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Nigeria's Infrastructure

A Continental Perspective

Vivien Foster
Nataliya Pushak

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Abstract

Infrastructure made a net contribution of around one percentage point to Nigeria's improved per capita growth performance in recent years, in spite of the fact that unreliable power supplies held growth back. Raising the country's infrastructure endowment to that of the region's middle-income countries could boost annual growth by around 4 percentage points.

Among its African peers, Nigeria has relatively advanced power, road, rail, and ICT networks that cover the national territory quite extensively. Extensive reforms are ongoing in the power, ports, ICT, and domestic air transport sectors.

But challenges persist. The power sector's operational efficiency and cost recovery has been among the worst in Africa, supplying about half of what is required, with subsequent social costs of about 3.7 percent of GDP. The water and sanitation sector has inefficient operations, with low and declining levels of piped water coverage. Irrigation development is also low relative to the country's substantial potential. In the transport sector, Nigeria's road networks are in poor condition from lack of maintenance, and the country has a poor record on air transport safety.

Addressing Nigeria's infrastructure challenges will require sustained expenditure of almost $14.2 billion per year over the next decade, or about 12 percent of GDP. Nigeria already spends about $5.9 billion. It is well placed to raise the funds needed for infrastructure, given the strength of the national economy, abundant oil revenues, and efforts at electricity cost recovery and other improvements to operations and management.

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Nigeria's Infrastructure: A Continental Perspective

Vivien Foster and Nataliya Pushak

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Synopsis

Infrastructure has made a net contribution of around 1 percentage point to Nigeria's improved per capita growth performance in recent years, in spite of the fact that unreliable power supply held growth back. Raising the country's infrastructure endowment to that of the region's middle-income countries could boost annual growth by around 4 percentage points.

Nigeria has made important strides toward improving much of its infrastructure. Compared to many African peers, Nigeria has relatively advanced power, road, rail, and information and communications technology (ICT) networks that cover extensive areas of the nation's territory. In recent years, Nigeria has conducted several important infrastructure sector reforms. The ports sector has been converted to a landlord model, and terminal concessions now attract private investment on a scale unprecedented for Africa. The power sector is undergoing a restructuring, paving the way for performance improvements; the sector is finally on a path toward raising tariffs to recover a larger share of costs. Bold liberalization measures in the ICT sector have resulted in widespread, low-cost mobile services, Africa's most vibrant fixed-line sector, and major private investments in the development of a national fiber-optic backbone. A burgeoning domestic air transport sector has emerged, with strong private carriers that have rapidly attained regional significance.

But worrisome challenges persist in a number of areas, and loom the largest in the power sector. Inoperative generation capacity and lack of investment mean that the country has been able to meet only about half of its power demand. This, in turn, has resulted in an extremely unreliable supply; social costs can be conservatively estimated at 3.7 percent of gross domestic product (GDP). Meanwhile, the sector is hemorrhaging resources: historically, power users have been charged a fraction of the true cost of production, and the utility's operational efficiency is among the worst in Africa. On a promising note, recent tariff and institutional reforms in the power sector have helped to significantly reduce hidden costs, saving about $1.3 billion (or 1.8 percent of GDP) per year. Notwithstanding this important gain, however, the hidden costs of Nigeria's power sector remain the highest in West Africa.

Less visible, but also disturbing, is the water and sanitation sector's lack of development, compared to other services. Piped water coverage is only a fraction of the nation's electrification rate, and access has been declining steeply in recent years, even as the practice of open defecation continues to rise. Moreover, water utilities appear no more efficient than the power utility. Irrigation development also remains low relative to the country's substantial potential. Last but not least, Nigeria's road networks are in relatively poor condition, testifying that assets are not being adequately maintained. The country's poor air transport safety record is reason for further concern.

Addressing Nigeria's infrastructure challenges will require sustained expenditure of almost $14.2 billion per year over the next decade, or about 12 percent of GDP. (As a point of comparison, China spent about 15 percent of GDP on just infrastructure *investment* in the mid-2000s.) About $10.5 billion is needed for federal infrastructure alone, most of it for capital spending and power.

Nigeria already spends $5.9 billion per year on federal infrastructure, equivalent to about 5 percent of GDP. Existing spending patterns are heavily skewed toward investment, with little provision for

operations and maintenance. (Information on the infrastructure spending of subnational governments was not available, and so could not be assessed.) A further $2.5 billion a year is being lost at the federal level due to inefficiencies of various kinds, most of them associated with the power sector. The underpricing of electricity is by far the single-largest source of inefficiency, even though cost-recovery tariffs would be affordable for the majority of the population. Low capital budget execution is also an issue across the infrastructure sector.

When spending needs are set against current spending—and potential efficiency gains—an annual funding gap of $3.6 billion per year, or around 3 percent of GDP, is revealed. With its abundant oil revenues, Nigeria is relatively well placed to raise additional public finance for infrastructure. Given the size of the economy, more could also be done to leverage domestic capital markets, and there is scope to build on the comparative success of public-private partnerships. Nigeria has also attracted much interest from financiers outside the Organisation for Economic Co-operation and Development (non-OECD), notably China.

In sum, Nigeria's infrastructure challenges, though substantial, are not daunting given the strength of the national economy. While recent policy measures suggest that the government is taking these challenges seriously, more remains to be done. The associated growth dividend is well worth pursuing.

A continental perspective

The Africa Infrastructure Country Diagnostic (AICD) has gathered and analyzed extensive data on infrastructure in more than 40 Sub-Saharan countries, including Nigeria. The results have been presented in reports covering different areas of infrastructure (ICT, irrigation, power, transport, water and sanitation) and policy (including investment needs, fiscal costs, and sector performance).

This report presents key AICD findings for Nigeria, with the aim of benchmarking the country's infrastructure conditions against those of its African peers. Two peer groups are considered in the analysis of Nigeria's performance: (i) resource-rich, low-income countries and (ii) middle-income countries. Where possible and relevant, Nigeria's performance is compared with that of countries in other developing regions, such as Asia. Detailed comparisons will also be made with immediate neighbors in the Economic Community of West African States (ECOWAS).

Several methodological issues should be borne in mind. First, because of the cross-country nature of data collection, a time lag is inevitable. The period covered by the AICD runs from 2001 to 2006. Most technical data presented are for 2006 (or the most recent year available), while financial data are typically averaged over the available period to smooth out the effects of short-term fluctuations. Second, when making comparisons across countries, we had to standardize the indicators and analyses to ensure their correspondence. This means that some of the indicators presented here may be slightly different from those that are routinely reported and discussed at the country level.

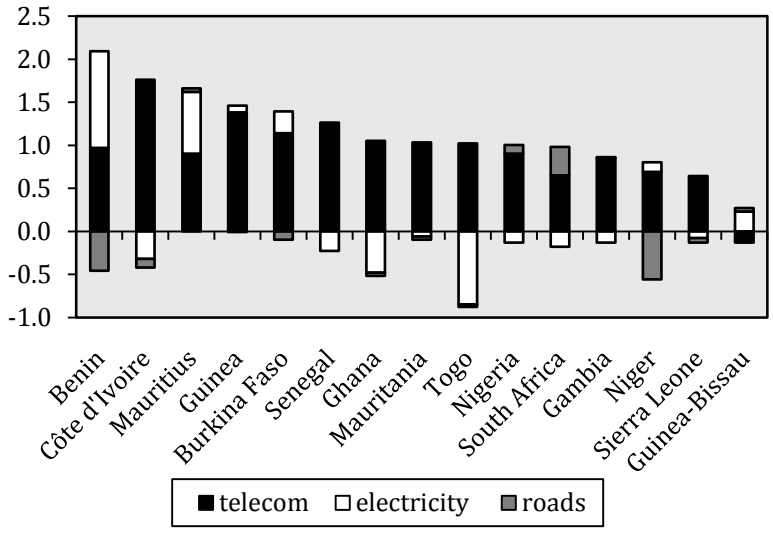
Why infrastructure matters

As in the rest of the continent, West Africa's growth performance improved markedly between the 1990s and 2000s. The overall improvement in per capita growth rates has been estimated at just under 2 percentage points, of which 1.1 percent is attributable to better structural policies and 0.9 percent to improved infrastructure. During the decade 1998–2008, Nigeria's economy grew at an average annual rate of over 5 percent. Improvements in infrastructure added 1 percentage point to Nigeria's *per capita* growth rate for the period 2003 to 2007 (figure 1a). Interestingly, the impact was not as large as in neighboring West African countries such as Benin, Côte d'Ivoire, and Senegal. We should note that the boost to Nigeria's growth came almost exclusively from the ICT revolution. Meanwhile, Nigeria's power sector held the per capita growth rate back by 0.13 percentage points over the same period.

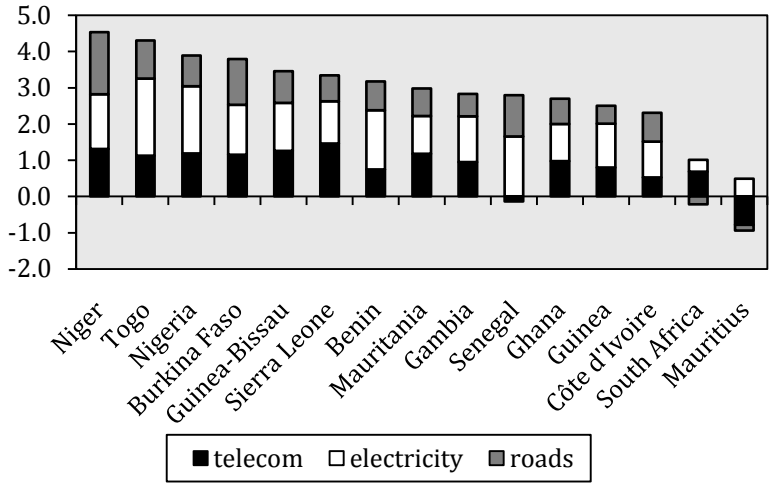
Raising Nigeria's infrastructure to the level of the African leader, Mauritius, would boost annual per capita growth rates by 4 percentage points, according to simulations. About half of this potential impact is associated with improvements in the power sector, which would contribute as much as 2 percentage points to the per capita growth rate (figure 1b). Overall, evidence from enterprise surveys suggests that infrastructure constraints are responsible for about 40 percent of the productivity handicap faced by African firms.

Figure 1. Infrastructure has contributed much to economic growth—but could contribute more

a. Infrastructure's contribution to annual per capita economic growth in select countries, 2003–07, in percentage points



b. Potential contribution of infrastructure to annual per capita economic growth in select countries, in percentage points



Source: Calderón 2009.

The state of Nigeria's infrastructure

The spatial distribution of Nigeria's economy shows marked differences between north and south. The south is characterized by relatively high population density, and this is where many of the country's cities and larger towns are clustered (figure 2a, b). Meanwhile, there is an important concentration of both population and agricultural activity in the north of the country (figure 2a, c). What is particularly striking is how rapidly the incidence of poverty rises with distance from the coast. While poverty rates in the coastal states are typically under 40 percent, they rise above 70 percent in many parts of central Nigeria and particularly in the far north (figure 2b). Relative to other African countries, the development of agriculture is pronounced: there are relatively few areas of agricultural potential that are not already being tapped (figure 2d). This is true across the national territory and is particularly so in the north. The bulk of the national territory lies squarely in the Niger River basin, which is shared by a number of neighboring countries (figure 2c).

