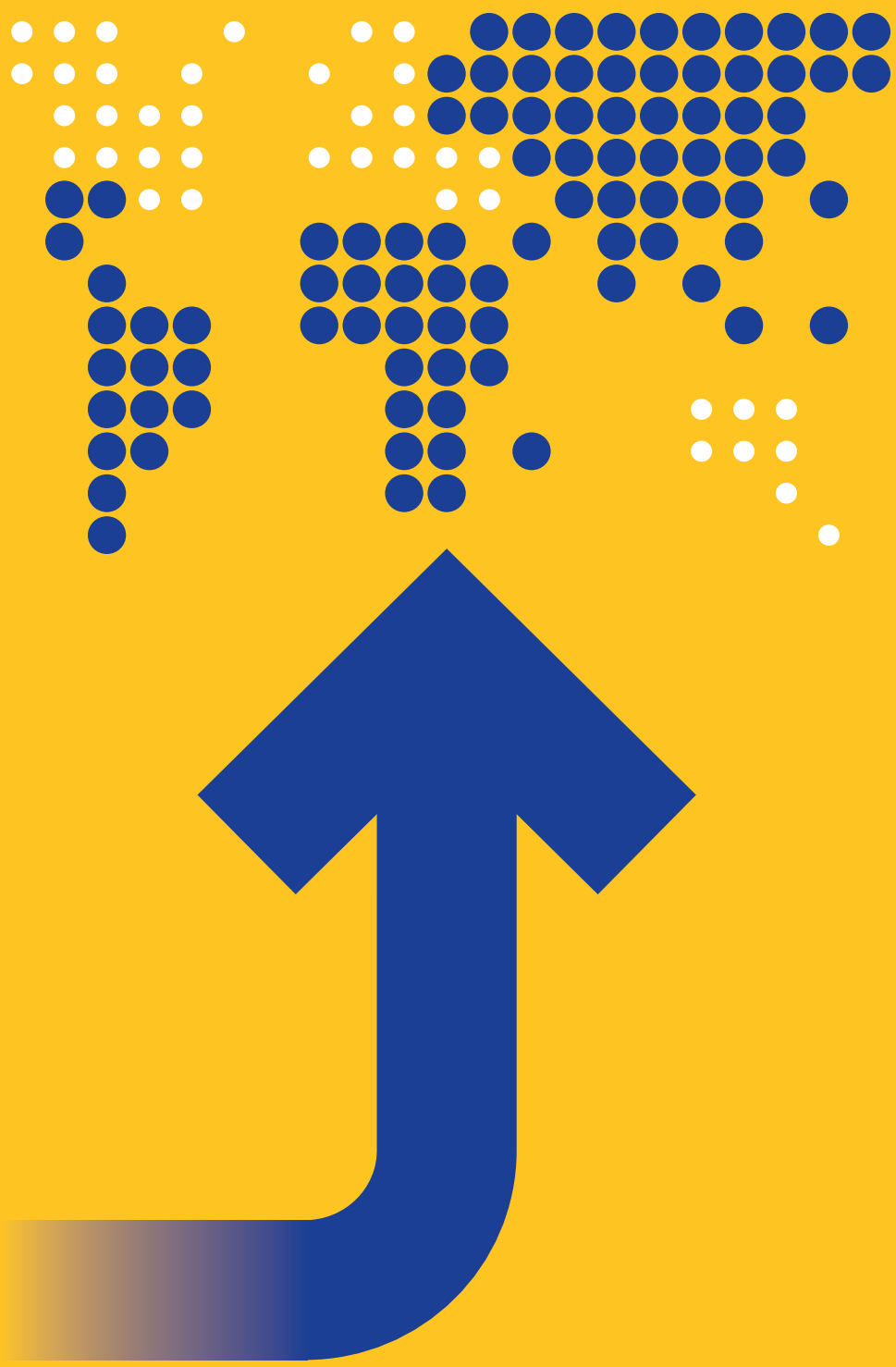

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JICA TICAD VI
Policy Papers

Infrastructure in Africa

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JICA

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Preface

The global economic environment at the time of TICAD VI (2016) is much less favorable than that prevailing at TICAD V (2013) when JICA presented a long-term vision—*Africa 2050: Realizing the Continent's Full Potential*—based on Africa's increasing convergence with the rest of the world. These changed circumstances have major implications for African policy makers.

This paper is one of six commissioned by JICA for TICAD VI to draw out these implications and suggest ways to move forward. The other five are:

- *Africa 2050 update*
- *The impact of commodity terms of trade in Africa: Curse, blessing, or manageable reality*
- *Africa's inclusive growth challenge: Reducing deprivation and creating jobs*
- *Economic diversification of African economies*
- *Regional economic integration in Africa*

We are confident that the papers will contribute to a fruitful dialogue among the Heads of State at TICAD VI. In addition, we hope that they will foster the concerted action by African policy makers needed to assure that Africa continues to converge with the rest of the world and, in doing so, meets the aspirations of its people.

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Vice President
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Executive summary

As a continent, Africa is the least endowed region in the world in terms of infrastructure. It also does not perform well on the quality of infrastructure services delivered to users. Infrastructure is scarce, and its performance is generally poor: high cost, erratic, and undependable.

Africa's low infrastructure endowment is particularly prevalent in Sub-Saharan Africa (SSA), above all a reflection of this region's low GDP per capita income levels and low population density. Poor quality of infrastructure services results from chronic financial weakness in the sector, as users do not pay full cost for services they receive, as well as from weak operational and financial management. Spending needs are not met, assets are not well maintained, and the sector suffers from a deficit in management skills. However, it will not be enough simply to increase financing flowing to infrastructure investments. New sources of financing, and systemic changes to the way infrastructure services are delivered to improve their quality, will also be needed to ensure that Africa's infrastructure is operated efficiently and maintained effectively.

Role of infrastructure in development

Getting infrastructure right is essential; it underpins development of the domestic economy, contributes to inclusive growth, and enables regional integration. Low cost infrastructure services are key for export competitiveness and economic diversification. Africa's combination of low infrastructure endowment and poor quality of infrastructure services relative to other developing regions holds back the continent economically, and also explains in part Africa's lag in regional integration.

Electricity

Africa, especially Saharan Africa, is starved for electricity. Both access to electricity and per capita power consumption are lower in Africa than in other regions. Yet Africa is rich in energy resources, and huge renewable resources remain untapped. The situation in North Africa is different, where the electricity sector is broadly on a par with the rest of the world; but much of Sub-Saharan Africa (with the exception of Gabon, Mauritius, Seychelles and South Africa) is a "continent in the dark."

Transport

Transport infrastructure (roads, rail, airports, and ports) is significantly less developed than in other regions of the world, and transport costs are twice the level of other developing countries (up to four times as high in landlocked countries). Road densities are low; rail networks (with the exception of South Africa) are underdeveloped and poorly maintained; and although air transport is growing strongly, it is expensive, connections are patchy, and safety is a problem. African ports are small, port services are costly and shipments are often delayed.

Information and communications technologies

Africa has undergone a revolution in mobile telephony due to the introduction of new technologies and private provision of these services. The number of subscribers in Africa has grown at a rate more than twice the global average during this decade, and mobile communications is transforming the economies of certain countries (e.g. Kenya) through mobile banking and other services. Mobile telephony is an African success story. But internet penetration via fixed broadband links remains inadequate.

Water and sanitation

Africa still lags the rest of the world in provision of clean drinking water and improved sanitation facilities. In Sub-Saharan Africa, only half the population enjoys access to safe drinking water and the gap is widening due to urbanization. Improved sanitation (septic tanks and improved latrines)

African policy makers need to consider both how to increase funding for infrastructure investments, and how to improve the quality of services delivered from infrastructure.

reaches less than one-fifth of Africa's population, and less than one-tenth in rural areas.

Policy directions for development of Africa's infrastructure

African policy makers need to consider both how to increase funding for infrastructure investments, and how to improve the quality of services delivered from infrastructure.

Infrastructure financing needs

Financing for infrastructure in sub-Saharan Africa tripled between 2004 and 2012, reaching $74.5 billion in 2014. Slightly less than half came from African national governments, but only four percent from the private sector (mainly for mobile telecommunications networks). Current annual spending needs are estimated to be $100 billion (2015 dollars) simply to maintain current endowment levels. Under an aspirational scenario which supposes that Africa's endowment would rise over a twenty-year period to levels consistent with the rest of the world, annual spending would have to reach $168 billion in 2020 and $250 billion in 2025 (2015 dollars).

Diversifying funding sources

It is unlikely that future financing needs can be met, as they are currently, mainly by mobilizing fiscal revenue and attracting development assistance (currently three-quarters of total financing). Policy makers will have to call to a much greater extent on private sector financing, an important source in other regions of the world. But private investors and lenders are wary of financing infrastructure in Africa because of the poor creditworthiness of the sector. This is the outcome of inadequate tariffs, poor payment by governments for the services they receive, and weak operational and financial management of public sector utilities.

For utilities to become financially viable, users will have to pay the full cost for the service they receive. This means that policy makers have to establish tariff mechanisms that cover costs and adjust over time, and government departments have to avoid accumulating arrears to utilities (e.g. through the use of prepaid cards). In addition, policy makers have to be more aggressive in the pursuit of private provision of many infrastructure services (notably, electricity, water supply, airports, and broadband internet) as this is an attractive option that has been demonstrated to work elsewhere in the world to both diversify sources of financing and improve operational and financial management.

Infrastructure in Africa

James Bond

Africa infrastructure – An overview

Africa's infrastructure lags the rest of the developing world

Infrastructure endowment

Sub-Saharan Africa is the lowest income region in the world and is characterized by a large number of small low income countries (48 in total). Of the 30 World Bank-classified low income countries in the world, 25 are in SSA. This presents a particular challenge for infrastructure development. Overall, the African continent is by all measures the least endowed region of the developing world in infrastructure stocks, even compared to low-middle income countries in other regions (Table 1).

Quality of infrastructure services

Countries in Africa are far from homogeneous, and their infrastructure problems and solutions are not everywhere the same. Worldwide analysis shows that the correlation of infrastructure stocks with income is strong and compelling,[1] and in this regard Africa's low infrastructure endowment is above all a reflection of its low GDP per capita income levels. However, infrastructure performance across countries – that is, the delivery of services related to physical infrastructure stocks (transport services, communication services, delivery of quality electricity and water services) – is generally not strongly related to income levels. Some countries with

1. Indeed, cross-country and time series analyses demonstrate that per capita GDP and infrastructure stocks rise in almost lock step across the world: an increase of one percent in per capita GDP is met by an increase of one percent in infrastructure stocks. It is not clear, however, what the causality mechanism is (World Bank, 1994. *World Development Report 1994: Infrastructure and Development*.).

Table 1: Key infrastructure statistics

Indicator	Sub-Saharan Africa	Low-income countries	Middle-income countries
Roads (km/1000 km2)			
Paved road density	49	134	461
Total road density	152	211	757
Telecommunications (lines/100 population)			
Main line density	1	1	10
Mobile density	71	57	94
Internet density	19	6	34
Electricity			
Generation capacity (MW/million population)	37	326	
Electricity coverage (% of population with access)	35	41	87
Water and sanitation (% of population with access)			
Improved water	66	66	92
Improved sanitation	30	28	65

Source: Gwilliam et al. (2008); World Bank (2016)

Africa does not perform well on either the endowment of physical infrastructure or on the quality of infrastructure services delivered.

low infrastructure endowments deliver relatively good infrastructure services with these endowments, whereas other countries with greater amounts of physical infrastructure may deliver far poorer infrastructure services. Moreover, the quality of infrastructure services across sectors is not highly correlated within countries. That is, the fact that a country has a poor performance in its electricity sector does not help to predict how well it does with phone services. The quality of infrastructure services delivered for a given level of physical infrastructure stock depends on intangible elements (the "service content" of infrastructure), which relate to levels of skills and human capacity, the efficiency of public administration, and the service focus of the business environment. For example, the ease of obtaining an electric power connection can vary significantly from one country to the next irrespective of the density of electric power networks, and in countries with more extensive electricity network, it is not necessarily easier to obtain a connection. The cost of transporting merchandise on a road network is not simply a function of the road density of the country; informal roadblocks will significantly degrade the quality of transport services by increasing cost and time for the transporter.

