrial buildings.
15. Foster and Briceno-Garmendia 2010.
16. Alliance for Affordable Internet 2017.
17. http://www.enterprisesurveys.org/data/exploretopics/infrastructure. Accessed November 20, 2017.
18. WHO 2015.
19. AfDB 2011.
20. Kodongo and Ojah 2016.
21. Foster and Briceño-Garmendia 2010.
22. World Bank 2014.
23. Shimeles and Nabasaga 2015.
24. Sy 2017.
25. See: https://www.afdb.org/en/topics-and-sectors/initiatives-partnerships/nepad-infrastructure-project-preparation-facility-nepad-ippf/. Or http://www.infracoafrica.com/who-we-are/#funding. Accessed November 27, 2017.
26. Castells and Sole-Olle 2005.
27. Arezki et al. 2017.
28. Vergne 2009.
29. Baliamoune-Lutz and Ndikumana 2009.
30. Stansbury 2005.
31. Locatelli et al. 2017.
32. MGI 2013.
33. Foster and Briceño-Garmendia 2010.
34. Foster and Briceño-Garmendia 2010.
35. Bhattacharya, Oppenheim, and Stern 2015.
36. Estimates drawn from Global Commission on The Economy and Climate (2014).
37. https://www.mckinsey.com/industries/capital-projects-and-infrastructure/our-insights/infrastructure-productivity.
38. Source for ASCE US: https://www.infrastructurereportcard.org/the-impact/failure-to-act-report/.

Source for McKinsey US: https://www.mckinsey.com/industries/capital-projects-and-infrastructure/our-insights/bridging-global-infrastructure-gaps.

Source for U.S. Department of Transportation: https://www.transportation.gov/grow-america/fact-sheets/roadways.

39. https://www.adb.org/sites/default/files/publication/227496/special-report-infrastructure-highlights.pdf.
40. Karpowicz, Matheson, and Vtyurina 2016.
41. Karpowicz, Matheson, and Vtyurina 2016.
42. CAF 2016.
43. ICA 2017.
44. ICA 2017.
45. G20 Huangzhou Communiqué.
46. The figure considers only countries with per capita incomes below 25,000 international dollars of 2005 and manufacturing shares below 25% of GDP.
47. Howells et al. 2011; Welsch et al. 2012.

REFERENCES

African Development Bank. 2011. Private Sector Development as an Engine of Africa's Economic Development. Abidjan, Côte d'Ivoire. Available at: https://www.afdb.org/fileadmin/uploads/afdb/Documents/Publications/African%20Development%20Report%202011.pdf

———. 2013. "The Africa Infrastructure Development Index (AIDI)." AfDB Chief Economist Complex. Abidjan, Côte d'Ivoire. Available at: https://www.afdb.org/fileadmin/uploads/afdb/Documents/Publications/Economic_Brief_-_The_Africa_Infrastructure_Development_Index.pdf

Alliance for Affordable Internet. 2017. "2017 Affordability Reports." Available at: http://a4ai.org/affordability-report/

Aschauer, David A. 1993. "Genuine Economic Returns to Infrastructure Investment." Policy Studies Journal 21 (2): 380–390.

Arezki, Rabah, Patrick Bolton, Sanjay Peters, Frederic Sanama, and Joseph Stiglitz. 2017. "From Global Savings Glut to Financing Infrastructure." Economic Policy 32: 221–261.

Baliamoune-Lutz, M., and L. Ndikumana. 2008. "Corruption and Growth: Exploring the Investment Channel." Economics Department Working Paper Series 33, University of Massachussetts–Amherst, Amherst, MA. Available at: http://scholarworks.umass.edu/econ_workingpaper/33.

Barro, R. 1990. "Government Spending in a Simple Model of Endogenous Growth." Journal of Political Economy 98 (5): 103–130.

Barro, R., and X. Sala-i-Martin. 2004. Economic Growth. Cambridge, MA: Massachusetts Institute of Technology (MIT) Press.

Bhattacharya, Amar, Jeremy Oppenheim, and Nicholas Stern. 2015. "Driving Sustainable Development through Better Infrastructure: Key Elements of a Transformation Program." Global Economy and Development Working Paper 92, Brookings Institution, Washington, DC.

CAF (Corporacion Andina de Fomento). 2016. How to Close the Infrastructure Gap in Latin America. Caracas, Venezuela.

Castells, A., and A. Solé-Ollé. 2005. "The Regional Allocation of Infrastructure Investment: The Role of Equity, Efficiency and Political Factors." European Economic Review 49 (5): 1165–1205. Available at: http://www.sciencedirect.com/science/article/pii/S0014292103001077.

Dethier, Jean Jacques. 2015. "Infrastructure in Africa." In The Oxford Handbook of Africa and Economics, Vol. 2: Policies and Practices, ed. Celestin Monga and Justin Yifu Lin. Oxford, UK: Oxford University Press.

Faye, I., and E. Mutambatsere. 2018. "Operationalizing Inclusive Growth in Multilateral Development Bank's Infrastructure Operations." African Development Bank, Abidjan, Côte d'Ivoire.

Fagernäs, S., and J. Roberts. 2004. "Fiscal Impact of Aid: A Survey of Issues and Synthesis of Country Studies of Malawi, Uganda and Zambia." ESAU Working Paper 11, Overseas Development Institute, Economic and Statistics Analysis Unit, London.

Foster, V., and C. Briceño-Garmendia. 2010. Africa's Infrastructure: A Time for Transformation. Washington, DC: World Bank.