Although Nigeria's infrastructure networks mirror the spatial concentration of economic activity in the south, the country (unlike some of its neighbors) has developed infrastructure backbones that are national in reach (figures 3a–d). Few areas remain unconnected to national backbones, and those few are generally concentrated in the central west and east of the country (figures 3a–d). That said, road network conditions are quite patchy, adversely affecting national connectivity. The conditions of many key routes alternate between good, fair, and poor across different sections (figure 3a). The national power transmission network is national; almost all major generation assets are on the interconnected system. While the global system for mobile communications (GSM) coverage is widespread, coverage gaps are more prevalent in the northern part of the country (figure 3c). Despite high levels of agricultural activity, irrigated areas are very limited and mainly flank river corridors, particularly in the north and northeast (figure 3d).

In terms of regional integration, the picture is mixed. Nigeria is connected to the South Atlantic 3 (SAT-3), MAIN-1, and Glo-1 submarine cables skirting the west coast of Africa, but lacks fiber-optic land links with its neighbors (figure 3c). There are five points where Nigeria's national road network intersects with the regional one: the east-west coastal routes and a handful of corridors to the landlocked hinterland. As far as power is concerned, there is the longstanding interconnector with Niger, to the north; there are plans to interconnect with Benin and Niger in the context of the West Africa Power Pool (WAPP); but there is no interconnection with Cameroon, to the east. The West Africa Gas Pipeline links Ghana to Nigeria and allows the export of gas for power generation.

Table 1. Achievements and challenges in Nigeria's infrastructure sectors

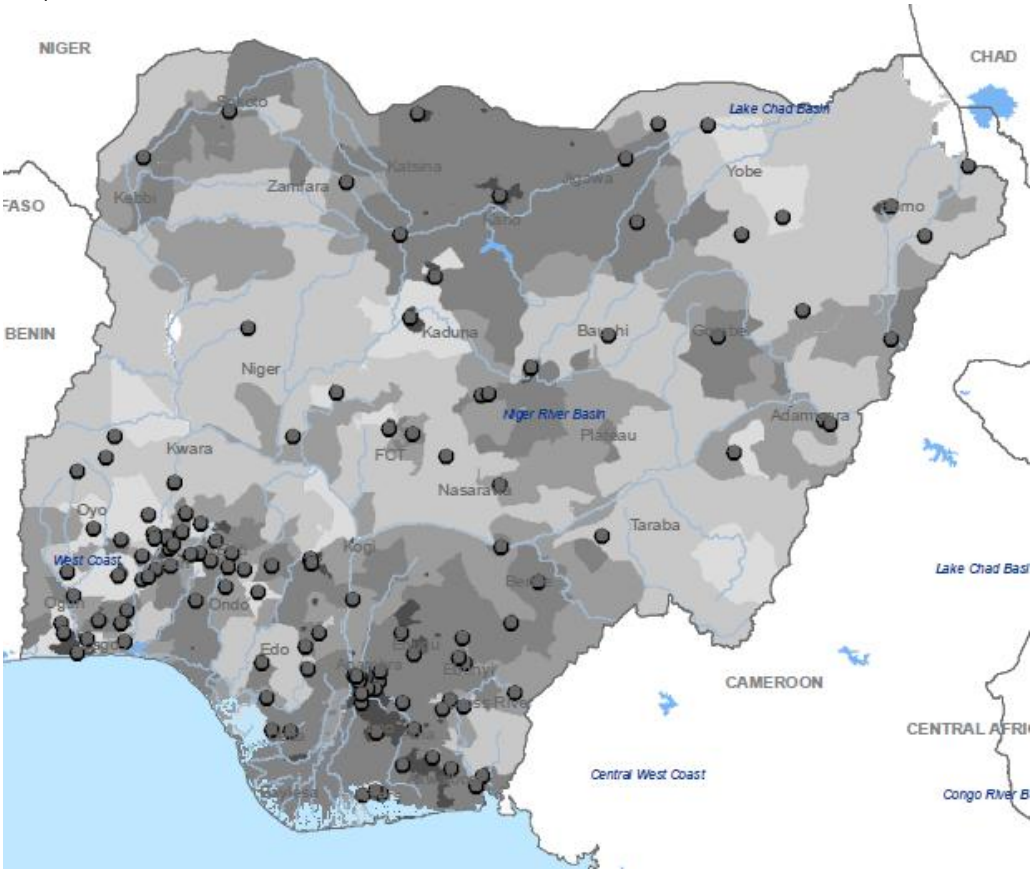
	Achievements	Challenges
Air transport	Recent expansion of domestic market Emergence of important regional carriers New routes to Europe and the United States Significant improvements in safety oversight	Developing potential as regional air transport hub Concessioning of airport terminals
ICT	Extensive low-cost GSM coverage Vibrant competitive fixed-line sector Extensive private fiber-optic backbones	Increasing penetration of ICT services Reducing cost of Internet services Addressing market-efficiency gap
Ports	Adoption of modern landlord model Award of numerous concessions	Improving customs performance Improving land and marine access Planning for new capacity additions
Power	High rates of electrification Sector restructuring and tariff hikes in progress	Investing to improve service reliability Addressing huge sector inefficiencies
Railways	Extensive national rail network	Improving performance to recapture traffic
Roads	Extensive national road network	Increasing funding for road maintenance Improving rural access
Water resources	Progress on institutional framework	Developing huge high-return irrigation potential
Water and sanitation		Improving access to improved water services Reversing growth in open defecation Addressing utilities' huge inefficiencies Paying greater policy attention to wells and boreholes Improving quality of traditional latrines

Source: Authors' elaboration of AICD findings.
Note: ICT = information and communications technology; GSM = global system for mobile communications.

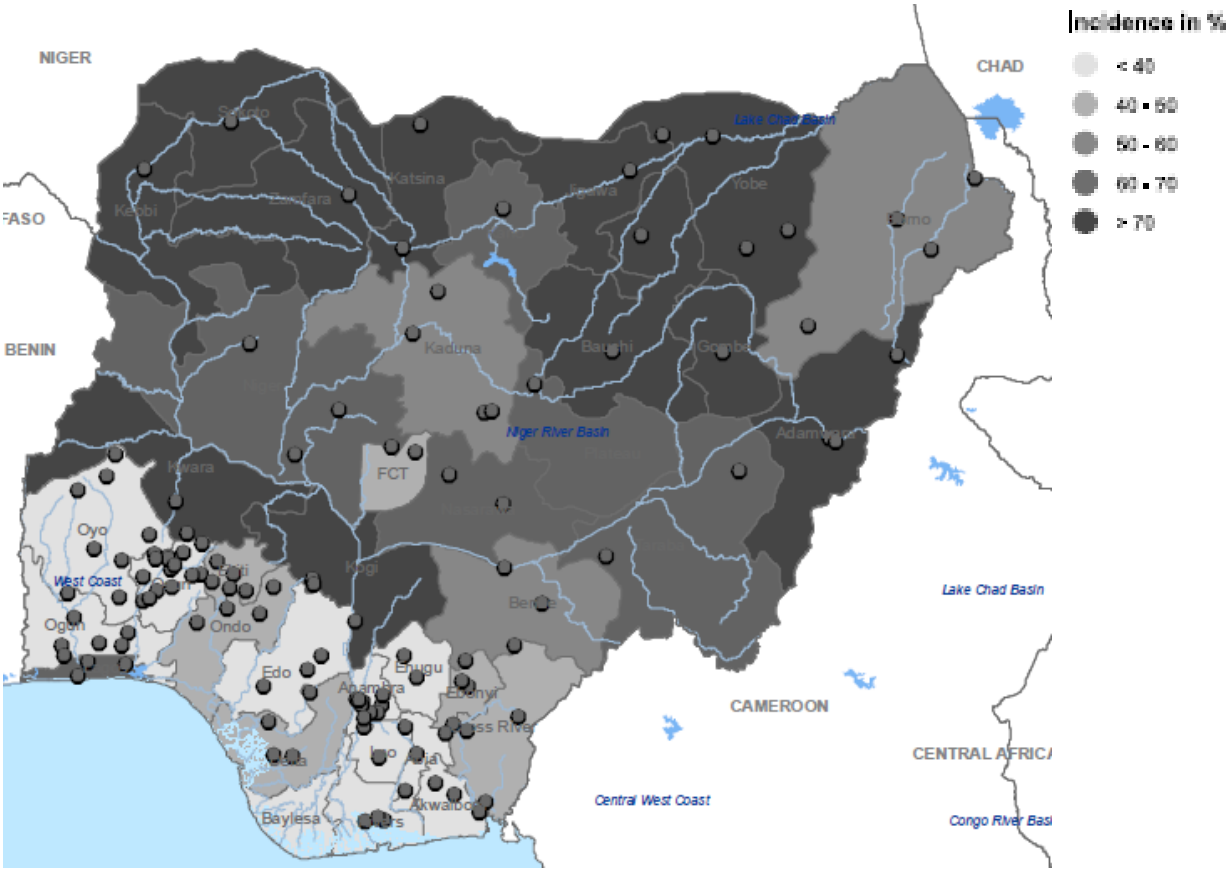
In this report we begin by reviewing the main achievements and challenges in each of Nigeria's major infrastructure sectors (key findings are summarized in table 1). Thereafter, attention will turn to the problem of financing Nigeria's outstanding infrastructure needs.