The quality of infrastructure services crucially depends on two factors: first, payment by users for the full cost of services (especially in power, ports and civil aviation) so that the service providers are financially viable. Without adequate internal cash generation from user fees operators can neither sustain good service standards nor attract external financing from the markets (public funding will never be adequate to fully meet Africa's infrastructure needs). Second, perhaps the biggest deficit in the African infrastructure sector concerns management skills at all levels. Without efficient management, investments cannot be adequately planned and executed, physical plant cannot be operated to its full capacity, and facilities cannot be adequately maintained, which shortens the physical life of the asset.

Africa does not perform well on either the endowment of physical infrastructure or on the quality of infrastructure services delivered. Performance of infrastructure in Africa is generally poor: high cost, erratic, and undependable.

Implications for infrastructure financing

The implication of Africa's dual infrastructure weakness—low infrastructure endowments and inefficient supply of services related to this infrastructure stock—is that it will not be enough just to increase financing flowing to infrastructure investments in Africa. Simply increasing finance for infrastructure would address the problem of low physical stock but would not improve its efficiency in delivery of infrastructure services. Systemic changes to the way infrastructure services are delivered, a greater focus on maintenance of existing capital stocks, and an enhanced attention to managerial capacity for the operation of these stocks will also needed to ensure that Africa's infrastructure is operated efficiently and maintained effectively. Better operation and maintenance will ensure that capital stocks, whatever the level, deliver quality infrastructure services to the continent's citizens.

Infrastructure's role in development

Adequacy of infrastructure helps determine one country's success and another's failure in diversifying production, expanding trade, coping with population growth, reducing poverty, or improving environmental conditions. Good infrastructure raises productivity and lowers production costs, but it has to expand fast enough to accommodate growth. The kind of infrastructure put in place also determines whether growth does all that it can to reduce poverty. [2] Rural roads, for example, linking rural and urban markets, or rural water supply, will do more for inclusive growth than other infrastructure services targeting higher income populations.

2. World Bank (1994)

A sometimes overlooked but critically important factor in the development of infrastructure services is the technology choice within infrastructure sectors.

Africa's combination of low infrastructure endowment and poor quality infrastructure services relative to other developing regions means that the continent has additional development hurdles to overcome. These development hurdles include:

Products and services tradeable on international markets have higher costs than those exported by other regions (Box 1). This reduces the international competitiveness of African exporters and limits the sectors that African firms can compete in.

Domestic markets, e.g. for agricultural produce, are less developed. Local suppliers are not always able to meet demand, e.g. because electric power is not readily available. Products are more expensive for consumers.[3]

Infrastructure weakness impedes inclusive growth. The absence of infrastructure means that the fruits of growth are not widely shared throughout the country. For example, the absence of transport linkages between rural and urban markets reduces opportunities for the evolution of agriculture from subsistence to market-based.

Regional integration requires both a coordinated set of rules across the region and physical interconnections such as road, rail and electricity transmission lines between and within countries. It is not enough simply to create regional institutions and coordinate tariffs and regulations at a regional level. Countries need to be connected by road, rail, electricity and communications networks. These are absent or weak in much of the continent. Africa's low infrastructure endowment means that these physical interlinkages are tenuous at best.

Technology choice

A sometimes overlooked but critically important factor in the development of infrastructure services is the technology choice within infrastructure sectors. For example, mobile telephony has better corresponded to the communication needs of Africa's population than fixed line communication, so the introduction of mobile phones – a then-new communications technology – two decades ago allowed a very significant increase in voice and text communication compared to what would have been the case with landlines. Similarly, in the electric power sector, new renewable technologies such as solar electricity allow for a new paradigm of electric power delivery (mini-grids or solar home systems) rather than traditional centralized grid delivery through an incumbent monopoly utility, a model that has not been a success on the continent. In urban transport, hybrid systems involving mini-buses, linking to large buses or rail, are

3. In past decades, localized famines in countries like Ethiopia and Malawi subsisted despite local food surpluses elsewhere. This was due to the inadequacy of transport infrastructure able to channel the surpluses to famine areas.

Box 1: Importing and exporting are costly in Africa

To import a 20-foot container in Sub-Saharan Africa:

- Average cost: $2,793
- Average time: 38 days

To import a 20-foot container in Singapore:

- Average cost: $440
- Average time: 4 days

For the 16 landlocked countries in Africa, the cost of trading is 50 times higher and the volumes of trade are 60% lower than in African coastal countries.

Source: The Infrastructure Consortium for Africa (2015)

With the exception of a few countries (Gabon, Mauritius, Seychelles, South Africa), Sub-Saharan Africa's power sector is significantly underdeveloped, whether from the point of view of energy access, installed capacity, or overall consumption.

making inroads into traditional transport service delivery models. It should be noted that in some cases earlier technology choices constrain later choices. Also, it seems that the African continent has had more success with decentralized approaches and multiple operators (e.g. mobile) than with centralized approaches.

Overall, the astute adoption of new technologies permits very significant possibilities for poorly endowed countries, because of the ability to leapfrog the older technologies prevalent in more developed countries. Again, mobile phones are a striking example of this phenomenon. Thus, decision-makers should be sensitive to the technological choices of infrastructure-related decisions.

Electric power

Electricity consumption and access

Africa generally, and Sub-Saharan Africa in particular, is starved for electricity. With the exception of a few countries (Gabon, Mauritius, Seychelles, South Africa), Sub-Saharan Africa's power sector is significantly underdeveloped, whether from the point of view of energy access, installed capacity, or overall consumption. African countries struggle to sustain GDP growth in part because of the lack of electricity.[4] Measured in terms of gross electricity generated[5] (Table 2), Africa represents 3.2% of total world generation, slightly more than Germany (2.7%) and two-thirds of Japan (4.3%).

Both access to electricity and per capita power consumption are lower in Africa than in other regions (Table 3). On-grid power generation capacity in Sub-Saharan Africa was 90 GW in 2012, with around half being located in South Africa. Nearly half – 45 percent -- of this capacity is made up of coal (mainly South Africa and Botswana); 22 percent hydroelectricity; 17 percent petroleum products and 14 percent natural gas (mainly Nigeria and along the route of the West African Gas Pipeline). Insufficient, unreliable or inaccessible grid supply has resulted in large-scale private ownership of oil-fueled generators and, more recently, greater focus on developing mini- and off-grid power systems. Modern renewables account for less than 2 percent of the total, but they are beginning to emerge across the continent.

The paradox is that Sub-Saharan Africa is rich in energy resources, and its huge renewable resources (solar, wind, hydroelectric, and geothermal in the Rift Valley) remain untapped. Africa's late start with renewable energy is surprising given that these sources are particularly appropriate for mini- and off-grid systems and more relevant for low-density populations such as those in Sub-Saharan Africa's rural areas.

In North Africa the situation concerning renewables is different. In February 2016 Morocco commissioned the world's largest concentrated solar power (CSP) plant, the Noor 1 Complex, near the city of Ouarzazate, of a capacity of 160 MW. This plant will produce enough energy to power over one million homes by 2018 and will reduce carbon emissions by an estimated 760,000 tons per year.[6] The plant was built and is being managed by a consortium led by Saudi Arabia's ACWA Power, which will sell the electricity produced for $0.19/kWh. The project is co-financed by the World Bank and the European Investment Bank. Noor 1 is expected to be followed by two subsequent phases with a total final capacity of 2000 MW, and delivery prices are expected to come down with each subsequent phase.

Progress is being made in the continent. Kenya has recently concluded a private sector wind generating farm in the Turkana Valley (capacity: 310 MW), and geothermal energy has been developed in the Rift Valley. Solar energy is beginning to emerge in Zambia, where the government has

4. Castellano, A., Kendall, A., Nikomarov, M., & Swemmer, T. (2015). "Powering Africa." McKinsey.
5. i.e. before transmission and distribution losses.
6. Climate Investment Funds (CIF).

Infrastructure services delivered by the electricity sector cannot be measured by total gross generation alone, which is an indicator of overall electricity consumption. Access to electricity is also an important, or indeed more important, indicator of the quality of the service delivered.

Table 2: Electricity generation by region (terawatt-hours)

Region	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2015/ 2014	Share
US	4257.5	4266.6	4365.4	4326.1	4147.8	4332.8	4305.2	4253.5	4275.1	4306.9	4303.0	-0.1%	17.9%
Canada	604.4	592.6	616.8	618.0	595.5	588.2	619.6	619.8	641.3	638.0	633.3	-0.7%	2.6%
Mexico	248.0	256.2	263.2	269.3	267.8	275.6	292.1	296.4	297.1	303.4	306.7	1.1%	1.3%
Total North America	5109.9	5115.5	5245.5	5213.4	5011.0	5196.6	5216.9	5169.7	5213.5	5248.3	5242.9	-0.1%	21.8%
Total S. & Cent. America	945.2	988.2	1034.7	1073.9	1085.4	1143.0	1182.6	1233.9	1268.0	1276.0	1302.4	2.1%	5.4%
Total Europe & Eurasia	5141.0	5246.7	5330.1	5365.4	5128.6	5357.8	5330.3	5385.0	5345.1	5273.0	5303.4	0.6%	22.0%
Total Middle East	627.0	668.4	717.2	760.2	805.7	869.2	906.9	970.5	982.3	1052.5	1089.3	3.5%	4.5%
Algeria	33.6	35.0	37.0	40.0	42.8	45.6	52.0	57.5	59.9	64.1	68.5	6.8%	0.3%
Egypt	104.0	110.7	119.0	127.9	133.3	143.5	148.6	161.9	164.0	170.2	180.6	6.1%	0.7%
South Africa	244.9	253.8	263.5	258.3	249.6	259.6	262.5	257.9	256.1	254.7	249.7	-2.0%	1.0%
Other Africa	179.4	190.3	191.7	198.2	199.6	218.3	218.5	238.4	247.6	252.5	260.9	3.3%	1.1%
Total Africa	562.0	589.8	611.1	624.3	625.3	667.0	681.7	715.6	727.6	741.5	759.6	2.4%	3.2%
Total Asia Pacific	5973.1	6457.6	7016.7	7313.2	7527.9	8260.2	8866.2	9278.7	9799.7	10302.2	10400.0	0.9%	43.2%
Total World	18358.1	19066.2	19955.3	20350.4	20183.9	21493.8	22184.6	22753.4	23336.3	23893.6	24097.7	0.9%	100.0%

Source: World Bank (2016)

launched an ambitious privately funded program with support from IFC (initially, two 50 MW solar photovoltaic plants). Solar home systems and mini-grids are being developed in an increasing number of countries (including Malawi, Kenya, Senegal, South Africa, and Tanzania).

Infrastructure services delivered by the electricity sector cannot be measured by total gross generation alone, which is an indicator of overall electricity consumption. Access to electricity is also an important, or indeed more important, indicator of the quality of the service delivered. In the case of

More than 620 million people in Sub-Saharan Africa are without access to electricity.