Global Commission on The Economy and Climate. 2014. Better Growth, Better Climate: The New Climate Economy Report. Washington, DC: New Climate Economy–World Resources Institute. Available at: http://newclimateeconomy.report.

Global Infrastructure Hub. 2017. Global Infrastructure Outlook: Forecasting Infrastructure Investment Needs for 50 Countries, 7 Sectors through 2040. Sydney, Australia.

Gramlich, Edward M. 1994. "Infrastructure Investment: A Review Essay." Journal of Economic Literature 32 (3): 1176–1196.

Howell A.J., R.L. Dopko, H. Passmore, and K. Buro. 2011. "Nature Connectedness: Associations with Well-Being and Mindfulness." Personality and Individual Differences 51: 166–171 10.1016/j.paid.2011.03.037

ICA (Infrastructure Consortium for Africa). 2017. Toward Smart and Integrated Infrastructure for Africa: An Agenda for Digitalisation, Decarbonisation and Mobility. Rome, Italy. Available at: https://www.icafrica.org/fileadmin/documents/Annual_Meeting/2017/2017_Annual_Meeting_-_background_paper_FULL.pdf

Karpowicz, I., T. Matheson, and S. Vtyurina. 2016. Investing in Infrastructure in Latin America and the Caribbean. Washington, DC: International Monetary Fund.

Kodongo, Odongo, and Kalu Ojah. 2016. "Does Infrastructure Really Explain Economic Growth in Sub-Saharan Africa?" Working Paper 653, Economic Research Southern Africa, Cape Town, South Africa.

Kularatne, C. 2006. "An Examination of the Impact of Social and Economic Infrastructure on Economic

Growth: An Application to South Africa." University of Cape Town, School of Economics, Cape Town, South Africa.

Locatelli, G., G, Mariani, T. Sainati, and M. Greco. 2017. "Corruption in Public Projects and Megaprojects: There is an Elephant in the Room!" International Journal of Project Management 35 (3): 252–268.

MGI (McKinsey Global Institute). 2013. "Infrastructure Productivity: How to Save $1 Trillion a Year." McKinsey & Company. [online] Available at: https://www.mckinsey.com/industries/capital-projects-and-infrastructure/our-insights/infrastructure-productivity

——. 2016. "Bridging Global Infrastructure Gaps." McKinsey & Company, [online] Available at: https://www.mckinsey.com/industries/capital-projects-and-infrastructure/our-insights/bridging-global-infrastructure-gaps.

PICC (Presidential Infrastructure Coordinating Commission). 2012. Summary of South African National Infrastructure Plan. PICC Secretariat: Pretoria, South Africa.

Sanchez-Robles, B. 1998. "Infrastructure Investment and Growth: Some Empirical Evidence." Contemporary Economic Policy 16 (1): 98–108.

Shimeles, A., and T. Nabasaga. 2015. "Why Is Inequality High in Africa?" Paper presented at the African Economic Conference 2015, Kinshasa, Democratic Republic of Congo.

Stansbury, N. 2005. "Exposing the Foundations of Corruption in Construction." In Global Corruption Report 2005: Corruption in Construction and Post Conflict Reconstruction, 36–38. London: Transparency International.

Straub, S. 2008. "Infrastructure and Development: A Critical Appraisal of the Macrolevel Literature." Policy Working Paper 4590, World Bank, Washington, DC.

Sutherland, Douglas, Sónia Araújo, Balázs Égert, and Tomasz Kozluk. 2009. "Infrastructure Investment: Links to Growth and the role of Public Policies." OECD Economics Department Working Paper 686, OECD Publishing, Paris.

Sy, Amadou. 2017. "Leveraging African Pension Funds for Financing Infrastructure Development." Brookings Africa Growth Initiative, Brookings Institution, Washington, DC. Available at: https://www.brookings.edu/wp-content/uploads/2017/03/global_20170314_african-pension-funds.pdf

United Nations. Online. "Closing the Infrastructure Gap." Inter-Agency Task Force on Financing for Development: Monitoring Development Finance. Available at: https://developmentfinance.un.org/closing-the-infrastructure-gap. Accessed November 26, 2017.

Vergne, C. 2009. "Democracy, Elections and Allocation of Public Expenditures in Developing Countries." European Journal of Political Economy 25 (1): 63–77. Available at: http://www.sciencedirect.com/science/article/pii/S0176268008000748

WEF (World Economic Forum), Bain and Co., and World Bank. 2013. Enabling Trade Valuing Growth Opportunities. Geneva.

WHO (World Health Organization). 2015. Global Status Report on Road Safety 2015. Geneva.

World Bank. 1994. World Development Report: Infrastructure for Development. Washington, DC.

——. 2014. Expanding the Possible in Sub-Saharan Africa: How Tertiary Institutions Can Increase Growth and Competitiveness. Washington, DC.

——. 2017. World Development Indicators [database]. Washington, DC.

Welch, V., M. Petticrew, E. Ueffing, M. Benkhalti Jandu, K. Brand, B. Dhaliwal, E. Kristjansson, J. Smylie, G. Wells, and P. Tugwell. 2012. "Does Consideration and Assessment of Effects on Health Equity Affect the Conclusions of Systematic Reviews? A Methodology Study." PLOS ONE 7 (3): e31360. Available at: https://doi.org/10.1371/journal.pone.0031360.

Wolde-Rufael, Y. 2006. "Electricity Consumption and Economic Growth: A Time Series Experience for 17 African Countries." Energy Policy 34 (10): 1106–1114.