Figure 2. Nigeria's population density tracks agricultural activity in the north and south, with wealth concentrated near the urbanized coastal strip

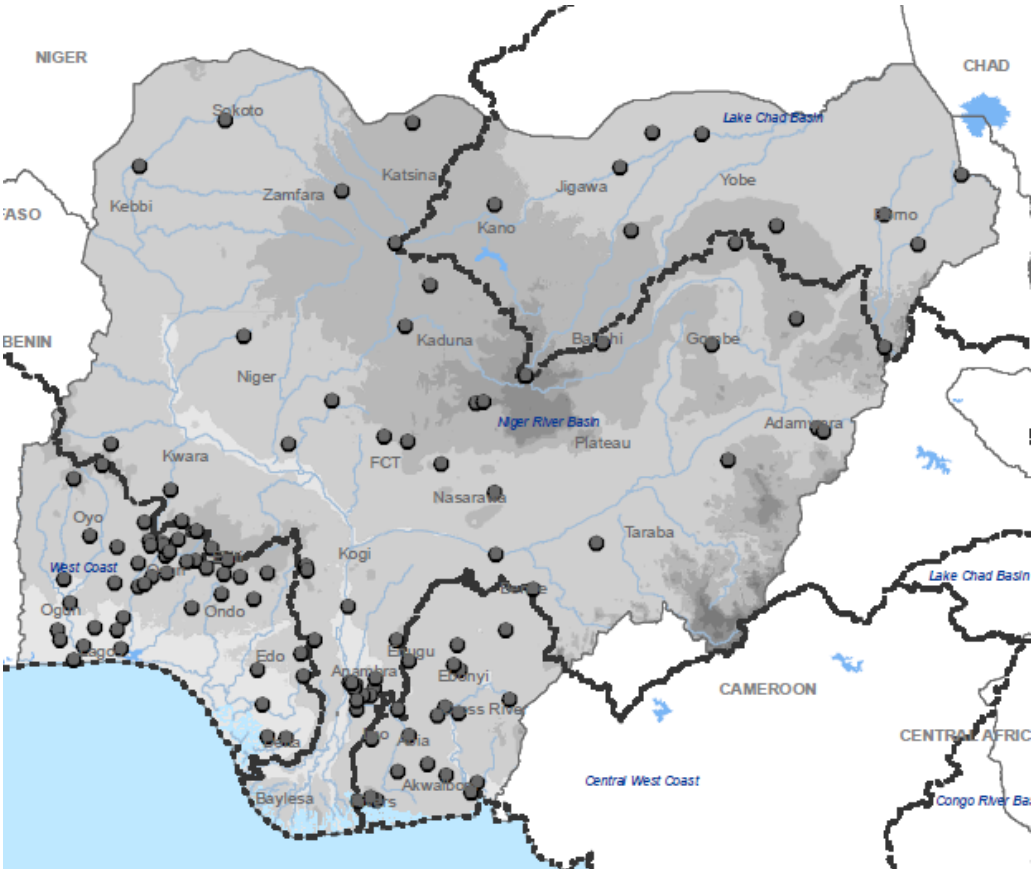
a. Population



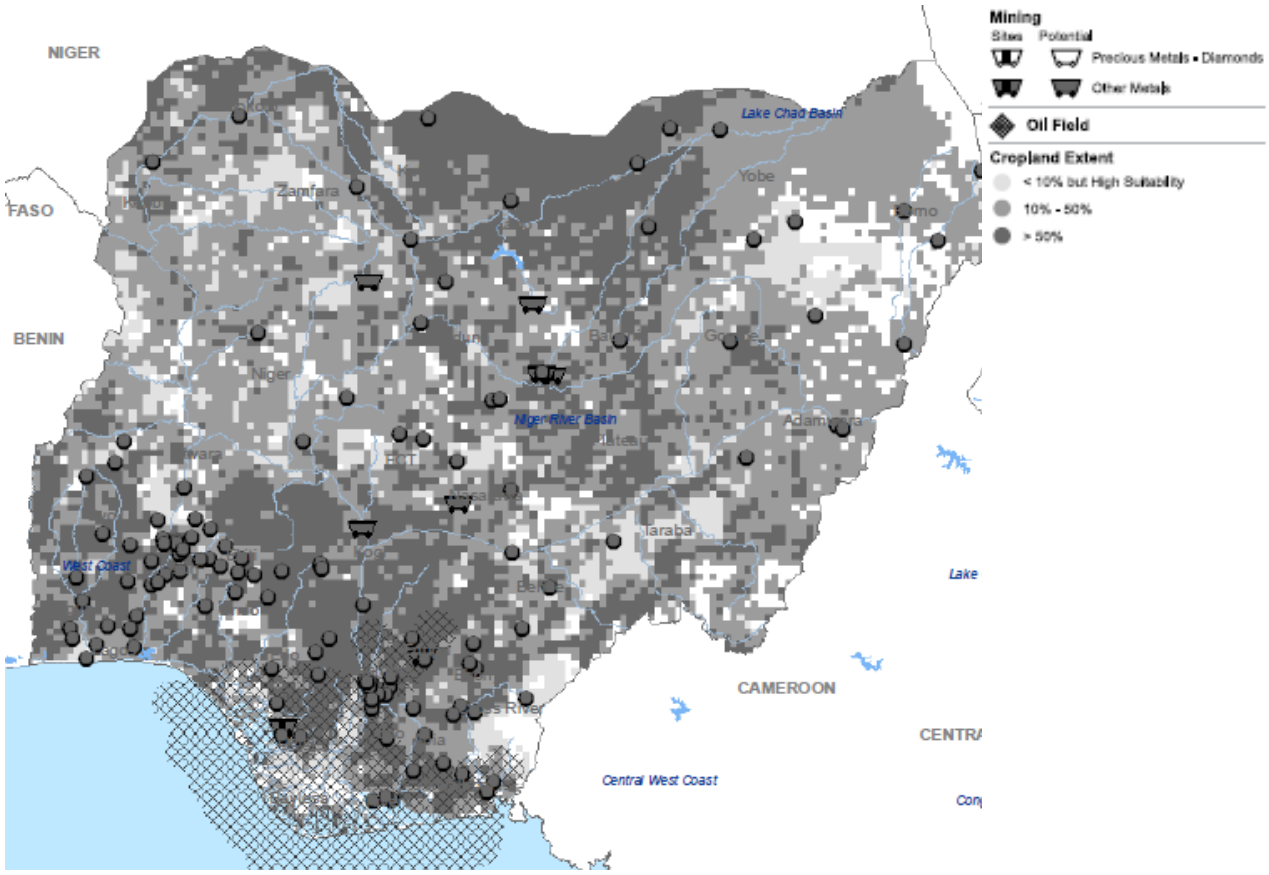
b. Poverty


Incidence in %
< 40
40 - 50
50 - 60
60 - 70
> 70
NIGER
CHAD
BENIN
CAMEROON
Lake Chad Basin
Niger River Basin
West Coast
Central West Coast
Katsina
Yobe
Kaduna
FCT
Oyo
Ogun
Ondo
Edo
Baylesa
Akwa Ibom
Cross River
Lake Chad Basin
Congo River Basi

c. Topography



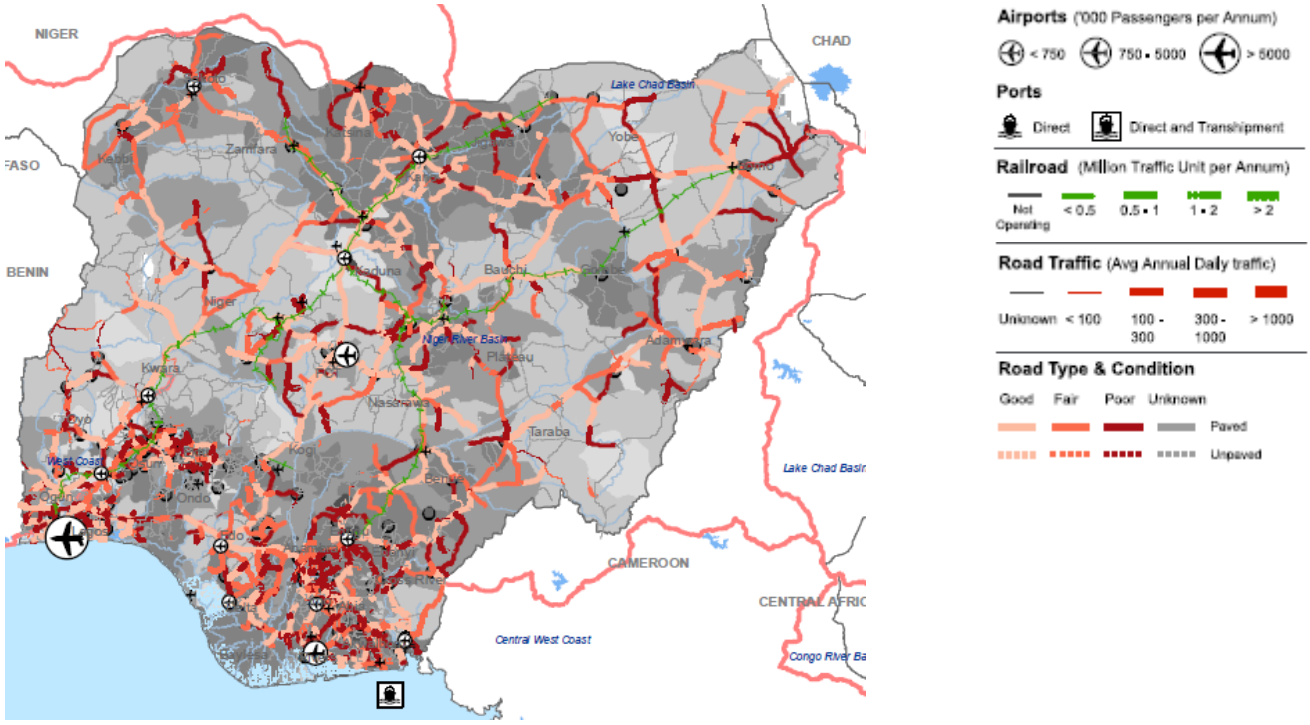
d. Natural resources



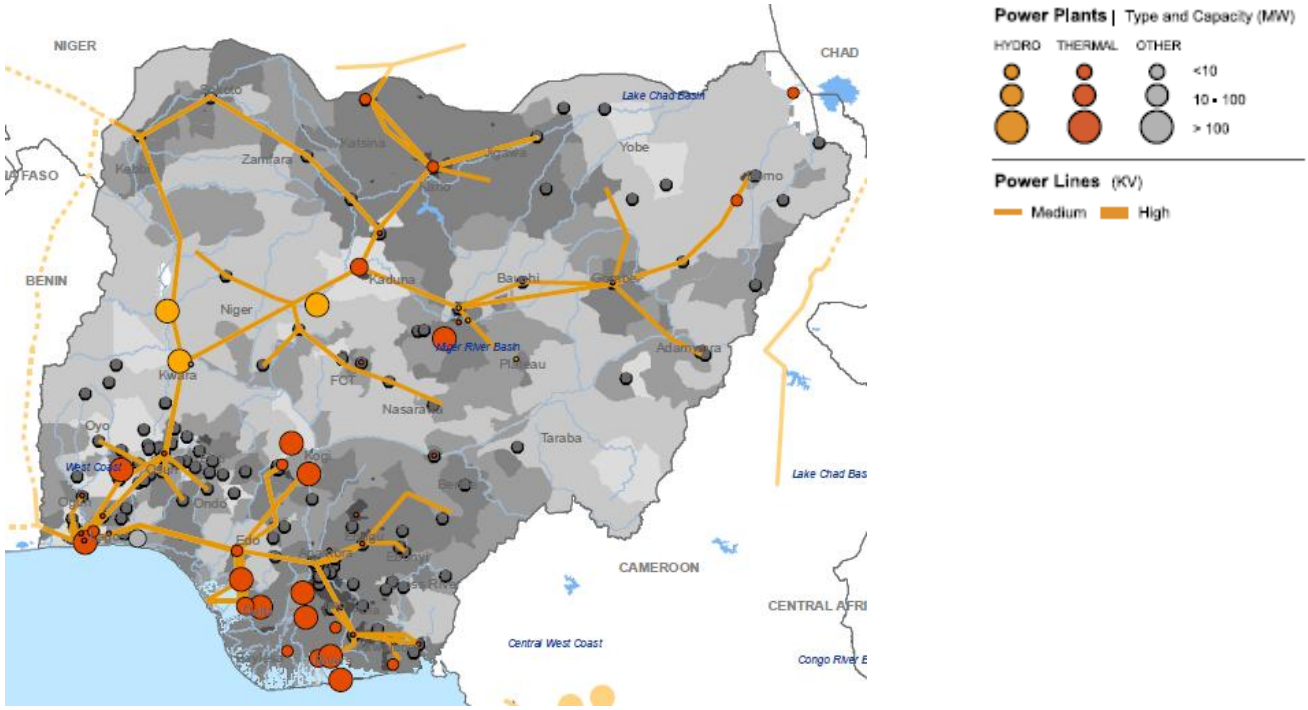
Source: AICD Interactive Infrastructure Atlas for Ghana (http://www.infrastructureafrica.org/aicd/system/files/gha_new_ALL.pdf).