Table 3: Access to electricity and power consumption

Region	Access to electricity (% of population)	Access to electricity, rural (% of rural population)	Access to electricity, urban (% of urban population)	Electric power consumption (kWh per capita)
Sub-Saharan Africa	35	15	72	496
Africa	44	26	70	846
Best, Africa	Algeria, Egypt, Libya, Mauritius, Morocco, Seychelles, Tunisia, Gabon (100)	Algeria, Egypt, Libya, Mauritius, Morocco, Tunisia, Gabon (100)	Algeria, Egypt, Libya, Mauritius, Morocco, Seychelles, Tunisia, Gabon (100)	South Africa (4407)
Comparators	79	68	97.4	844
Best, Comparator	Kyrgyz Republic, Moldova, Uzbekistan (100)	Kyrgyz Republic, Moldova, Uzbekistan (100)	Kyrgyz Republic, Moldova, Uzbekistan, Vietnam (100)	Uzbekistan (1611)
East Asia & Pacific (developing)	96	93	98	2720
Latin America & Carib. (developing)	96	86	99	1849
South Asia	78	69	97	640
Low & middle income countries	81	69	95	1666

Source: World Bank (2016)

electricity access, North Africa is for the most part on a par with the rest of the world, with electrification rates of more than 99 percent. Sub-Saharan Africa however is significantly underserved compared to other regions (Table 4), with overall electrification rates of less than one-third; i.e. two out of three sub-Saharan Africans have no access to electricity at all. In urban areas in Sub-Saharan Africa, electrification reaches 59 percent compared to a worldwide average of 95 percent. In rural areas, electrification is only on the order of 17 percent compared to a worldwide average of 70 percent. More than 620 million people in Sub-Saharan Africa are without access to electricity. For those that do have electricity access in Sub-Saharan Africa, average residential electricity consumption per capita is equivalent to around half the average level of China or one-fifth of Europe. Sub-Saharan Africa is literally a "continent in the dark."

The reasons for Sub-Saharan Africa's electric power scarcity are multiple. Africa has almost universally chosen a delivery model of a centralized public sector utility. The public sector utility model has two crucial weaknesses. First, incentives for adequate tariff setting, billing and collection for power consumed are not well aligned, and users for the most part do not cover the full cost of the power they receive. This undermines the financial viability of the utility. Second, the model does not allow to call on private sector management skills which are for the most part more appropriate for the operation of complex technical installations than public sector skills.

In essence, the centralized utility model of public sector ownership and operation has not been good in Sub-Saharan Africa at mobilizing financing for electricity investments (generation, transmission and distribution) nor has it been good at operating installed assets.

Table 4: Electricity access, regional aggregates (2013)

Region	Population without electricity (millions)	Electrification rate (%)	Urban electrification rate (%)	Rural electrification rate (%)
Developing countries	1200	78%	92%	67%
Africa	635	43%	68%	26%
North Africa	1	99%	100%	99%
Sub-Saharan Africa	634	32%	59%	17%
Developing Asia	526	86%	96%	78%
China	1	100%	100%	100%
India	237	81%	96%	74%
Latin America	22	95%	98%	85%
Middle East	17	92%	98%	79%
Transition economies & OECD	1	100%	100%	100%
World	1201	83%	95%	70%

Source: IEA (2015)

One notable exception to the public sector model is Côte d'Ivoire, which two decades ago introduced a privately owned and managed enterprise Compagnie Ivoirienne de l'Électricité operating under a concession system. The results of the Ivorian system have been very good both in terms of access and reliability of supply, but there are questions about how easy it would be to replicate the example in other Sub-Saharan countries.[7] In many, if not most, Sub-Saharan African countries the generation segment of the sector is theoretically open to private investment in the form of Independent Power Producers (IPPs). However, the lack of creditworthiness of power utilities and their inability to pay for electricity delivered by the IPPs, coupled with perceptions of political risk, have severely constrained the amount of private financing available.

In essence, the centralized utility model of public sector ownership and operation has not been good in Sub-Saharan Africa at mobilizing financing for electricity investments (generation, transmission and distribution) nor has it been good at operating installed assets. Sub-Saharan Africa's power utilities also have not pursued the most appropriate technologies and have in many cases preferred large investments in conventional equipment over more distributed investments in renewable technologies.[8] Perhaps most importantly, these utilities have been unable to assure adequate maintenance of existing assets, which have often fallen into disrepair and are operating at a fraction of their installed capacity.

Sector issues

Low electricity access: The consequences of low electricity access rates in rural areas constrain the possibilities for inclusive growth. Lack of electricity reduces the ability for transformation and cold storage of agricultural products,

7. An attempt to replicate the model in Guinea was unsuccessful, for example.

8. For example, landlocked Niger, faced with a reduction in electricity supply from its neighbor Nigeria, has installed expensive diesel generating power plants based on fuel imported from the coast, rather than resorting to abundant solar energy.

In urban areas, low electrification rates constrain the development of industries such as manufacturing and of a modern service sector.

hence constrains incomes in rural areas; it precludes the provision of clean lighting and thus reduces the productive period to daylight hours only, with negative consequences for cottage industries and after-hours learning. Nearly 730 million rely on the traditional use of solid biomass (mainly fuelwood and charcoal) for cooking. Each year nearly 600,000 premature deaths in Africa can be attributed to household air pollution resulting from the traditional use of these solid fuels.

In urban areas, low electrification rates constrain the development of industries such as manufacturing and of a modern service sector. In the absence of supply from the formal system, many middle-income Africans, desperate for electricity, install high-cost diesel generators. Such generators are polluting and the cost of electricity produced is multiples of what electricity from a modern sector with appropriate technology would cost. Such added costs reduces competitiveness for African firms (Box 2).

Inefficient system operation: Systems in Sub-Saharan Africa are in many cases poorly run (Box 2). The most egregious weakness concerns the commercial aspects of the operation, notably inadequate billing of electricity consumed and low rates of collection of outstanding bills. Non-technical losses – essentially, theft of electricity – can be very high, sometimes as much as one-third of total electricity generated. Poor billing and collection, and theft of electricity, reduces utility income with the result that power utilities are financially weak and often unable to finance maintenance and new investments. North African power utilities on the other hand have a significantly better track record at operation and maintenance, and have better financial viability.

Insufficient maintenance of installed assets: This is due in part to the fragile financial situation of most of Sub-Saharan Africa's power utilities, with the result that these systems have fallen into disrepair. Inadequate maintenance reduces

Box 2: Nigeria—A failed electric power system

Nigeria, with a population of 175 million, has installed generating capacity of an estimated 8,000 MW, of which only around 4,000 MW can function at any given time given poor operation and maintenance. At 125 kWh per capita, Nigeria's electricity consumption is one of the lowest in the world. (South Africa, with a population of about a quarter of Nigeria's, has 45 000 MW installed and functional, nine times superior.) The Nigerian middle class has installed an estimated further 10,000 MW of expensive, polluting diesel generators to make up for failings of government utility. Inefficiencies in Nigeria's power sector have traditionally been a major constraint to growth, costing the economy as much as $100bn per year according to government estimates.

Nigeria ranks among the worst performers in the world when it comes to power, according to the World Bank's most recent "Doing Business" report. Nigeria is placed 182nd out of 189 countries surveyed in terms of ease of getting electricity, behind South Africa (168th) and Kenya (127th).

The lack of a reliable supply of electricity is seen as a major impediment to growth in Nigeria's industrial sector, adding to the cost of doing business for many firms. The private sector's backup diesel-fueled generators run at a cost of $0.30-0.50 per KWh, compared to the average grid tariff of $0.13.

Supported by the development community, Nigeria has embarked on a very ambitious reform program to completely overhaul the system and bring in private capital and expertise. It is still not clear whether this reform can work, given its complexity. Notably, the reform does not address the underlying poor financial viability and lack of creditworthiness of local distribution companies

Source: The Infrastructure Consortium for Africa (2015)

The combination of regulated tariffs that do not cover long run marginal costs associated with inadequate billing and collection (in particular, poor payment by governments for the electricity they consume) means that financial returns are not adequate, and utilities can afford neither to finance needed investments nor maintenance.

the life span of investments in the power sector and diminishes the economic return on assets.

Poor technology choice: Sub-Saharan Africa's utilities have traditionally invested in centralized systems using conventional energy sources (e.g. coal, petroleum products and natural gas), associated with a transmission network for transport of electricity generated to centers of consumption. Distributed electricity generation and supply models based on renewables (notably solar and wind, with geothermal in the Rift Valley) would in many cases be a useful addition to existing centralized systems, particularly to accelerate access in rural areas where population densities are low. Such decentralized investments represent a real opportunity for African countries, particularly as they could seek greater amounts of private financing, and would seem to be a high priority for decision-makers.

Inadequate regional integration of national electricity systems: Power trading in Africa started in the 1950s, in the form of bilateral agreements between Democratic Republic of Congo and Zambia in the Copper Belt. Over the past two decades, electricity transmission systems have begun to be more integrated on the African continent following the creation of several regionally integrated systems. However, at this point country systems are integrated only to a very limited extent.

The North African countries created an association of power utilities, the "Comité Maghrébin de l'Electricité (COMELEC)" established in 1989. The Southern Africa Power Pool (SAPP) was created in 1995, covering South Africa and other SADCC countries. It is now the most advanced power pool on the continent. SAPP introduced the Short-Term-Energy Markets (STEM) in April 2001 to trade spot electricity. The Western Africa Power Pool (WAPP) was established in 2001 to promote energy trade between member countries. Currently the power trade in WAPP is still under bilateral or multilateral agreements and market-based energy trade through WAPP has not yet started. The Central Africa Power Pool (CAPP) was launched in 2003 and the Eastern Africa Power Pool (EAPP), in 2005. The two power pools are still in the developmental stage, with more progress shown by the EAPP.

All four power pools in South, West, Central and East Africa and COMELEC are recognized, specialized institutions in their respective Regional Economic Communities (RECs). Although all power pools are working to promote energy trade, the level of energy traded in 2009 ranges only between 0.2 percent (in CAPP) and 7.5 percent (in SAPP), a tiny fraction compared to power pools in Asia or Latin America.

Inadequate financing for electricity: This is due most notably to the inability of public sector power utilities to generate sufficient internal cash flow from user fees to finance adequate maintenance, undertake existing investments and roll out new capacity. The combination of regulated tariffs that do not cover long run marginal costs associated with inadequate billing and collection (in particular, poor payment by governments for the electricity they consume) means that financial returns are not adequate, and utilities can afford neither to finance needed investments nor maintenance.

Transport

Roads, rail, airports, ports

Transport infrastructure in Africa is significantly less developed than in other developing regions of the world (Table 5). Transport costs are twice the level of other developing countries and in landlocked countries, up to four times as high as developing countries. The high cost of transport services significantly reduces African competitiveness and exports, and constrains economic growth.

- Road density in Africa is 152 km/km2, compared with 211 km/km2 for low income countries

In Africa, not only is there a low overall endowment of transport infrastructure but the African transport sector does not use its physical assets inefficiently.

worldwide, and 757 km/km2 for middle income countries.[9] Under one-third of African roads are paved compared with over 60 percent for low and middle income countries. Road quality is lower and road transport costs higher than in other regions of the world. Also, non-physical constraints such as roadblocks and trucking cartels, significantly reduce the efficiency of transport of goods by road.