Figure 3. Nigeria's infrastructure networks cover its national territory extensively

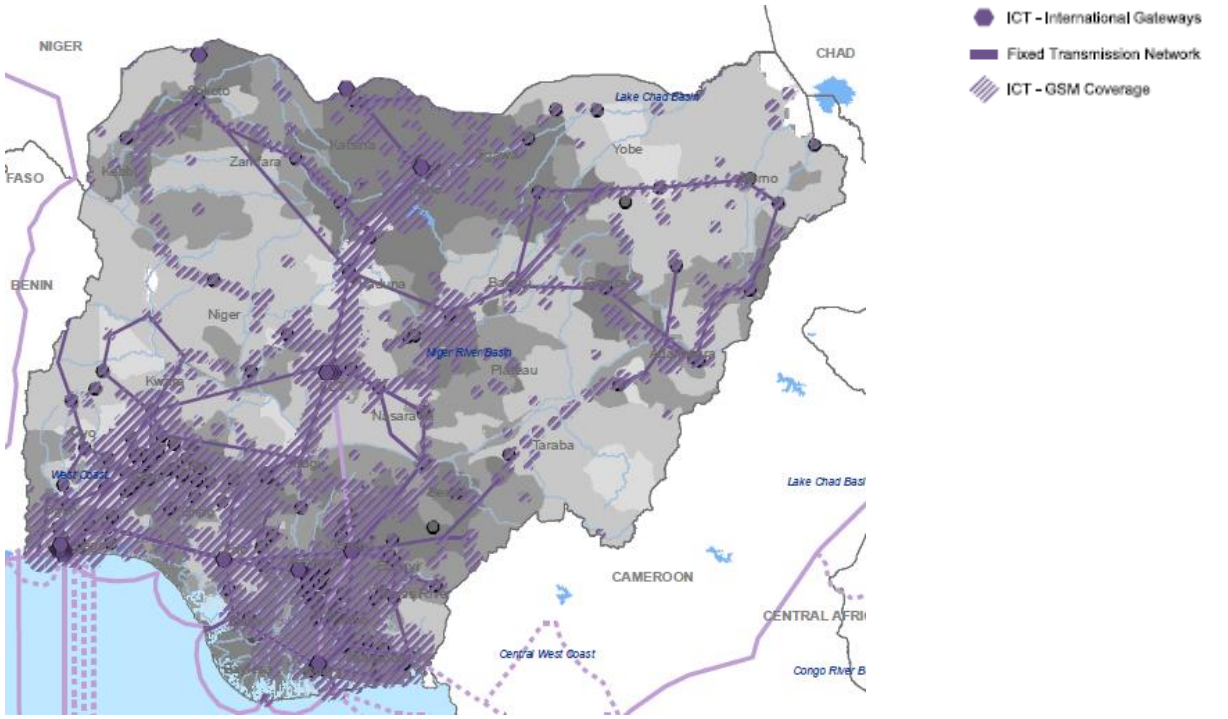
a. Roads



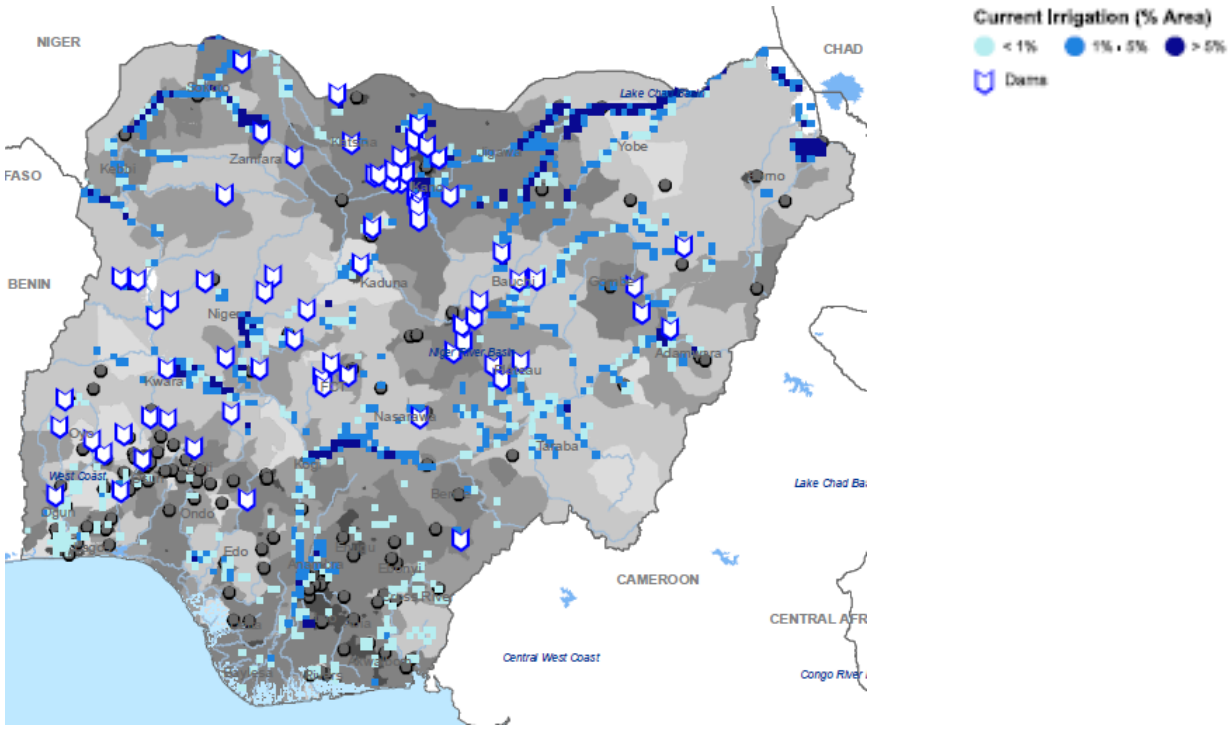
b. Power



c. ICT



d. Water



Source: AICD Interactive Infrastructure Atlas for Ghana (http://www.infrastructureafrica.org/aicd/system/files/gha_new_ALL.pdf).
Note: ICT = information and communications technology.

Roads

Achievements

Nigeria has developed an extensive national road network. Both paved and unpaved road network densities are more than twice as high as those for the peer group of resource-rich African countries, although still only half of the levels found in Africa's middle-income countries. Traffic volumes on Nigeria's paved and unpaved networks are also relatively high compared with those of similar countries, and indicate that networks are being utilized.

Table 2. Nigeria's road indicators benchmarked against Africa's low- and middle-income countries, 2006

	Unit	Resource-rich countries	**Nigeria**	Middle-income countries
Paved road density	km/1000 km^2 of arable land	59.1	**174.1**	318.4
Unpaved road density	km/1000 km^2 of arable land	38.0	**94.2**	278.4
GIS rural accessibility	% of rural population within 2 km of all-season road	26.0	**19.7**	31.5
Paved road traffic	Average annual daily traffic	1,408.2	**1,772.4**	2,558.3
Unpaved road traffic	Average annual daily traffic	24.7	**32.7**	74.7
Paved network condition	% in good or fair condition	67.9	**67.4**	82.0
Unpaved network condition	% in good or fair condition	61.4	**32.9**	57.6
Perceived transport quality	% firms identifying roads as major business constraint	30.2	**29.9**	18.2
Overengineering	% paved network with <300 vehicles per day	19.8	**4.8**	18.4
Underengineering	% unpaved network with >300 vehicles per day	9.3	**26.7**	20.0

Source: Gwillliam and others 2009. Derived from the AICD national database (http://www.infrastructureafrica.org/aicd/tools/data).
Note: GIS = geographic information system.

Challenges

Nigeria has established a federal road maintenance agency (FERMA) as a stopgap before undertaking more substantive sector reforms, but continues to rely on traditional budget allocations to fund road maintenance and rehabilitation. In recent years a substantial number of African countries have taken measures to establish road-user charges or fuel levies of various kinds. These feed into a ring-fenced road fund, with the aim of providing a stable source of revenue for road maintenance. In many cases, the establishment of a road fund has been accompanied by the creation of a road agency, an autonomous entity charged with the implementation of road maintenance and rehabilitation works. In Nigeria's case, FERMA is responsible for the federal (or primary) network, but continues to rely on general budget resources for the funding of road maintenance. Its governance structures and procedures (human resource management, operational decision making, and so on) are still overshadowed by public service norms, presenting an obstacle to institutional independence, efficiency, and accountability. Considering these issues, the current arrangement would require review even if adequate funds for road maintenance were being secured through the budgetary process. Sadly, however, road maintenance remains underfunded.

Nigeria has been allocating ample resources to federal road rehabilitation, but does not appear to have reserved enough of these resources for preventive maintenance (figure 4). In the years between 2001 and 2006, Nigeria spent just over $700 million on the federal network per year. Network simulations indicate that a yearly budget of around $580 million should be adequate both to maintain the federal network and

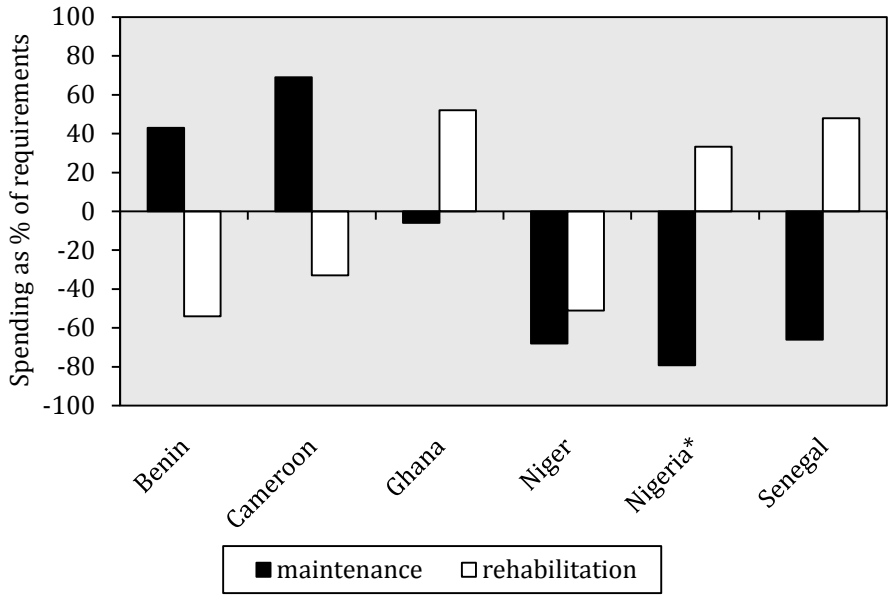
to complete pending rehabilitation works within a five-year horizon. Higher spending may simply indicate a more accelerated rehabilitation program, or relatively high unit costs; in any case, recent spending levels are nearing the right levels. The problem lies in the fact that only $50 million per year has been allocated to preventive maintenance, compared to a benchmark requirement of $240 million. The amount currently being allocated to maintenance is just about adequate for routine maintenance, but does not cover periodic, preventive activities. Thus, while the overall allocation is adequate, there appears to be a marked bias toward capital expenditure. This finding is borne out by the fact that only 75 percent of the federal network is in good or fair condition.