- Rail could be an alternative, but rail networks outside South Africa are underdeveloped, poorly maintained, and of incompatible gauges. According to the International Union of Railways, in 2014 sub-Saharan African trains carried about 158 billion ton-kilometers of freight, or roughly half of what Australia's railways carried. Of that, 84 percent was in South Africa, which has a modern network. Elsewhere in Africa, railways carry a fraction of the volumes of two or three decades ago, due to absence of maintenance and deterioration of networks. However, several new rail regional projects are under consideration or construction, notably in East Africa (Kenya-Uganda, and Djibouti-Ethiopia) and West Africa (Benin-Niger-Burkina Faso-Côte d'Ivoire).[10]
- Air transport has grown strongly in Africa in recent years. The availability of air freight services, in particular, has helped boost exports. However, air transport in Africa is expensive, connections are patchy, and safety is a problem. Airports are often inadequate, and landing charges are high owing to the absence of support from concessions enjoyed in many parts of the world (notably, revenue from commercial installations within airports). Continent-wide, air traffic control requires major upgrades to improve the continent's baleful safety record. Policy challenges include strengthening regulatory oversight and achieving full liberalization of the air transport sector. In particular, cartelization of national systems and the absence of a regional open skies policy significantly increases the cost of air transport.[11]
- African ports are small compared to their peers worldwide. Only Durban in South Africa, and Damietta/Port Said in Egypt have annual capacities equivalent to other developing country ports (4-5 million TEU/year). Only six of the continent's ports are able to accommodate Post and Super Panamax vessels (Durban, Damietta/Port Said, Port Elizabeth, Cape Town, Port Louis and Tangiers). Many of the ports operate at below capacity due to low berth/docking facilities, weak terminal freight and handling management, inadequate maintenance and dredging capacity. As a result, port services are costly and shipments are often delayed leading to physical and financial losses.

Issues in the transport sector

Transport service quality is important in an economy. Transport services underpin all logistics operations, i.e. the detailed coordination of interactions involving many people, facilities or supplies. Logistics underpin trade and the market economy. Inefficient logistics operations thus constitute a dead weight, which reduces growth and overall welfare in the economy. The quality of transport services is a function both of the country's endowment in physical infrastructure and the efficiency with which it is used. In Africa, not only is there a low overall endowment of transport infrastructure but the African transport sector does not use its physical assets inefficiently. This is for several reasons, given below.

9. Infrastructure density (e.g., road km. per 1000 sq. km.) is very highly correlated with GDP density, i.e., GDP per sq. km. Many African countries have both low GDP per capita and low population density, yielding low GDP per sq. km.—and hence low infrastructure density.
10. The Economist. (4 June 2016). "Railways in Africa: Puffed out."
11. African Development Bank.

Not only is physical transport infrastructure less dense and its quality lower than infrastructure in other developing regions of the world, but there are significant constraints in policy, regulations, procedures, norms, standards and certification that increase the cost and time of transport.

Table 5: Key transport statistics

Region	Air transport, freight (million ton-km)	Air transport, passengers carried	Air transport, registered carrier departures worldwide	Container port traffic (TEU: 20 foot equivalent units)
Sub-Saharan Africa	2755	44,853,930	704,648	1,3879,582
Best, Africa	South Africa (1062)	South Africa (16,606,348)	South Africa (195,714)	Egypt (8,810,990)
Best, Comparator	India (1739)	India (82,751,555)	India (720,050)	India (11,655,635)
Africa	3232	72,319,921	1,003,384	28,036,660
East Asia & Pacific (developing)	24,458	641,252,790	5,337,532	240,855,146
Latin America & Carib. (developing)	3580	204,419,282	2,206,993	39,156,198
South Asia	37,192	99,147,414	912,858	20,900,073
Low & middle income countries	2688	1,157,201,360	10,706,313	342,476,160

Source: World Bank (2016)

"Soft" infrastructure constraints: Not only is physical transport infrastructure less dense and its quality lower than infrastructure in other developing regions of the world, but there are significant constraints in policy, regulations, procedures, norms, standards and certification that increase the cost and time of transport. Soft infrastructure has not received the same degree of attention as physical stocks from policy makers and development finance institutions although, in recent decades, countries have reduced high tariff levels and tariff complexity. Nevertheless, average tariff levels in Africa still remain above those in other developing countries, and there are still many exemptions.

Non-tariff barriers, however, remain a significant issue and have not received the same amount of attention. Non-tariff barriers include the number and complexity of procedures and administrative processes, different and incompatible technical regulations, norms and product standards and certification. These allow discretion on the part of officials and increase the time and cost of trading. By some estimates some 75 percent of delays on major transport corridors are due to the shortcomings in soft "behind the border" infrastructure, rather than the constraints due to physical infrastructure[12].

Lack of competition and cartelization of transport services: In many African countries (particularly in Sub-Saharan Africa) there is an insufficient degree of competition among transporters. Trucking cartels exist, for example, in West Africa where the added cost hinders development of landlocked countries (Niger, Burkina Faso, Mali). Air transport is controlled by a small number of airlines leading to excessively high ticket prices, and air links between African countries are spotty.[13] Maritime transport is in many cases cartelized as

12. Harmon, L.M., et al. (2009), as quoted in Tuluy, H. (2016). "Regional integration in Africa," *TICAD VI Policy Papers*, Centennial Group International.
13. Travel between some neighboring countries requires a connection to be made in Europe, or a distant hub such as Addis Ababa or Johannesburg.

Africa has a large number of landlocked countries (16 in total) and the development of transport corridors into the interior would significantly improve competitiveness of the continent.

well. Such lack of competition is in certain cases reinforced by national legislation and regulations, e.g. the absence of region-wide open skies policies and requirements that foreign truckers unloading in ports return to their home base empty. A regional approach to transport regulation and competition has the potential of significantly reducing transport costs even with existing physical infrastructure.

National systems rather than regional systems: Development of transport infrastructure has in most cases been undertaken at national rather than regional levels. For example, countries compete for air transport, so that air hubs have not been able to develop other than South Africa and Ethiopia. Inter-country competition in maritime transport has underpinned the development of a number of small ports dimensioned at the level of national rather than regional requirements, increasing overall port costs. Africa has a large number of landlocked countries (16 in total) and the development of transport corridors into the interior would significantly improve competitiveness of the continent. These are for the moment highly underdeveloped. (A list of such transport corridors is provided in the Annex.)

Rural roads provide inclusive growth and accelerate agricultural transformation

Finally, in addition to underpinning trade and competitiveness, transport infrastructure has an important role in supporting inclusive growth. Rural roads play an essential part in interconnecting rural communities to urban centers, to export points and to each other. Interconnection of rural areas enables greater participation in the fruits of growth by poor rural communities and accelerates the transformation of agriculture from subsistence to market-based.

Information and communications technologies

Fixed line, mobile and internet connectivity

From a very low base two decades ago, Africa has undergone a revolution in communication technologies. Before the introduction of mobile telephony Africa's incumbent fixed line telephone operators, operating for the most part under a public sector utility model, had been unable to deploy fixed lines ("POTS": plain old telephone service) to a sufficient segment of the population. The introduction of new mobile technologies, and a new delivery model based on private investment and operation coupled with competition between operators rather than on incumbent state owned enterprises, completely overturned the situation. The number of subscribers in Africa grew by 13 percent a year during the first half of this decade—more than twice the global average of six percent. Today there are nearly as many mobile cellular subscriptions in Africa as the population. The rapid growth in the first half of the decade was partly due to starting from a low base, with less than a quarter of the population having a mobile subscription in 2010. (Key telecom indicators are provided in Table 6.)

The rapid penetration of mobile telephony in Africa, based on new and more appropriate technologies and private operators operating in a competitive environment, which led to a very significant reduction in costs for users, provides a useful model for other infrastructure sectors such as electric power.

Internet penetration via fixed broadband links has been significantly less successful. With 13.9 Internet users per 100 people the continent lags other low and middle income developing countries, which stand at 31.1 users. Africa's best performer, Mauritius, has rates of Internet usage close to that of developed countries and this connectivity has underpinned the island's strong trade links and international competitiveness. But in the rest of the continent, broadband connectivity is poor.

The rapid penetration of mobile telephony in Africa, based on new and more appropriate technologies and private operators operating in a competitive environment, which led to a very significant reduction in costs for users, provides a useful model for other infrastructure sectors such as electric power.

Table 6: Key global telecom indicators for the world telecommunication service sector, 2014

Indicator	Global	Developed nations	Developing nations	Africa	Arab states	Asia & Pacific	CIS	Europe	The Americas
Mobile cellular subscriptions (millions)	6915	1515	5400	629	410	3604	397	780	1059
Per 100 people	95	121	90	69	110	89	141	125	108
Fixed telephone lines (millions)	1147	511	636	12	33	512	70	245	256
Per 100 people	16	41	11	1	9	13	25	39	26
Active mobile broadband subscriptions (millions)	2315	1050	1265	172	92	920	138	399	577
Per 100 people	32	84	21	19	25	23	49	64	59
Mobile broadband growth (2013-2014)	N/A	11%	26%	43%	19%	21%	15%	12%	16%
Fixed broadband (millions)	711	345	366	3	12	313	40	173	163
Per 100 people	10	27	6	<1	3	8	14	28	17

Source: International Telecommunication Union (2014)

Table 7: Key ICT statistics

Region	Internet users (per 100 people)	Mobile cellular subscriptions (per 100 people)	Fixed broadband subscriptions (per 100 people)	Fixed telephone subscriptions (per 100 people)
Sub-Saharan Africa	19	71	<1	1
Africa	14	78	1	3
Best, Africa	Mauritius (57)	Gabon (171)	Mauritius (15)	Mauritius (30)
Comparators	23	96	3	8
Best, Comparators	Vietnam (48)	Vietnam (147)	Moldova (15)	Moldova (3)
East Asia & Pacific (developing)	42	101	12	14
Latin America & Caribbean (developing)	47	111	9	17
South Asia	17	75	1	2
Low & middle income countries	31	90	6	9

Source: World Bank (2016)

Infrastructure services provided by connectivity, particularly mobile communications, have the potential to spur development of other sectors.

Mobile telephony: An African success story

Infrastructure services provided by connectivity, particularly mobile communications, have the potential to spur development of other sectors. The most important of these has been mobile banking (Box 3). However, other uses such as providing market information (e.g. prices for cacao on international markets for farmers in Ghana and Côte d'Ivoire) or weather-related information improve the functioning of the market as well, and create opportunities for low income economic actors.

Internet still lags

Africa's mixed performance with fixed broadband Internet connections, associated with the high cost of Internet usage for those with connections, represent a cost to economy and a missed opportunity. More Africans access the Internet through smartphones than via a fixed broadband connection. Because of poor Internet connectivity African countries find it more difficult to tap into highly attractive openings for trade in services such as call centers, provision of back-office financial services, tourism and the like, although the continent has a number of clear-cut advantages for such developments (proficiency in English and French, and being on the same time zones as Europe). African firms are also less competitive than their peers because of inability to interconnect efficiently with customers and suppliers in a timely fashion. Improving broadband connectivity would appear to be a high priority for African decision-makers.

Box 3: Mobile banking in Kenya—A real success story

Kenya's M-Pesa brought banking-by-phone to Africa. Since its introduction the service has grown into a bona fide payment network. More than 60 million Africans use basic mobile phones to transfer money from one person to another, take out insurance policies and collect payment from government agencies. Africa's "mobile money" market exceeded $61 billion in 2012—greater than the amount of money sent via mobile in Europe and North America combined. In some months the value of Kenya's mobile money transactions equals or exceeds 60 percent of GDP (source: GSM Association).