Problems of road maintenance are apparently much more severe at the subnational level. Road condition indicators for the entire national network are much worse than for the federal network (table 2). Only 67 percent of paved roads are in good or fair condition. Even more worrisome is the fact that only 33 percent of unpaved roads are in good or fair condition. These indicators are themselves evidence that maintenance activities are not being adequately funded or implemented at the subnational level. While it was not possible to collect data on subnational road maintenance expenditures, estimates suggest that the annual maintenance and rehabilitation requirement for the subnational network is around $500 million, or approximately the same as that for the federal network.

Rural accessibility remains a serious problem in Nigeria, with major repercussions for agricultural and rural development. As already noted, the country's unpaved roads are in particularly poor condition. Furthermore, there is evidence of substantial underengineering in the unpaved network, of which a quarter is above the economic traffic threshold usually used to justify the paving process (table 2). The evidence on rural access levels is somewhat conflicting. According to household survey evidence, about 47 percent of rural inhabitants live within 2 kilometers (km) of an all-season road. This is well above the average of around 34 percent for Sub-Saharan Africa, but still falls well short of the 67 percent average found in other developing countries. On the other hand, geographic information system (GIS) analysis suggests that only about 20 percent of rural Nigerians have access to an all-season road, a figure somewhat below the average for the peer group. (The survey and GIS analysis should not be expected to give consistent answers, each having its own limitations.) In any case, it is clear that Nigeria's rural road network falls well short of what is needed to service the rural economy.

Realistic extension of rural access will require strategic alignment of road and agricultural development policies. Nigeria's classified road network amounts to 85,000 km. To provide all-season road coverage to just 75 percent of the rural population would require the classified network to be extended by a further 20,000 km—a tall order. Nevertheless, if rural road development were to be closely aligned with agricultural priorities, a fully functional classified network of just 50,000 km would be adequate to provide connectivity to areas producing 80 percent of the country's agricultural output by value.

Figure 4. Nigeria's spending falls substantially short of maintenance needs, 2006



Source: Gwillliam and others 2009.
*Note:** Analysis of the adequacy of road-maintenance spending can be performed for only the primary network under federal jurisdiction.

Rail

Achievements

Nigeria has one of the most extensive national rail networks in Africa, second only to South Africa in length. Rail lines run to the northwest, northeast, southwest, and southeast of the country. Historically, Nigeria's railway was among the best in West Africa, but it has since fallen into neglect.

Challenges

Despite Nigeria's potentially significant demand for rail, traffic volumes have all but collapsed—much more so than in many other African countries. Nigeria's large population and economy create substantial demand for intercity passenger traffic as well as freight movements. But due to deficient performance and erratic service, traffic volumes have been on a long-term decline from 3 million tonnes in 1960 to 15,000 in 2005—equivalent to about five trucks per day. Similarly, passenger traffic has declined from 3 million to 500,000 passengers per year over the same period—equivalent to about 25 buses per day. As of today, traffic density—at only 15,000 tonnes per kilometer (tonne-kms)—is a tiny fraction of the already-low levels found on other African railways.

Table 3. Railway indicators for Nigeria and select countries, 2006

	NRC (Nigeria)	GRC (Ghana)	OCBN (Benin)	SITARAIL (Côte d'Ivoire—Burkina Faso)	TRANSRAIL (Senegal—Mali)	CAMRAIL (Cameroon)	SPOORNET (South Africa)
Concessioned (1)/ state run (0)	**1**	1	0	1	1	1	0
Traffic density, freight, 1,000 tonne-km/km	**15**	242	148	494	318	1,091	5,319
Efficiency							
Staff: 1,000 UT per staff	**37**	84	40	481		603	3,037
Coaches: 1,000 passenger-km per coach	**737**	416	900	862		4,738	596
Cars: 1,000 tonne-km per wagon	**59**	458	74	1,020	804	868	925
Locomotive availability in %	**13**	7	3	35	40	26	—
Tariffs							
Average unit tariff, freight, US cents/tonne-km	—	2.4	2.0	3.3	2.2	2.2	—
Average unit tariff, passenger, US cents/passenger-km	—	4.4	5.8	5.5	3.3	5.2	—

Source: Bullock 2009. Derived from the AICD rail operator database (http://www.infrastructureafrica.org/aicd/tools/data).
Note: UT = unit tariff.
— = Not available.

Ports

Achievements

Nigeria's port system has traditionally put a brake on economic development, due to poor performance and high costs. As of 2006, the performance parameters for Nigeria's major ports were very poor by global and even African standards (table 4). The global benchmark for container dwell time was around 7 days, compared with 30 to 40 days in major Nigerian ports at that time. Similarly, for truck cycle time, global best practice is on the order of one hour, compared with around one day in some of Nigeria's major ports. And for container crane productivity, the figure for Apapa in 2006 was 12 moves per hour compared to 25–30 moves internationally. Meanwhile, for general-cargo crane productivity, the figure was 8–9 tonnes per hour (tonnes/hr) for the major Nigerian ports compared to 30 tonnes/hr internationally.

Table 4. Benchmarking port indicators for Nigeria and select countries, 2006

	Apapa (Nigeria)	**Port Harcourt (Nigeria)**	**Onne (Nigeria)**	Abidjan (Côte d'Ivoire)	Cotonneou (Benin)	Tema (Ghana)	Dakar (Senegal)	Durban (South Africa)
Capacity								
Actual containers handled ('000sTEU/year)	**336**	**8**	**86**	500	158	420	331	1,899
Container-handling capacity ('000sTEU/year)	**500**	**—**	**100**	—	—	375	—	1,450
Actual general cargo handled ('000s tonnes/year)	**3,379**	**882**	**1,630**					
General-cargo-handling capacity (tonnes/year)	**5,000**	**2,000**	**4,000**	n.a.	2,500	8,500	—	—
Efficiency								
Average container dwell time in terminal (days)	**42**	**30**	**30**	12	12	25	7	4
Average truck-processing time for receipt and delivery of cargo (hours)	**6**	**24**	**24**	2.5	6	8	5	5
General cargo vessel preberth waiting time (hours)	**36**	**38**	**6**	2.9	48	9.6	24	—
General cargo vessel turnaround time (hours)	**—**	**46**	**38**	2.2	48	48	60	—
Average container crane productivity (containers loaded/unloaded per crane working hour)	**12**	**—**	**—**	18		13	—	15
Average general cargo crane productivity (tonnes loaded/unloaded per crane working hour)	**9**	**8**	**8**	16	15	13.5	—	25
Tariffs								
Average container-handling charge, ship to gate ($/TEU)	**155**	**—**	**145**	260	180	168	160	258
Average general-cargo-handling charge, ship to gate ($/tonne)	**8.0**	**8.0**	**6.5**	13.5	8.5	10.0	15.0	8.4
Average dry-bulk-handling charge, ship to gate or rail ($/tonne)	—	—	—	5.0	5.0	3.0	5.0	1.4
Average liquid-bulk-handling charge, ship to gate or rail ($/tonne)	**1.0**	**1.0**	**—**	—	—	1.5	4.0	—

Source: Ocean Shipping Consultants 2009. Derived from the AICD ports database (http://www.infrastructureafrica.org/aicd/tools/data).

Note: TEU = 20-foot equivalent unit.

— = Not available.

n.a. = Not applicable.

A comprehensive reform of the port sector began in the year 2000. It was designed to remove the major impediments to efficient operation and thereby facilitate streamlined import and export activities. Nigeria's port sector reform program was wide ranging, detailed, and implemented on a scale unprecedented for this sector in Africa. The reforms undertaken were well planned, for the most part well implemented, and placed the country's port system on a much more sound footing. They included a shift of management toward the landlord port model and the extensive award of private sector concessions for frontline cargo-handling facilities.

To fit the landlord model, the Nigerian Ports Authority (NPA) has been extensively restructured. This includes its decentralization into four new autonomous port authorities: Lagos, Calabar, Port Harcourt, and Delta. Under the new structure, the NPA's key functions were defined as planning and developing port infrastructure, facilitating the financing of new construction through build-operate-transfer (BOT)

arrangements, licensing private operators to provide port services, collecting port authority tariffs, and generally acting as a landlord on behalf of the federal government. Furthermore, extensive provisions were made for the retrenchment of human resources in case of overstaffing.

At the same time, a comprehensive program of concessions for key cargo terminals, including container-terminal facilities, was implemented. In all, 25 concessions were identified among the 11 ports under the NPA's control. The concessions awarded in 2005–06 have raised as much as $716 million for capital investment in the sector—more than half of the cumulative total of private port financing ever raised in Sub-Saharan Africa.

Challenges

Despite the important progress made by Nigeria's port sector reforms, a number of key challenges remain (see box 1 for the example of Apapa).

Box 1. Impact of reforms at Lagos's Apapa port

The Lagos port has long been notorious for inadequate facilities and congestion. As part of a broader program of port reform, in early 2006 the Nigerian Ports Authority (NPA) awarded a concession to APM Terminals to manage, operate, and develop the Apapa container terminal, increasing capacity from 220,000 TEUs per year to 1.6 million TEUs. Within months of the award of that concession, berthing space delays dwindled significantly, and shipping lines reduced their congestion surcharge from €525 to €75 per TEU, saving the Nigerian economy $200 million a year. By early 2009, new gantry cranes had been acquired to triple the original capacity.

But that was not the end of the story. Although the port's equipment was able to process more than 500 containers per day for customs examinations, the majority of containers were returned to stacking by the end of each day. By January 2009, the port was clogged by uncollected containers, and at the end of February, the head of the NPA announced a temporary suspension of ship entry with immediate effect, lasting until mid-April, to enable terminals to clear "alarming" backlogs. The controller of the Nigeria Customs Service for Apapa blamed the low clearance volume on the need to physically examine every container due to the high incidence of concealment and false declaration by importers.

But even cleared containers were not being collected. At the end of January, of the reported 9,741 containers waiting in the port for delivery to importers, 851 had been cleared by customs with all charges paid and documentation completed but had not been picked up by agents. The NPA consequently proposed introducing demurrage charges of 680 naira per TEU in a bid to force owners to move their containers out of the ports. In turn, however, many agents blamed a lack of trucks, arguing that the number needed to empty containers exceeded current supply. Although the moratorium on entry of new vessels was lifted in early March, some backlogs and delays and significant organizational and regulatory problems remained.

Source: Foster and Briceño-Garmendia 2009: chapter 12.
Note: TEU = 20-foot equivalent unit.

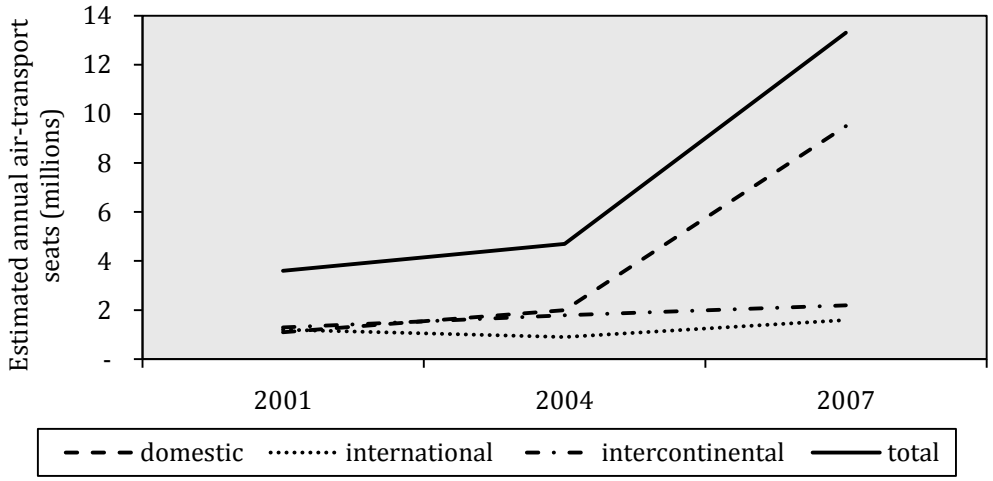
The reforms have not managed to circumvent some of the broader-based problems that negatively impact the port system, such as poor customs performance and corruption. For example, the Onne port actually had to close at one point due to the slow clearance of cargo by customs. There is also the need to improve both marine and landside access to port, as well as to plan for new capacity infrastructure (particularly at Lagos's Apapa port). In this context, there is a clear need for detailed long-term planning, to be headed by the NPA in its new landlord role. There have also been recent complaints about rising cargo-handling costs.

Air transport

Achievements

Nigeria's air transport market tripled in size between 2004 and 2007, largely due to the rapid expansion of domestic services. The number of seats serving the Nigerian market was almost stable, at around 4 million a year over the period 2001 to 2004, but mushroomed thereafter to reach over 12 million annually by 2007. This growth was driven almost entirely by a dramatic expansion in the domestic air transport market. Among its Sub-Saharan peers, the size of Nigeria's market is second only to South Africa. Moreover, with a Herfindahl index[1] of 18 percent, Nigeria's domestic air transport market is much more competitive than that of most other countries in the region.

Figure 5. Nigeria's domestic air traffic has mushroomed in recent years



Source: Gwillliam and others 2009.

Some of Nigeria's private carriers have also become major players regionally. As of 2001, the regional air transport market in West Africa was dominated by three carriers—Air Afrique, Ghana Airways, and SN Brussels—that together accounted for 54 percent of the market. Following the demise of Air Afrique and Ghana Airways, as well as Nigeria Airways itself, there was a major shift in the regional air transport market. Three new players—Air Senegal, Virgin Nigeria, and Bellview Airlines—have emerged, accounting for 44 percent of the regional market. Virgin Nigeria and Bellview Airlines were both privately owned registered operators that each held a roughly 11 percent share of the regional market. Virgin Nigeria's share continued to grow, until by 2007 it had over 50 percent of the seat capacity in the West African air transport market (taking both domestic and intraregional flights into account). But a major shift occurred when Bellview ceased operations in 2009, and Virgin decided to sell its 49 percent stake in Virgin Nigeria (the airline went on to rebrand itself as Air Nigeria in September 2009). In the meantime, Arik Air rapidly rose to prominence with a broadened domestic network and new destinations that include Johannesburg, London, and New York.

[1] The Herfindahl index, a measure of market concentration, is computed by summing the squares of the market share of each market participant.

Nigeria is one of the few countries in Africa whose safety standards support direct flights to the United States. In August 2010 Nigeria became one of the few countries in Sub-Saharan Africa (Cape Verde, Ethiopia, and South Africa) whose safety oversight is considered good enough for the United States to allow direct flights by Nigerian carriers from Nigeria to the United States. By passing the U.S. Federal Aviation Administration (FAA) International Aviation Safety Assessment (IASA) program audit, Nigeria proved itself after a deliberate and determined effort. A string of fatal accidents between 2005 and 2006 had prompted the government to demand all airlines in Nigeria to recapitalize and reregister themselves to obtain a valid operating certificate.

Challenges

While traffic has mushroomed, connectivity has remained largely unchanged, and remains limited within ECOWAS. As of 2007 Nigeria's network consisted of some 20 domestic city pairs and 50 international city pairs. In terms of intraregional connectivity within the ECOWAS, by far the best-served route is between Lagos and Accra, with 44 flights per week in 2010. Among domestic pairs, Abuja/Lagos registered 208 flights per week in 2010. Thereafter, connectivity drops off markedly: both Bamako/Abidjan and Accra/Abidjan registered 17 flights per week. No other regional destination comes close to having a daily service, which is striking given that Nigeria is a major regional player.

Lagos has not yet assumed its place as an air transport hub for the region. On the eastern and southern side of the continent, a strong hub-and-spoke structure has developed around Johannesburg, Nairobi, and Addis Ababa. By contrast, a functioning hub system is conspicuously absent in West Africa. Due to its size and location, an airport such as Lagos has the potential to play such a role, one that it has not yet fulfilled, mainly because the Federal Airport Authority of Nigeria has not been reformed and has not been allowed to proceed with the private sector concessioning of key airport terminals in dire need of investment, such as Lagos International Terminal II.

Intense competition may herald further industry consolidation. Nigeria's aviation industry now boasts the most modern aircraft fleet in the region and has the only regional carrier offering wide-body aircraft services (for example, Arik's Airbus A340 and 330). Meanwhile, a rapid increase in seat supply has exerted downward pressure on domestic fares within Nigeria and, in a highly leveraged industry, is likely to result in some much-needed consolidation.

Table 5. Benchmarking air transport indicators for Nigeria and other select countries, 2007

Country	**Nigeria**	Ghana	Côte d'Ivoire	Senegal	Kenya	Tanzania
Traffic (2007)						
Domestic seats (millions per year)	**9.30**	0.14	0	0.13	2.09	1.87
Seats for international travel within Africa (millions per year)	**1.37**	0.91	0.85	1.26	3.14	1.27
Seats for intercontinental travel (millions per year)	**2.44**	0.83	0.30	1.23	2.76	0.59
Seats available per capita	**0.09**	0.08	0.06	0.23	0.28	0.12
Herfindahl Index—domestic market (%)	**18.0**	100.0	—	100.0	60.5	31.0
Herfindahl Index—international market	**6.4**	6.4	9.8	10.3	34.1	13.0

Quality						
Percent of seat-km in medium or smaller aircraft	**29.6**	15.7	52.3	39.3	23.3	48.6
Percent of seat-km in newer aircraft	**71.4**	96.8	90.8	98.3	80.2	79.3
Registered carriers on EU blacklist	**0**	0	0	0	0	0
FAA/IASA audit status	**No audit**	Fail	Fail	No audit	No audit	No audit
Percent of carriers passing IATA/IOSA audit	**28.6**	0	0	50.0	11.1	33.3

Source: Bofinger 2009. Derived from the AICD national database (http://www.infrastructureafrica.org/aicd/tools/data).

Note: EU = European Union; FAA = U.S. Federal Aviation Administration; IASA = International Aviation Safety Assessment; IATA = International Air Transport Association; IOSA = IATA International Safety Audit.

— = Not available.

Water supply and sanitation

Achievements

Nigeria's performance in sanitation is somewhat better than that of the resource-rich country peer group. Access to flush toilets, at 23 percent, is twice the average for resource-rich countries in Africa, even if still half that in middle-income countries. More than one-third of Nigerians rely on improved latrines as their main source of sanitation, a level comparable to other resource-rich countries. Access to traditional latrines, at 13 percent of the population, is below the level of resource-rich countries. But one in three Nigerians continues to practice open defecation (table 6).

Challenges

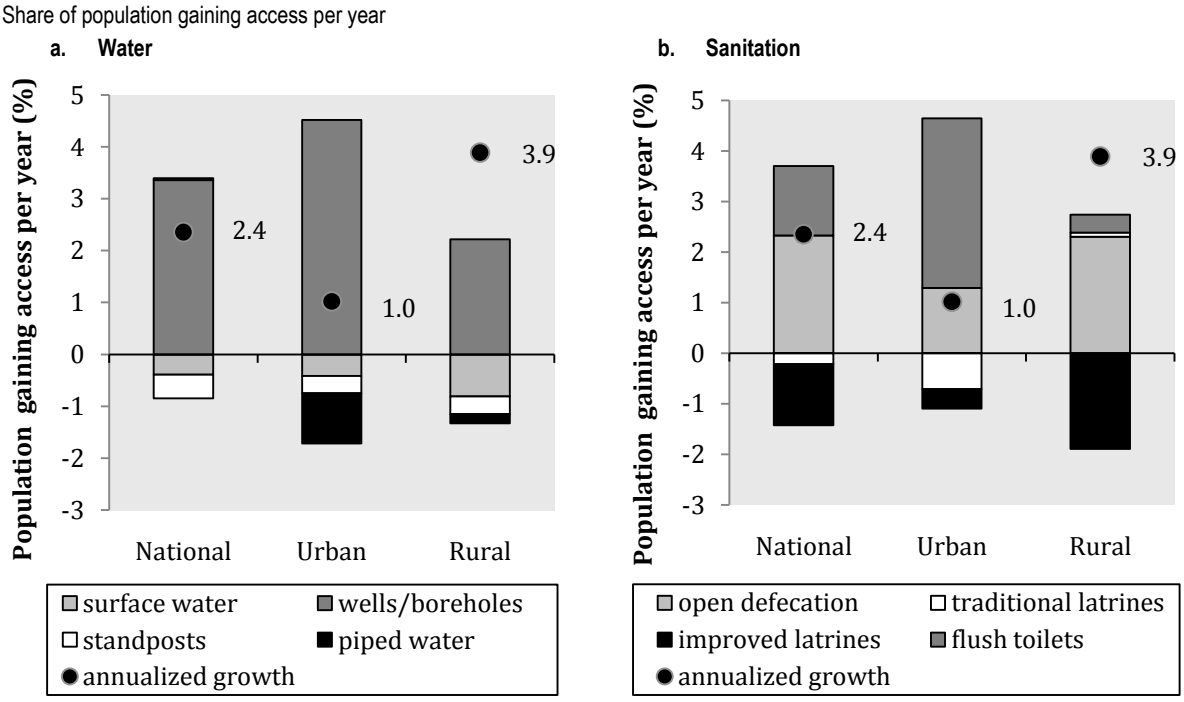
The practice of open defecation continues to increase, and little net progress is being made toward improving sanitation overall. In 1998, 24 percent of the population practiced open defecation; within 10 years this had increased to 29 percent. Progress with higher-end modalities is mixed. Although the expansion of septic tanks has been significant, it has been largely offset by the decline in both improved and traditional latrines. Whereas about 1.3 percent of the population gained access to septic tanks between 2003 and 2008, about 1.2 and 0.3 percent of the population lost access to improved and traditional latrines, respectively, each year. The use of septic tanks also looks low relative to annual population growth, at 2.4 percent per year (figure 6b). Meanwhile, around 2.3 percent of the population fell into the practice of open defecation during the same period.