Launched in 2007 by carriers Safaricom and Vodacom, M-Pesa's success is based on its simplicity. Customers buy credit on their mobile phone accounts to pay bills or buy products. To transfer money to a person, merchant, or government agency, all they need is the creditor's related phone number. The debits are deducted directly from the mobile phone account, with no need to fuss over a bank account. Customers give debtors their mobile number to use in settling up; when a debt payment comes in, their mobile phone account is credited.

Mobile phones have spread faster than bank branches. Mobile money accounts outnumber bank accounts in Kenya, Tanzania, Uganda and Madagascar. Today 150 mobile money services such as M-Pesa serve more than 81.8 million customers in Africa, the Middle East and Asia; 41 new mobile money operators launched in these emerging economies over the past year, the GSMA reported. Africa is the world's largest market: In Sub-Saharan Africa, more people have a mobile money account than are signed up for Facebook.

These systems have obvious appeal for people without bank accounts, or what the financial services industry calls the "unbanked." In Kenya, this represents more than 80 percent of the market. For many Kenyans, their first mobile phone contract served to introduce them to the world of debit and credit. With minimal banking regulations in the region, African mobile companies were able to add various retail banking services (insurance, microfinance, remittances) to the traditional pay-as-you-go contract.

Source: Bloomberg (2013).

While electricity, transport, and telecommunications infrastructure support country competitiveness and trade, and also (perhaps to a lesser extent) inclusive growth, provision of safe water and sanitation is directly responsible for reducing poverty and supporting inclusive growth.

Water and sanitation

Installed water and sanitation capacity

While electricity, transport, and telecommunications infrastructure support country competitiveness and trade, and also (perhaps to a lesser extent) inclusive growth, provision of safe water and sanitation is directly responsible for reducing poverty and supporting inclusive growth. Serious waterborne illnesses such as diarrhea are leading causes of infant mortality and malnutrition, with impacts that extend beyond health to the productive sectors of the economy through lost work days and school absenteeism. Meeting the Millennium Development Goal (MDG) for access to safe water would produce an economic benefit of US$3.1 billion (in 2000 dollars) in Africa, through time savings and health benefits.

Adequate sanitation (defined as any private or shared, but not public, facility that guarantees that waste is hygienically separated from human contact) also makes a key contribution to public health, particularly in densely populated areas. Adequate sanitation reduces the risk of a broad range of diseases—including respiratory ailments, malaria, and diarrhea—and reduces the prevalence of malnutrition. Access to this standard of sanitation produces direct health gains by preventing disease and delivering economic and social benefits. A reduction in diarrheal illness would produce a gain of 99 million days of school and 456 million days of work for the working population ages 15–59 in Africa.

Africa lags the rest of the world in provision of clean drinking water and improved sanitation facilities (Table 8). The international adoption of the MDGs in 2000 created a framework for focusing poverty reduction efforts. MDG 7 calls for reducing by half the number of people without sustainable access to safe drinking water and improved sanitation. Although the world overall is on track to meet the MDG drinking water target, Africa remains behind. The gap is most acute in Sub-Saharan Africa, where only 58 percent of the population enjoys access to safe drinking water, and the gap is widening, as the increase in urban population places a greater strain on existing service providers. Of the 828 million people in the world whose water sources remain unimproved, 37 percent live in Sub-Saharan Africa.[14]

Key issues

Access to improved water and sanitation remains inadequate, particularly in rural areas: In rural areas, reliance on surface water remains prevalent. Boreholes (which serve a further 40 percent of the population) are the principal improved source of water. Access to piped water and standposts is very low. Indeed, in many African countries, less than 1 percent of the rural population receives piped water. In urban areas, piped water remains the single largest source of urban water, but coverage fell markedly over the past decade as the extension of piped water supply could not keep up with rapid population growth. Coverage of standposts saw a similar decline in urban areas. Overall, about two-thirds of the urban populace depends on utility-supplied water, either through piped water supply or standpipes. Utilities are this the central actors responsible for water supply in urban areas.

Sanitation: Traditional pit latrines are by far the most common sanitation facility in both urban and rural areas, but more than a third of the population—mostly in rural areas—still defecates in the open. Improved sanitation (septic tanks and improved latrines) reaches less than 20 percent of Africa's population, and less than 10 percent in rural areas. Coverage of improved latrines is no greater than that of septic tanks, despite the significant difference in cost between them. Only 10 percent of the population uses a septic tank; coverage in rural areas is practically negligible. In urban areas, septic tanks are much more common than

14. Banerjee, S. & Morella, E. (2011). *Africa's Water and Sanitation Infrastructure -- Access, Affordability, and Alternatives*. Washington: World Bank.

Many African governments have reformed their water and sanitation systems in the past two decades to provide better services for their citizens.

Table 8: Key water and sanitation access statistics

Region	Improved water source (% of population with access)	Improved water source, rural (% of rural population with access)	Improved water source, urban (% of urban population with access)	Improved sanitation facilities (% of population with access)	Improved sanitation facilities, rural (% of rural population with access)	Improved sanitation facilities, urban (% of urban population with access)
Sub-Saharan Africa	66	55	86	30	23	40
Africa	75	65	89	40	32	51
Best, Africa	Mauritius (100)	Mauritius (100)	Egypt, Tunisia, Niger (100)	Seychelles (98)	Seychelles (98)	Seychelles (98)
Comparators	87	81	95	71	64	84
Best, Comparators	Vietnam (96)	Vietnam (95)	Nicaragua (99)	Uzbekistan (100)	Uzbekistan (100)	Uzbekistan (100)
East Asia & Pacific (developing)	93	89	97	75	64	85
Latin America & Caribbean (developing)	94	83	97	81	62	86
South Asia	92	91	95	45	35	65
Low & middle income countries	89	83	95	61	47	76

Source: World Bank (2016)

improved latrines, and less than 10 percent of the population practices open defecation.

High water tariffs: African water utilities operate in an environment of high costs. Despite this, Africa's experience in recovering operating costs is positive overall, with many utilities setting tariffs at levels high enough to recoup operations and maintenance (O&M) costs. In fact, African tariffs are highest among the developing regions. Despite this, African utilities are not able to adequately fund either capital expenditures or maintenance.

Water sector performance: Many African governments have reformed their water and sanitation systems in the past two decades to provide better services for their citizens. Countries that have pursued institutional reforms have built more efficient and effective sector institutions and achieved faster expansion of higher quality services (Box 4). The potential dividend of such efforts is large, because addressing utility inefficiencies alone could make a substantial contribution to closing the sector funding gap in many countries. Utilities that have decentralized their services or adopted private sector management have done a better job of eliminating

Infrastructure underpins development of the domestic economy and contributes to inclusive growth.

Box 4: Senegal's successful experience with private sector participation

Water supply and sanitation in Senegal is characterized by a relatively high level of access compared to the average of Sub-Saharan Africa. Water supply and sanitation has been provided under a public-private partnership that has been operating in Senegal since 1996, with Senegalaise des Eaux (SDE), a subsidiary of Saur International, as the private partner. SDE does not own the water system but manages it on a 10-year lease contract with the Senegalese government under an affermage contract. Between 1996 and 2014, water sales doubled, to 131 million cubic meters per year, and the number of household connections increased by 165% to more than 638,000.

The Senegal experience under the affermage is characterized by significant expansion of access, and a large increase in operational efficiency that mainly originated from a reduction of nonrevenue water (NRW).

Expansion of access was mainly related to a massive subsidized connection program sponsored by donors and, in part, to the cash-flow surplus generated by the private operators. The social connection program, implemented with donor support, provided about 129,000 connections (75 percent of all new connections installed) benefiting poor households living in targeted neighborhoods.

Improved efficiency was related to contract innovations geared toward increasing the operator's incentives to perform efficiently. The affermage contract included targets for reduction of NRW and improved bill collection, backed by financial penalties for noncompliance.

Another innovation in Senegal's public-private partnership was the responsibility of the private operator to finance part of the network's rehabilitation using cash flow. This approach provided the operator with more flexibility to identify and reduce water losses, lessening its dependency on the public asset-holding company.

The impact of these innovations on efficiency has been remarkable, making Senegal's affermage a prominent example of private participation in Africa. Today, Senegal can report a level of NRW comparable to the best water utilities in Western Europe. These results also confirm that operational efficiency is perhaps the area in which a private operator can make the most positive and consistent impact.

Source: Adapted from Banerjee, S. & Morella, E. (2011)

inefficiencies and other hidden costs than those that have not. Unbundling of services can also be beneficial, but unbundling is rare in Africa and is exclusively concentrated in middle income countries, whose superior performance can be explained for many other reasons. The reform agenda has had two major thrusts: increasing private participation and improving governance from within. Private sector participation has helped to improve utility performance, with Senegal being particularly noteworthy.

Future infrastructure requirements and financing needs

Drivers of physical infrastructure needs

Infrastructure underpins development of the domestic economy and contributes to inclusive growth. It is also the enabler of regional integration. Low cost infrastructure services are key for export competitiveness. They reduce transport costs and provide connectivity between suppliers and their markets, and thus allow for greater economic diversification.

As indicated earlier, while countries in Africa are far from homogeneous, worldwide analysis shows that Africa's low

Financing for infrastructure in Sub-Saharan Africa tripled between 2004 and 2012...The most striking feature of this surge is the changing share of financing offered by traditional and non-traditional partners and private sector sources.

infrastructure endowment is above all a reflection of its low GDP per capita income levels. Estimating physical infrastructure needs will depend to a large extent on expected GDP and population growth over the period. Fulfilling these requirements for new physical infrastructure will require very significant financing from a variety of sources.

However, the quality of Africa's infrastructure services, even after taking account of its physical endowment, is low. This is a reflection of the priority given to new investment over operations, rehabilitation and maintenance. It would be an error to focus exclusively on requirements for new investment without also considering the need for greater attention to O&M.

Financing for infrastructure – Needs and sources

Current infrastructure financing

In 2014, total funding for infrastructure is estimated to have reached $74.5 billion.[15] Of this total, $34.5 billion was provided by African national governments (46 percent); $17.9 billion by international financial institutions (IFIs) and government-to-government lending (24 percent); $9.1 billion in the form of subnational financing (12 percent); and only $2.9 billion from the private sector (under 4 percent). The bulk of private sector financing was for mobile telecommunications networks.

Transport was the sector that attracted the most financing ($34.3 billion or 46 percent), followed by electric power ($22.4 billion, or 30 percent). Water and sanitation attracted $9.7 billion (13 percent) and ICT $2.3 billion (3 percent). $2.9 billion was spent on multi-sector projects (4 percent).

North Africa received the most significant amount: $23.4 billion (32 percent), followed by Southern African countries ($18.0 billion, or 24.2 percent). The rest ($31.4 billion) was shared among the other regions.

Financing for infrastructure in Sub-Saharan Africa tripled between 2004 and 2012. During this period, financing from IFIs increased (especially from the World Bank and the African Development Bank - AfDB), and China became a major bilateral source. The most striking feature of this surge is the changing share of financing offered by traditional and non-traditional partners and private sector sources.

This funding increase benefitted a wide range of sub-Saharan African countries. In absolute terms, the top recipients of external financing for 2009-2012 are concentrated in the five large economies—South Africa, Nigeria, Ghana, Kenya and Ethiopia. The electricity sector has had the fastest growth across all external financing sources since 2009. Excluding telecom, private finance for other sectors, especially energy, is highly concentrated in a few countries. Official Chinese investments are now expanding beyond the country's earlier focus on financing for resource-rich economies, and is reaching sectors in which it has particular technical expertise—such as hydropower—and those that are not as amenable to the private sector—such as transport (especially road and rail).