Relative to its neighbors, Nigeria's water performance scores are significantly worse than its sanitation. According to the Demographic and Health Survey (DHS) 2008, only 5 percent of the population have access to a private tap and only 8 percent to a public standpost (table 6). By contrast, about 12 percent of the population have access to each of these modalities in Africa's resource-rich countries, and in Africa's middle-income countries more than 60 percent have access to piped water. By far the most important sources of water are wells and boreholes, which serve 63 percent of Nigeria's population. But as many as one in four Nigerians continue to rely on surface water, without access to any better alternative.

Particularly worrying is a decrease in access to utility water. By comparing results from successive DHS surveys between 2003 and 2008, it is possible to estimate the rate at which different types of

services are expanding (figure 6a). During this period, the percentage of the population with access to utility water—whether through private taps or standposts—was actually declining, by around 0.4 percentage points each year. By contrast, more than 3 percent of the population each year has been gaining access to wells and boreholes, making this by far the fastest-growing source of water supply in Nigeria. A particularly positive finding is that the percentage of the population relying on surface water has been on the decline, with 0.4 percent of the population moving away from this unsafe practice every year.

Figure 6. Rural access to water and sanitation versus population growth, 2008–08



Source: WHO (2010), from the DHS (2003 and 2008).

Table 6. Benchmarking water and sanitation indicators

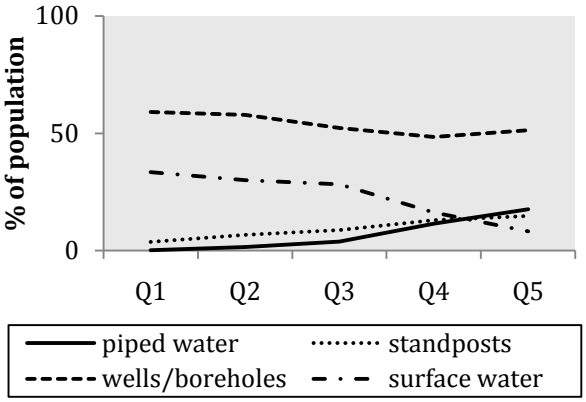
	Unit	Resource-rich countries	Nigeria			Middle-income countries
		Mid-2000s	**1999**	**2003**	**2008**	**Mid-2000s**
Access to piped water	% pop	12.5	12	8	5	61.1
Access to standposts	% pop	12.4	16	11	8	22.1
Access to wells/boreholes	% pop	47.0	45	53	63	4.8
Access to surface water	% pop	26.6	27	28	22	10.9
Access to septic tanks	% pop	12.9	15	16	23	47.7
Access to improved latrines	% pop	37.0	42	46	35	33.7
Access to traditional latrines	% pop	21.5	17	16	13	6.9
Open defecation	% pop	28.3	24	22	29	11.0
				2005		
Domestic water consumption	liter/capita/day	115.0		109		194.8
Revenue collection	% sales	60.1		44		99.3
Distribution losses	% production	39.7		59		26.2
Cost recovery	% total costs	67.1		62		86.3
Operating cost recovery	% operating costs	94.0		180		120.8
Labor costs	connections per employee	96.4		57		203.4
Total hidden costs as % of revenue	%	193		291		67

	Nigeria	Scarce water resources	Other developing regions
U.S. cents per m³	**2005**		
Average effective tariff	0.38	60–120	3.0–60.0

Source: AICD water and sanitation utilities database (http://www.infrastructureafrica.org/aicd/tools/data); access figures from DHS (1999, 2003, and 2008).

Access to utility water is inequitable. Access to various types of water supply is strongly correlated with household purchasing power. Access to utility water, in particular, is almost nonexistent at the bottom half of the income distribution, and strongly skewed toward higher-income households. But even among these, access to utility water is far from universal, reaching at best 20 percent of this group. Thus, even those able to pay for piped water are unlikely to have access. Particularly striking is the fact that access to standposts is just as inequitable as access to private taps, even though standposts supposedly represent a lower-cost option for the poor. Access to wells and boreholes, on the other hand, is much more equitable and reaches over half of the population, across the socioeconomic spectrum. As is to be expected, reliance on surface water is heavily concentrated among the poor (figure 7).

Figure 7. Access to water sources is highly inequitable

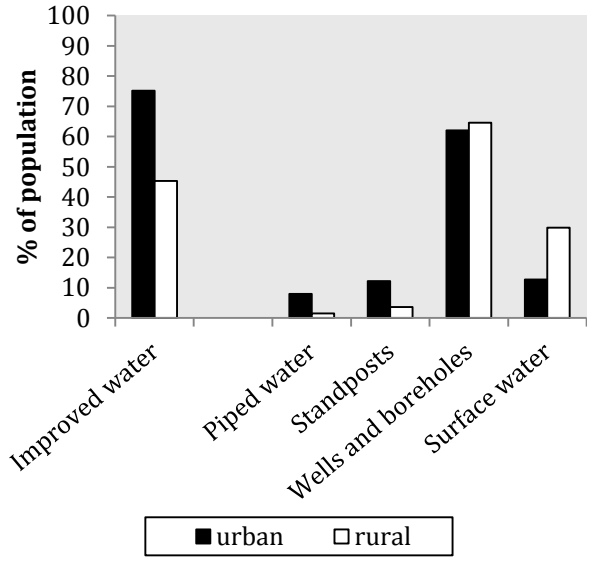


Source: Banerjee and others 2009, based on DHS 2003.
Note: Q1—first budget quintile, Q2—second budget quintile, and so on.

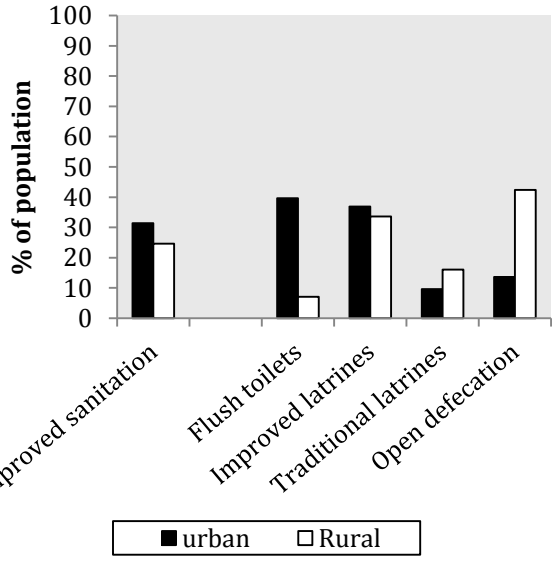
Access to improved water is much higher in urban than in rural areas. Access to improved water in urban areas is 75 percent, versus 45 percent in rural areas (figure 8a). The main reasons behind this are the higher prevalence of surface water dependence in rural areas, and the fact that 21 percent of the wells and springs in rural areas are unprotected versus only 6 percent in urban areas.

Figure 8. Access to water sources is highly inequitable across urban and rural communities

a. Water supply



b. Sanitation



Source: AICD water supply and sanitation utilities database (http://www.infrastructureafrica.org/aicd/tools/data); access figures calculated

by AICD using data from the 2008 DHS Survey published by the JMP in March 2010.

Nigeria's water utilities suffer high levels of inefficiency, both in absolute terms and relative to their neighbors. Available data on the performance of Nigeria's water utilities are limited. Although Nigeria has as many as 36 state water utilities, it was possible to obtain reasonably sound data for only a handful of them—Borno, the Federal Capital Territory, Kaduna, Katsina, Lagos, and Platea—at a single point in time in 2005. These data were later complemented with data for Nasarawa from the IbNet database. Together these utilities serve a substantial customer base of 25 million people, comprising about half of the urban population of Nigeria. The indicators presented are a weighted average for this sample (table 7). They indicate that the Nigerian utilities perform as poorly, and in some areas worse, than utilities in the resource-rich peer group. In particular, performance on revenue collection and labor productivity is substantially worse than the peer group. Revenue collection is as low as 44 percent of billed amounts, and labor productivity—at 57 connections per employee—is just a quarter that of a well-performing utility in Africa. Distribution losses, at 59 percent, are also substantially worse than the 39 percent reported for the peer group.

Cost-recovery tariffs for water appear to be perfectly affordable for those enjoying access today. The average effective residential tariff, at just under \$0.38 per cubic meter (m^3), more than covers average operating costs of around \$0.21/m^3, but falls significantly short of the estimated \$0.61 cost-recovery level (table 7). This raises the important question of whether cost-recovery tariffs would be affordable to utility customers. Considering subsistence consumption of 4 m^3/month—which amounts to an absolutely minimal consumption of 25 liters per capita per day for a family of five—a monthly water bill charged at cost-recovery tariffs would be \$3.20. With a somewhat more generous definition of subsistence consumption of around 10 m^3/month, the cost of a monthly water bill charged at cost-recovery tariffs would be \$8.00. Based on an affordability threshold of 5 percent of the household budget, and looking at the distribution of purchasing power across Nigeria's households, a monthly bill of \$3.20 would be affordable to 95 percent of the population, while a bill of \$8.00 would be affordable to 60 percent of the population (figure 7). Given that, as of today, access to water is confined to less than 10 percent of the population at the high end of distribution, there do not appear to be any significant problems in the affordability for cost-recovery tariffs. Nor would such problems arise until access to piped water had expanded significantly, to reach about 50 percent of the population.