Public sector budgets are the primary source of funding for infrastructure as in other regions of the world. Public sector budgets are critical as they establish the strategic framework within which support through external financing is coordinated. In absolute terms, South Africa dominates these public expenditures with about $29 billion (2012), with Kenya, the next country, allocating about $3 billion.

Future infrastructure financing needs

Current spending on infrastructure in the African continent is estimated at $74.5 billion, excluding maintenance. There is a wide variation across the continent of the share of GDP devoted to infrastructure financing, with some countries

15. Infrastructure Consortium for Africa Secretariat: ICA Report 2014. African Development Bank, Abidjan.

If the African continent as a whole has economic growth rates going forward equivalent to recent performance of 6 percent in real terms, infrastructure stocks would be expected to grow at the same rate.

(e.g. Lesotho, Cape Verde, Angola) investing over 8 percent, while at the bottom end, Nigeria invests under 3 percent and South Sudan less than 1 percent. The results do not appear to reflect any direct relationship of budgetary allocation with either infrastructure capacity or needs.[16]

It is not easy to estimate future infrastructure financing needs, and there is a difference of thinking among economists about how best to undertake this exercise. Development practitioners advocate a benchmark of 5-6 percent of GDP for infrastructure financing to sustain growth.[17] Infrastructure economists, on the other hand, estimate infrastructure spending based on growth in countries' physical infrastructure stocks and the elasticity of stocks' growth with respect to national income.[18]

External estimates: In 2009 the World Bank issued a comprehensive report on African Infrastructure,[19] which estimated that $93 billion per year would be needed to meet the infrastructure needs of Sub-Saharan Africa alone. Scaling up spending for the continent as a whole based on GDP shares, the spending requirement would be of the order of $125 billion per year. It is assumed that these figures include replacement costs, i.e. spending to replace infrastructure that has been retired over the year.

Benchmark estimates: Applying the widely accepted 5-6 percent benchmark across the continent to Africa's current estimated GDP of $2.5 trillion (2015 dollars) would lead to infrastructure investment figures of around $125 billion to $150 billion per year, broadly in line with World Bank's 2009 figure. Again, it is assumed that these figures include replacement costs.

Elasticity estimates: Elasticities of infrastructure stocks with respect to GDP vary significantly between sectors (from 0.2 to 1.2), but in aggregate across all infrastructure sectors, elasticities are close to 1. Thus, at a first approximation, overall physical infrastructure stocks measured in financial asset terms (i.e. in dollars) increase more or less in line with GDP growth. It is difficult to estimate Africa's existing physical stock of infrastructure. Worldwide, the value of infrastructure stock in most developed or middle income economies is estimated to average around 70 percent of GDP.[20] In Africa the overall infrastructure endowment is lower than in these countries and is estimated to be of the order of 50 percent of GDP, or around $1.25 trillion. Thus, if the African continent as a whole has economic growth rates going forward equivalent to recent performance of 6 percent in real terms, infrastructure stocks would be expected to grow at the same rate.

Under the elasticity method, spending outlays on infrastructure can be estimated as the increase in infrastructure stocks from one year to the next, plus the replacement cost for infrastructure that has been retired over the year. Historical expenditure on infrastructure replacement is on the order of 2 percent of the existing stock. Applying this method to existing infrastructure stocks of $1.25 trillion, and with historical growth rates of 6 percent (real) per year, would imply a current annual increase of infrastructure stocks of $75 billion, plus replacement costs of $25 billion. Together these provide a total annual infrastructure spend of $100 billion (2015 dollars) for the African continent, somewhat higher than, but still consistent with estimates for 2014. This spending would of

16. Gutman, J., Sy, A., & Chattopahyay, S. (2009). F*inancing African Infrastructure – Can the World Deliver?* Washington: World Bank.
17. Worldwide, historical infrastructure spending for the 84 countries that account for more than 90 percent of global GDP indicates that global investment on roads, rail, ports, airports, power, water, and telecommunications infrastructure has averaged about 3.8 percent of global GDP. (McKinsey (2013). Infrastructure productivity: How to save $1 trillion a year.)
18. Ingram, G., Liu, Z., & Brandt, K. (2013). *Metropolitan Infrastructure and Capital Finance*.
19. World Bank. (2009). *Africa's Infrastructure: A Time for Transition*. Washington: World Bank.
20. Estimate of the worldwide value of infrastructure stock using a perpetual inventory model for 12 countries for which comprehensive historical spending data are available across asset classes. (McKinsey (2013). Infrastructure productivity: How to save $1 trillion a year.)

Private financing will not flow regularly for infrastructure until the different sectors are creditworthy, which in most cases involves moving away from the rigid state-owned enterprise (SOE) utility models to new institutional setups.

course rise over time with continuing economic growth and increasing infrastructure stocks.

Estimates of future spending: The above estimate, based on historically observed elasticities, would leave African infrastructure endowments at 50 percent of GDP indefinitely, meaning that Africa would be less endowed than other regions rather than trending toward ratios observed in middle income and developed countries which are equivalent to 70 percent of GDP. Under an aspirational scenario where the African continent were to seek to catch up with these countries over the two decades until 2035, infrastructure spending elasticities would need to be at 1.3 rather than the historically observed 1.0, i.e. infrastructure spending growth needs to be 30 percent higher than GDP growth. Thus if GDP growth is 6 percent (real) per year, growth in infrastructure spending would need to be 7.8 percent per year. Under this scenario spending would need to rise to $168 billion per year in 2020 and $245 billion in 2025 (2015 dollars).

Current estimates of GDP growth point to a significant slowdown in Africa in the past two years as a result of the global economic slowdown and the collapse in commodity prices. Growth rates for 2016 and 2017 are slated at 3 percent and 3.8 percent, respectively.[21] It is possible that future African growth rates, and with them, infrastructure spending, moderate over the next few years. If longer term growth remains at 3.5 percent per year in real terms, infrastructure spending would be of the order of $80 billion in 2020 and $95 billion in 2025 under the stability scenario (2015 dollars).

Key findings for infrastructure financing

Inadequate private financing: With the exception of telecoms, Africa does not call on significant private financing for infrastructure, so current financing is mostly in the form of sovereign financing (from fiscal revenue or government-guaranteed borrowings) or official development assistance. Private financing will not flow regularly for infrastructure until the different sectors are creditworthy, which in most cases involves moving away from the rigid state-owned enterprise (SOE) utility models to new institutional setups. In particular, in order to attract private funding, utilities have to become financially viable, which means that users have to pay the full long run marginal cost for the infrastructure service. While private sector models have been successfully introduced in

21. IMF (April 2016). *World Economic Outlook – Too Slow for Too Long*. IMF, Washington DC.

Table 9: Projected infrastructure spending

	Stability Scenario		Catch-up Scenario	
	Constant Ratio Infrastructure/GDP = 0.5		Trending to Infrastructure/GDP = 0.7	
	Elasticity	Spending ($billion/yr)*	Elasticity	Spending ($billion/yr)*
	Africa GDP Growth = 6%/yr (real)			
2015	1	$100 billion	1.3	$100 billion
2020	1	$136 billion	1.3	$168 billion
2025	1	$171 billion	1.3	$245 billion

**Investment figures in 2015 dollars.*

Africa needs more infrastructure investment, and it needs better operation and maintenance of its infrastructure stocks to achieve better infrastructure services from these stocks for its economies and its population.

a number of countries, most notably delegation of water and sanitation to a private enterprise in Senegal, and a privately-run electric power system in Cote d'Ivoire, this approach does not seem to attract much enthusiasm from the continent's decision makers.

Fiscal revenue: Despite the progress in raising fiscal revenues, Sub-Saharan African countries need to raise more domestic finance, both tax revenue and on the domestic debt markets, to meet the infrastructure gap. While tax revenues to GDP have recently increased across sub-Saharan Africa to over 20 percent, this increase is mainly attributable to the resource-rich countries, and tax revenue to GDP varies across the board—ranging from 25 percent in South Africa to 2.8 percent in the Democratic Republic of the Congo. Taxation rates are moreover falling again with the decline in commodity prices.

International debt markets: In addition to raising tax revenues, Sub-Saharan African countries have increasingly accessed international capital markets with 13 countries issuing $15 billion worth of international sovereign bonds since 2006. While this is a worthwhile strategy it increases public debt stocks and can introduce currency risk into future coupon payment requirements. It should, therefore, only be undertaken with prudence. A better debt strategy would be to mobilize long term domestic savings through improvements to domestic debt markets, by enabling the creation of long term instruments attractive to contractual savings institutions such as pension funds and insurance companies.

Need for urban infrastructure financing: Compared to other regions, Sub-Saharan Africa is still predominantly rural. However, that is changing rapidly, with some estimates showing that by 2035, 50 percent of the population will live in urban areas. In many cities, the challenge of urbanization and the need for critical infrastructure is already evident. One-third of urban residents in Sub-Saharan Africa are located in 36 cities, each with more than a million inhabitants. The United Nations estimates that by 2025, the population in Lagos and Kinshasa will reach 18.9 million and 14.5 million, respectively (they are already among the 30 most populous cities in the world).

Sub-sovereign financing: As countries increasingly decentralize the responsibility for infrastructure services to local governments, they have also devolved fiscal responsibility. African efforts at functional devolution of responsibility for services and fiscal decentralization seriously lag behind other regions of the world. Within Sub-Saharan Africa, South Africa is the most decentralized, with 60 percent of public expenditures handled by local governments, which illustrates the level of devolution that can be achieved.

Action agenda

As this paper indicates, Africa needs more infrastructure investment, and it needs better operation and maintenance of its infrastructure stocks to achieve better infrastructure services from these stocks for its economies and its population. These dual but compatible objectives suggest that African decision makers need to focus on three sets of actions.

New models for the delivery of infrastructure services

Depending on the infrastructure sector concerned, African governments need to consider moving away from the existing SOE utility model, just as they did with the telecom sector following the introduction of mobile phones. A model based on multiple privately owned and financed operators (or jointly owned by the public and private sector) is in many cases not applicable (e.g. for road infrastructure). But where technology allows, this model should be considered. Specifically, the following merit consideration:

- *Power*: The electric power sector has the most potential for tapping new technologies, notably solar and other renewables, in a delivery model that involves privately owned and financed off-grid and mini-grid

The most glaring area for progress in infrastructure financing is to increase flows of private finance, over and above the telecoms sector.

systems. However, governments must accept to dismantle the de facto and de jure monopolies that currently favor the incumbent utility, and they must be willing to forego investments in large centralized fossil fuel-powered generating plants.

- *Transport*: This sector needs to move away from national systems toward a regional (multi-national) planning and investment program. Notably, governments need to seek real physical integration by developing transport corridors with significant private sector investment (ports, rail, toll-roads) and with bonded transport and storage facilities such as inland ports.
- *ICT*: Mobile telephony functions for the most part quite well, although better attention could be paid to interconnectivity of competing systems. The most urgent need is to strengthen fixed broadband Internet access by introducing open access to trunk-line fiber-optic cables and gateways, encouraging competition. This needs a policy decision from governments to move away from current monopoly situations, in many cases run by the rump of the former fixed line telecoms operator and encourage competition and open markets.
- *Water and sanitation*: This sector has had the greatest success in moving to privately run (and to some extent privately financed) operational models, notably concessions and affermages, because of robust cost recovery. Other countries need to consider such institutional setups.

Improved management of assets

New institutional setups: As outlined above, institutional change will begin to address the poor operation and maintenance records of African infrastructure operators. In the case of concessions and affermages, specific maintenance requirements can be included in relevant contractual documentation, with penalties in case of non-respect. In the case of privately owned assets (telecoms), investors have an economic incentive to operate and maintain their asset correctly.

Cost-reflective tariffs: In addition to new institutional setups, there needs to be a focus on principles to ensure that operation and maintenance are fully funded. Current tariff mechanisms often set prices for consumers below long run marginal costs, with the result that the investor/operator is not financially viable and is therefore unable to cover its costs. Maintenance, as it can be deferred (unlike direct costs such as salaries), is generally the first cost item to be cut, which leads to deterioration of the physical asset.

Another advantage of tariffs that cover costs is their promotion of end-user efficiency. For example, when electricity is more expensive, people use less of it and energy efficient appliances become more worthwhile. This increases the value of infrastructure services for users from a given physical infrastructure stock.

Payment by government: Governments and government agencies have a poor track record for paying infrastructure tariffs (electricity and water in particular) across the continent. This foregone revenue contributes to sector operators' financial hardship and inability to fully finance operation and maintenance. African governments need to consider approaches such as hard budget constraints and fixed line-items in national budgets to cover payment for these services. There have been interesting experiences for payment of tariffs by government agencies, e.g. through the use of pre-paid mobile telecoms cards, that could be further explored in other sectors such as electricity.

Innovative financing

Need for private financing: The most glaring area for progress in infrastructure financing is to increase flows of private finance, over and above the telecoms sector. The

The priority for African governments must be to develop domestic financial markets and instruments to channel national savings to long term infrastructure projects.

measures outlined above (new delivery models and improved operations and maintenance), associated with cost-reflective tariffs and payment by government for the services it consumes, will go some way toward improving the financial viability of the sector and hence its creditworthiness and ability to attract private financing.

However, there is a difference between financing received from the offshore private sector, and domestic investors and lenders, because the latter have the advantage of not incurring currency and devaluation risk on future financial flows. Therefore, the priority for African governments must be to develop domestic financial markets and instruments to channel national savings to long term infrastructure projects. This will involve, in particular, development of domestic debt markets to increase their tenor and ability to consider these investments through, for example, issuance of infrastructure bonds. Also, increased private ownership of infrastructure assets will increase the ability for equities markets to channel financing to infrastructure.

In the realm of infrastructure financing in Africa, it is necessary to be realistic. Current private financing of African infrastructure is only $2.9 billion (4 percent of total financing). Even if this figure is multiplied by a factor of five, it would still be far less than fiscal flows or external flows from government. This means that African governments will need to continue to focus on good fiscal management and on adequate coordination of external public financiers for the foreseeable future.

Annex

Table A1: Key access corridors in Africa

Corridor	Distances	Remarks
Dakar – Mali	1,250 km	Rail
Abidjan – Burkina Faso – Mali	1,200 km	Multimodal options to Ouagadougou, then road
Tema/Takoradi – Burkina Faso – Mali	1,100 km to Ouagadougou	Road
Lome – Burkina Faso – Niger/Mali	200 km	Road
Cotonou – Niger – Burkina Faso – Mali	1,000 km up to Niger	Multimodal options
Lagos – Niger	1,500 km	Road
Douala Corridor **Douala – Central African Republic -- Chad**	1,800 km	Multimodal (mainly road, some rail)
Pointe Noire – Central African Republic – Chad	1,800 km	Rail/river
Lobito Corridor **Lobito (Angola) – Lubumbashi (DRC) – Lusaka (Zambia)**	1,345 km	Multimodal Not currently used
Trans – Caprivi **Walvis Bay – Zambia-DRC**	2,100 km to Lusaka	Road
Trans – Kalahari Walvis Bay – Botswana – South Africa	1,800 km	Road
North – South Corridor **Durban – Zimbabwe – Zambia –DRC**	2,500 km to DRC	Multimodal options available
Maputo – South Africa	600 km	Multimodal options available
Beira – Zimbabwe – Zambia – DRC		Multimodal options available
Central Corridor **Mombasa (Dar es Salaam) – Rwanda – Burundi –Uganda – DRC**	1,400 km to Kigali 1,600 km to Kampala	Multimodal options available (Road, rail, inland waterways)
Northern Corridor **Mombasa – Rwanda – DRC**	1,200 km to Kampala 2,000 km to Bujumbura	Multimodal options available
Berbera – Ethiopia	850 km	Road
Djibouti – Ethiopia	900 km	Multimodal options available
Assab – Ethiopia	900 km	Not currently used
Massawa – Ethiopia		Not currently used
Lagos – Niger – Mali and Lagos – Chad	8,000 km as part of the CLRT	Multimodal options available

Table A2: Transport statistics, by country

Country	Air transport, freight (million ton-km)	Air transport, passengers carried	Air transport, registered carrier departures worldwide	Container port traffic (TEU: 20 foot equivalent units)
Algeria	14.0	46908245.0	59588.2	360522.0
Angola	78.4	1335850.4	13817.6	1000000.0
Benin	0.5	60259.5	646.1	408146.5
Botswana	0.1	205992.7	8298.1	..
Burkina Faso	<0.1	117414.6	3669.8	..
Burundi	..	..	..	..
Cabo Verde	1.9	590310.2	7728.6	..
Cameroon	0	275762.2	5633.4	367331.8
Central African Republic	..	..	..	..
Chad	0.5	28330.0	74.8	..
Comoros	..	..	..	..
Congo, Dem. Rep.	0.1	560301.2	12849.0	..
Congo, Rep.	2.0	553946.1	10370.1	436716.7
Cote d'Ivoire	4.7	237115.0	4034.4	783101.9
Djibouti	..	..	..	773141.28
Egypt, Arab Rep.	401.0	9007209.1	90784.4	8810989.9
Equatorial Guinea	0.3	303013.7	14143.5	..
Eritrea	..	..	..	..
Ethiopia	950.9	6180235.6	69396.5	..
Gabon	..	..	..	197997.6
Gambia, The	2.2	151777.6	1842.7	..
Ghana	1.3	407542.8	16736.0	833771.3
Guinea	..	..	..	..
Guinea-Bissau	..	..	..	..
Kenya	280.7	4792266.9	96779.6	1010000.0
Lesotho	..	..	..	..
Liberia	..	..	..	..
Libya	3.7	2677312.3	32722.8	456773.4
Madagascar	31.1	520421.0	10385.0	181808.0
Malawi	<0.1	5854.9	1648	..
Mali	..	..	..	..
Mauritania	0.0	271209.6	4040.1	84665.4
Mauritius	188.3	1354562.0	12738.5	653635.0
Morocco	43.4	6482274.6	70509.3	3070000.0
Mozambique	5.7	751528.3	20521.3	328200.1
Namibia	3.4	522216.0	9197.0	131180.45
Niger	1.1	87932.0	1040.0	..
Nigeria	0.0	4289094.0	66079.8	1062388.6
Rwanda	20.7	626925.1	12097.1	..
Sao Tome and Principe	..	..	..	..
Senegal	3.9	131966.3	4040.7	450008.2
Seychelles	32.3	404977.3	14521.5	..
Sierra Leone	..	..	..	..
Somalia	1.4	251649.2	3446.7	..
South Africa	1062.3	16606348.3	195713.8	4831462.0
South Sudan	..	..	..	..
Sudan	11.9	501855.4	6848.5	565810.6
Swaziland	..	..	..	..

Table A2: Transport statistics, by country (cont.)

Tanzania	2.3	1474326.5	26032.3	638023.4
Togo	34.0	779259.2	10522.3	..
Tunisia	14.5	4608369.0	45132.0	600985.8
Uganda	0.7	163830.3	6846.1	..
Zambia	0.0	8591.6	7685.8	..
Zimbabwe	32.7	301265.1	25222.9	..
Sub-Saharan Africa	2755.2	44853930.5	704647.8	..
Africa	3231.9	72319920.6	1003384.4	28036660.0
East Asia & Pacific (developing)	24458.4	641252789.7	5337532.2	240855145.8
LAC (developing)	3579.7	204419282.1	2206992.5	39156198.4
South Asia	37192.2	99147414.2	912858.0	20900073.3
Low & middle income countries	2688.0	1157201360.0	10706312.7	342476160.5
Bangladesh	260.3	3116217.4	58589.5	1655365.1
Cambodia	0.8	1089788.3	10811.6	288904.9
Honduras	0.9	239130.5	24214.1	704933.5
India	1739.0	82751554.9	720050.3	11655635.4
Kyrgyz Republic	0.2	712285.9	17389.7	..
Laos	1.4	1310119.9	12723.8	..
Moldova	0.6	706353.9	8528.9	..
Myanmar	4.0	1272290.3	29358.4	244887.9
Nicaragua	..	..	..	101392.2
Pakistan	226.8	5559595.5	48394.9	2597395.1
Uzbekistan	110.2	2545935.0	23149.0	..
Vietnam	587.5	24703605.2	144630.3	9531076.4

Source: World Bank (2016)

Table A3: ICT statistics, by country

Country	Internet users (per 100 people)	Mobile cellular subscriptions (per 100 people)	Fixed broadband subscriptions (per 100 people)	Fixed telephone subscriptions (per 100 people)
Algeria	18.1	92.9	4.0	7.8
Angola	5.3	63.5	0.4	1.3
Benin	18.5	99.6	0.4	1.8
Botswana	9.4	167.3	1.6	8.3
Burkina Faso	1.4	71.7	<0.1	0.7
Burundi	40.3	30.5	<0.1	0.2
Cabo Verde	11.0	121.8	3.4	11.6
Cameroon	4.0	75.7	0.07	4.6
Central African Republic	2.5	24.5	..	<0.1
Chad	6.7	39.7	0.1	0.2
Comoros	3.0	50.9	0.2	3.1
Congo, Dem. Rep.	7.1	53.5	0.0	0.0
Congo, Rep.	14.6	108.1	<0.1	0.4
Cote d'Ivoire	10.7	106.2	0.6	1.2
Djibouti	31.7	32.4	2.3	2.5
Egypt, Arab Rep.	18.9	114.3	3.7	7.6
Equatorial Guinea	1.0	66.4	0.5	1.9
Eritrea	2.9	6.4	0	1.0
Ethiopia	9.8	31.6	0.5	0.8

Table A3: ICT statistics, by country (cont.)

Gabon	15.6	171.4	0.6	1.1
Gambia, The	19.0	119.6	0.1	2.9
Ghana	1.7	114.8	0.3	1.0
Guinea	3.3	72.1	<0.1	0.0
Guinea-Bissau	43.4	63.5	0.1	0.3
Kenya	11.0	73.8	0.2	0.4
Lesotho	5.4	85.0	0.1	2.0
Liberia	17.8	73.3	0.1	0.2
Libya	3.7	161.1	1.0	11.3
Madagascar	5.8	41.2	0.1	1.1
Malawi	7.0	33.5	<0.1	0.4
Mali	10.7	149.1	<0.1	1.0
Mauritania	41.4	94.2	0.2	1.29
Mauritius	56.8	132.2	14.6	30.0
Morocco	5.9	131.7	3.0	7.4
Mozambique	14.8	69.8	0.1	0.3
Namibia	1.9	113.8	1.8	7.8
Niger	42.7	44.4	<0.1	0.6
Nigeria	10.6	77.84	<0.1	0.1
Rwanda	24.4	64.0	<0.1	0.4
Sao Tome and Principe	17.7	64.94	0.6	3.44
Senegal	54.3	98.8	0.71	2.1
Seychelles	2.1	162.2	12.7	22.7
Sierra Leone	1.6	76.7	..	0.3
Somalia	49.0	50.9	0.6	0.5
South Africa	15.9	149.2	3.2	6.9
South Sudan	24.6	24.5	0	0.0
Sudan	27.1	72.2	0.05	1.08
Swaziland	4.9	72.3	0.4	3.5
Tanzania	5.7	62.8	0.2	0.3
Togo	46.2	64.6	0.2	0.8
Tunisia	17.7	128.5	4.5	8.5
Uganda	17.3	52.4	0.3	0.8
Zambia	19.9	67.3	0.1	0.8
Zimbabwe	21.3	80.8	1.0	2.3
Sub-Saharan Africa	19.2	71.0	0.4	1.1
Africa	13.8	78.3	1.2	3.3
East Asia & Pacific (developing)	42.1	100.8	11.9	14.5
LAC (developing)	47.5	111.3	9.2	16.9
South Asia	16.6	75.4	1.3	2.2
Low & middle income countries	31.1	90.0	6.3	9.2
Bangladesh	9.6	80.0	1.9	0.6
Cambodia	9.0	132.7	0.4	2.3
Honduras	19.1	93.5	1.4	6.4
India	18.0	74.5	1.2	2.1
Kyrgyz Republic	28.3	134.5	4.2	7.9
Lao PDR	14.3	67.0	0.2	13.4
Moldova	46.6	108.0	14.7	35.2
Myanmar	2.1	54.0	0.3	1.0

Table A3: ICT statistics, by country (cont.)

Nicaragua	17.6	114.6	2.5	5.5
Pakistan	13.8	73.3	1.1	2.6
Uzbekistan	43.5	78.4	1.9	8.5
Vietnam	48.3	147.1	6.5	6.0
Comparator Average	22.5	96.5	3.0	7.6

Source: World Bank (2016)

Table A4: Electricity statistics, by country

Country	Access to electricity (% of population)	Access to electricity, rural (% of rural population)	Access to electricity, urban (% of urban population)	Electric power consumption (kWh per capita)
Algeria	100.0	100.0	100.0	1236.1
Angola	37.0	6.0	83.0	219.5
Benin	38.4	14.5	68.0	..
Botswana	53.2	23.9	71.0	1514.0
Burkina Faso	13.1	1.4	48.5	..
Burundi	6.5	1.2	58.5	..
Cabo Verde	70.6	46.7	84.3	..
Cameroon	53.7	18.5	87.5	260.8
Central African Republic	10.8	8.1	14.9	..
Chad	6.4	3.0	18.3	..
Comoros	69.3	61.4	85.1	..
Congo, Dem. Rep.	16.4	5.7	36.3	104.7
Congo, Rep.	41.6	11.7	58.9	222.1
Cote d'Ivoire	55.8	29.0	88.1	239.7
Djibouti	53.3	12.9	65.2	..
Egypt, Arab Rep.	100.0	100.0	100.0	1700.4
Equatorial Guinea	66.0	43.0	93.1	..
Eritrea	36.1	11.9	100.0	62.3
Ethiopia	26.6	7.5	100.0	57.5
Gabon	89.3	44.9	98.1	1094.5
Gambia, The	34.5	25.6	41.0	..
Ghana	64.1	40.9	84.9	348.2
Guinea	26.2	2.9	74.2	..
Guinea-Bissau	60.6	21.4	100.0	..
Kenya	23.0	6.7	58.2	156.8
Lesotho	20.6	10.1	46.9	..
Liberia	9.8	1.2	18.9	..
Libya	100.0	100.0	100.0	4386.5
Madagascar	15.4	8.1	60.7	..
Malawi	9.8	2.0	37.1	..
Mali	25.6	11.9	50.4	..
Mauritania	21.8	4.3	46.0	..
Mauritius	100.0	100.0	100.0	2075.0
Morocco	100.0	100.0	100.0	875.2
Mozambique	20.2	5.4	54.5	444.4
Namibia	47.3	17.3	94.1	1590.6
Niger	14.4	5.2	61.8	49.8
Nigeria	55.6	34.4	83.6	155.8
Rwanda	18.0	7.7	61.5	..
Sao Tome and Principe	60.5	46.9	68.3	..

Table A4: Electricity statistics, by country (cont.)

Senegal	56.5	26.6	87.8	209.6
Seychelles	100.0	17.2	100.0	..
Sierra Leone	14.2	1.2	46.5	..
Somalia	32.7	17.2	57.7	..
South Africa	85.4	66.8	96.6	4407.0
South Sudan	5.1	3.4	12.3	38.2
Sudan	32.6	17.7	62.1	156.9
Swaziland	42.0	24.4	100.0	..
Tanzania	15.3	3.6	46.4	94.6
Togo	31.5	8.8	67.6	145.0
Tunisia	100.0	100.0	100.0	1417.9
Uganda	18.2	8.1	71.2	..
Zambia	22.1	5.7	46.9	717.3
Zimbabwe	40.5	16.0	78.5	561.8
Sub-Saharan Africa	35.3	15.3	71.6	496.4
Africa	43.8	26.3	69.9	846.3
East Asia & Pacific (developing)	95.7	92.8	98.5	2719.7
LAC (developing)	95.8	86.2	98.9	1849.1
South Asia	78.0	69.3	97.5	640.1
Low & middle income countries	81.0	69.2	95.1	1665.6
Bangladesh	59.6	49.3	90.2	275.7
Cambodia	31.1	18.8	91.3	206.5
Honduras	82.2	65.8	96.9	711.08
India	78.7	69.6	98.2	724.5
Kyrgyz Republic	100.0	100.0	99.8	1809.1
Lao PDR	70.0	54.7	97.9	..
Moldova	100.0	100.0	100.0	1514.5
Myanmar	52.4	31.1	95.0	152.6
Nicaragua	77.9	42.7	100.0	579.5
Pakistan	93.6	90.5	99.8	451.7
Uzbekistan	100.0	100.0	100.0	1610.7
Vietnam	99.0	97.6	100.0	1243.4
Comparator Average	78.7	68.4	97.4	843.6

Source: World Bank (2016)

Table A5: Water and sanitation statistics, by country

Country	Improved water source (% of population with access)	Improved water source, rural (% of rural population with access)	Improved water source, urban (% of urban population with access)	Improved sanitation facilities (% of population with access)	Improved sanitation facilities, rural (% of rural population with access)	Improved sanitation facilities, urban (% of urban population with access)
Algeria	84.0	81.9	84.9	87.4	81.5	89.9
Angola	48.6	28.2	75.4	51.1	22.5	88.6
Benin	77.8	72.1	85.2	19.6	7.3	35.6
Botswana	96.2	92.3	99.2	63.3	43.1	78.5
Burkina Faso	82.1	75.8	97.5	19.4	6.7	50.4
Burundi	75.8	73.8	91.1	48	48.6	43.8
Cabo Verde	91.7	87.3	94.0	72.0	54.3	81.6
Cameroon	75.4	52.7	94.8	45.6	26.8	61.8
Cent. Afr. Rep.	68.4	54.4	89.6	21.7	7.2	43.6

Table A5: Water and sanitation statistics, by country (cont.)

Chad	50.8	44.8	71.8	12.0	6.5	31.4
Comoros	90.1	89.1	92.6	35.8	30.9	48.3
Congo, Dem. Rep.	52.1	30.9	81.3	28.3	28.1	28.6
Congo, Rep.	76.3	40.0	95.8	14.9	5.6	20.0
Cote d'Ivoire	81.8	68.8	93.1	22.3	10.3	32.8
Djibouti	90.0	64.7	97.4	47.4	5.1	59.8
Egypt, Arab Rep.	99.2	98.7	100.0	94.7	93.1	96.8
Equatorial Guinea	47.8	31.5	72.5	74.5	71.0	79.9
Eritrea	57.7	53.3	73.2	15.6	7.3	44.5
Ethiopia	55.4	46.7	92.7	26.8	26.7	26.9
Gabon	93.2	66.7	97.2	41.8	31.5	43.4
Gambia, The	90.2	84.4	94.2	58.8	55.0	61.5
Ghana	87.6	82.2	92.3	14.8	8.6	20.2
Guinea	76.7	67.4	92.7	20.0	11.8	34.1
Guinea-Bissau	77.4	59.1	96.7	20.7	8.5	33.5
Kenya	63.1	56.8	81.6	30.1	29.7	31.2
Lesotho	81.6	76.9	94.5	30.2	27.6	37.3
Liberia	74.7	61.9	87.8	16.6	5.8	27.8
Libya	..	..	..	96.6	95.7	96.8
Madagascar	50.6	34.5	81.2	11.9	8.7	17.9
Malawi	88.4	87.0	95.5	40.6	39.3	47.3
Mali	75.0	62.3	94.8	24.2	15.8	37.3
Mauritania	57.9	57.1	58.4	39.7	13.8	57.5
Mauritius	99.9	99.8	99.9	93.2	92.6	93.9
Morocco	85.3	65.3	98.7	76.6	65.5	84.1
Mozambique	50.9	37.0	80.6	20.4	10.1	42.4
Namibia	90.3	83.6	98.2	34.0	16.6	54.7
Niger	58.1	48.6	100.0	10.8	4.6	37.9
Nigeria	67.6	56.0	80.6	29.3	25.9	33.0
Rwanda	75.5	71.3	86.5	60.8	61.7	58.7
Sao Tome and Principe	97.1	93.6	98.9	34.6	23.3	40.8
Senegal	77.8	66.3	92.8	47.1	33.3	65.1
Seychelles	95.7	95.7	95.7	98.4	98.4	98.4
Sierra Leone	61.6	46.7	84.3	13.1	6.8	22.8
Somalia	..	..	..	..	..	..
South Africa	92.8	80.7	99.5	65.8	59.5	69.3
South Sudan	58.7	56.9	66.7	6.7	4.5	16.4
Sudan	55.5	50.2	66.0	23.6	13.4	43.9
Swaziland	74.1	68.9	93.6	57.5	56.0	63.1
Tanzania	55.5	45.5	77.8	15.0	8.2	30.3
Togo	62.4	43.8	90.9	11.6	3.1	24.6
Tunisia	97.7	93.2	100.0	91.6	79.8	97.4
Uganda	78.9	75.8	95.5	19.0	17.3	28.5
Zambia	64.6	50.2	85.7	43.7	35.4	55.8
Zimbabwe	77.1	67.5	97.1	37.0	31.0	49.4
SSA	66.5	55.0	85.9	29.7	23.3	40.2
Africa	74.9	65.0	89.2	40.3	31.7	50.9
EAP (developing)	93.0	88.9	96.8	74.9	63.6	84.9
LAC (developing)	94.1	83.0	97.3	80.6	61.9	85.9
South Asia	92.3	90.8	95.4	44.8	35.1	64.6
Low & middle income countries	88.6	82.8	95.1	60.8	46.7	76.3

Table A4: Water and sanitation statistics, by country (cont.)

Bangladesh	86.2	86.1	86.3	60.6	62.1	57.7
Cambodia	73.4	67.1	97.8	42.4	30.5	88.1
Honduras	90.6	82.8	97.2	82.6	77.7	86.7
India	94.1	92.6	97.1	39.6	28.5	62.6
Kyrgyz Republic	89.2	85.1	96.7	93.3	95.6	89.1
Lao PDR	75.5	69.4	85.6	70.9	56.0	94.5
Moldova	88.4	81.4	96.9	76.4	67.1	87.8
Myanmar	80.5	74.4	92.7	79.6	77.1	84.3
Nicaragua	86.9	69.4	99.3	67.9	55.7	76.5
Pakistan	91.3	89.6	94.0	63.5	51.1	83.1
Uzbekistan	..	..	98.5	100.0	100.0	100.0
Vietnam	96.4	95.2	98.7	78.0	69.7	94.4
Comparator Average	86.6	81.2	95.1	71.2	64.3	83.7

Source: World Bank (2016)

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