Table 7. Operational indicators associated with select Nigerian utilities, as of 2005

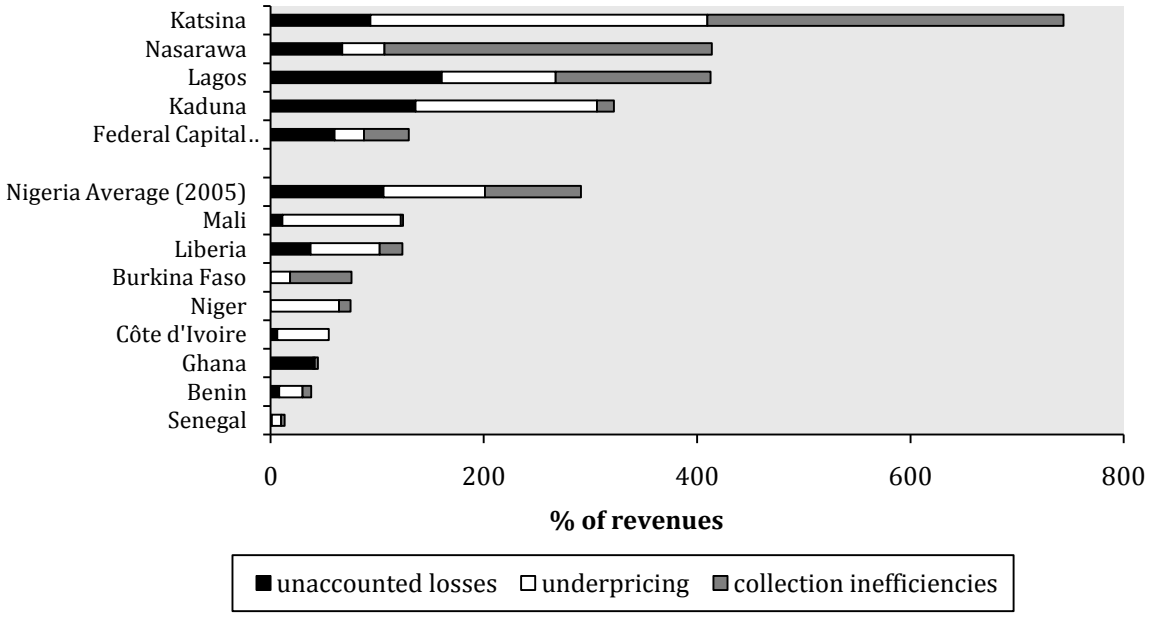
Utility	Water delivered (million m^3/year)	System losses (%)	Collection ratio (%)	Average total cost (US\$/m^3)	Average effective tariff (US\$/m^3)	Total hidden costs (US\$ millions/year)	Total hidden costs (% revenues)
FCT	86	80	20	0.66	0.43	18	130
Kaduna	81	58	86	0.53	0.21	20	322
Katsina	36	30	23	0.56	0.33	14	743
Lagos	116	57	41	0.66	0.46	39	413
Nasarawa	10	32	25	0.48	0.44	3	414
Nigeria	330	59	44	0.61	0.38	95	291

Source: Derived from Briceño-Garmendia, Smits, and Foster (2009).
Note: For Nigeria water delivered (million m^3/year) and total hidden costs (US\$/year) are reported as the sum of the utilities; the other indicators are calculated as weighted averages.

By comparing Nigerian utilities with well-performing benchmarks, it is possible to quantify the hidden costs that arise from these inefficiencies. Here three types of such costs are considered: first, those associated with distribution losses in excess of the good-practice benchmark of 20 percent of production; second, those associated with revenue collection that falls short of the 100 percent best-practice benchmark; and, third, any shortfall in the average effective tariff relative to what is needed to fully recover operating and capital costs.

The hidden costs of Nigerian water utilities look to be among the highest in the region. The combined effects of underpricing, overstaffing, undercollection, and distribution losses imply a sizeable financial hemorrhage. In the case of the Nigerian utilities sampled, the value of these hidden costs is estimated to be almost three times as great as the utilities' turnover. In the worst-performing utility of the sample (Katsina), the hidden costs are *seven* times as large as the utility's turnover. Even for the most efficient of the sample utilities (FCT), hidden costs are still worse than those among other utilities in West Africa (figure 9).

Figure 9. Hidden costs of select water utilities, as percentage of revenues



Source: Derived from Banerjee and others (2008b) and Briceño-Garmendia, Smits, and Foster (2009).

While improving utility performance will be a key to expanding access, more attention needs to be given to those alternatives that are most widely used. In the medium term, Nigeria needs to work hard to provide more of its population with access to utility services for water and sanitation. To this end, addressing the performance deficiencies of service providers is key. Nevertheless, it is important to recognize that for the foreseeable future the bulk of Nigeria's population will continue to rely on boreholes for water and traditional latrines for sanitation services. Policy makers therefore need to give some attention to ways of improving the quality and effectiveness of these basic services. In the case of

boreholes, there are many policy issues surrounding their unregulated and uncoordinated use. In the case of traditional latrines, policy makers should promote the use of better design and building techniques among artisans. Furthermore, there are potential health issues that arise when groundwater and low-grade in situ sanitation are found in close proximity in urban areas.

Power

Achievements

Nigeria has achieved relatively high rates of electrification, particularly in urban areas, and access is expanding rapidly. As of 2003, Nigeria had electrified over 50 percent of its population, just slightly ahead of the peer group of resource-rich countries (table 8). Power coverage in urban areas, at 84 percent, was well ahead of the resource-rich peer group, and on par with Africa's middle-income countries. Even rural electrification, at almost 35 percent, represents strong performance. Not only does Nigeria have high access to power, but electrification expanded relatively rapidly between the mid-1990s and the mid-2000s. The pace of electrification seems to have slowed subsequently.

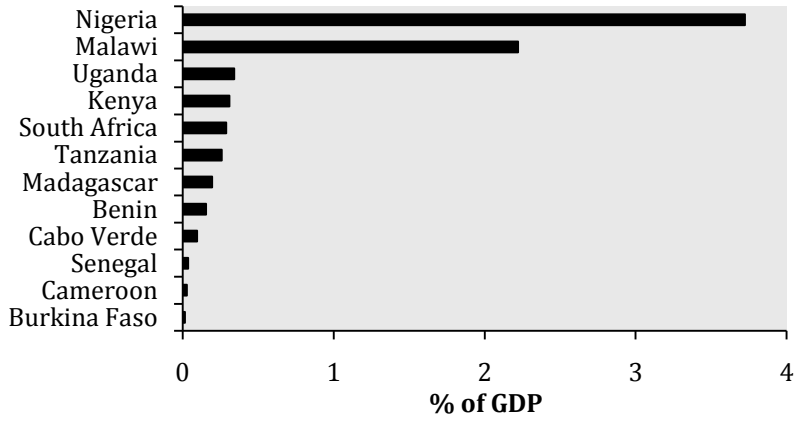
Challenges

Despite high levels of electrification, Nigeria's power sector has struggled to provide an adequate supply of reliable power. The country's installed power capacity, at around 42 megawatts (MW) per million people, is typical of the resource-rich peer group (table 7), but it is only about 5 percent of the installed capacity of 800 MW per million people found in Africa's middle-income group. Moreover, in Nigeria's case as much as 35 percent of this capacity is not in functioning order. As a result, the country was able to meet only 67 percent of peak demand as of 2007, and the power system was able to supply only 55 percent of total estimated demand as of 2008. Indeed, electricity generated in 2007 was actually lower than in 2002. As a result, indicators such as generation capacity per million population and power consumption per capita actually deteriorated slightly between the mid- and late 2000s.

The economic impacts of Nigeria's power deficit are substantial. According to enterprise surveys, Nigeria is affected by power outages more than 320 days a year, a level many times higher than that found in other African countries. As a result, the percentage of Nigerian firms owning their own backstop generators is 60 percent, again substantially higher than elsewhere in Africa. Formal private sector revenues lost as a result of power outages come close to 10 percent. If we (very conservatively) estimate the value of lost load as the cost of backstop generation to the private sector (approximately $0.40 per kilowatt-hour, kWh), then the aggregate social cost of power outages in recent years amounts to as much as 3.7 percent of GDP, well beyond levels found in other African countries (figure 10). If the value of lost load is instead estimated with reference to the likely economic losses in production (of easily $1.00 per kWh), then the aggregate social cost of power outages could be two to three times as high.

Figure 10. Power outages are a major tax on Africa's economies

Economic cost of power outages in select countries



Source: Derived from Eberhard and others (2009).

Nigeria's power sector has been characterized by a high degree of operational inefficiency and underpricing. As of 2005 only 64 percent of billed revenues were collected, compared with 81 percent in the resource-rich peer group (table 6). Distribution losses were as high as 30 percent, compared to best-practice levels of 10 percent. Tariffs covered about 28 percent of the historic costs of power production, on average, compared with over 50 percent for the peer group.

Nigeria's power tariffs are set very low, both by global standards and relative to any relevant cost benchmark. With respect to power pricing, as of 2005, Nigeria's residential power tariffs, at around $0.03/kWh, were among the lowest in Africa—and well below the average of $0.16/kWh found in African countries predominantly reliant on thermal generation technologies (figure 8). Nigeria's rates were also well below the range—typically between $0.05 and $0.10 per kWh—found in other parts of the developing world (table 8). According to the Nigerian government, the average total historic cost of producing power in the country has been on the order of $0.15/kWh (22 naira). Looking ahead to 2015, the long-run marginal cost of producing additional power is projected to be slightly lower, at around $0.13/kWh.

As a result, Nigeria faces enormous hidden costs in the power sector, by far the worst in Africa. Each of the inefficiencies in the power sector results in hidden costs, which when tallied amount to more than *five* times the sector turnover (figure 11). *In absolute terms, these hidden costs amount to a staggering $3.3 billion annually, equivalent to 2.9 percent of GDP.* While substantial hidden costs are typical of African power utilities, the scale of the problem in Nigeria is much higher than anywhere else (figure 12).

Following the sector reforms, tariffs have been increasing and sector performance improving. A major reform program initiated in 2005 had significant repercussions for the sector. The reforms led to the horizontal and vertical unbundling of the national power utility into six generating companies, one transmission company, and eleven distribution companies. In August 2010, the Nigerian government issued the Road Map for Power Sector Reform (Presidency 2010) to galvanize the reform process. The road map points to the difficulties ahead if status quo operations are maintained, and recommends removing obstacles to the private sector participation that promises to fill the sector's large investment

gaps. Meanwhile, the government set appropriate pricing mechanisms to ensure the financial viability of the public distribution companies and any offtaker in power purchase arrangements. The government also committed to a Multi-Year Tariff Order (MYTO), introduced in 2005, whose initial objective was to gradually raise the power tariff to $0.07/kWh (10 naira) by 2011. The government, however, is currently revising the MYTO to specify an aim of $0.14/kWh (22 naira) over the next 5 to 10 years. Meanwhile, the Nigeria Bulk Electricity Trading Company has been established to act as a "single buyer" purchasing power on behalf of distribution companies and other bulk customers until the sector reaches financial sustainability. The government expects that it will take several years before the benefits of the reforms will effectively transform the sector's financial performance and creditworthiness.

The benefits of the reform process can already be clearly seen in the dramatic reduction of the sector's hidden costs, even if these remain high in both relative and absolute terms. As a result of the MYTO, the average effective tariff increased from around $0.04/kWh in 2005 to $0.06/kWh in 2009. At the same time, institutional reforms led to significant improvements in operational efficiency. Revenue collection rates increased from 64 to 88 percent, even as system losses fell from 30 to 20 percent (table 9). The overall effect of this was the reduction of hidden costs from 548 percent to 247 percent of sector revenues (figure 11). This led to savings of $1.3 billion annually, or 1.8 percent of GDP. While these gains are very important, there is still a long way to go: Nigeria's power utilities still present the highest hidden costs of any in West Africa (figure 12), with an equivalent economic value of nearly $2 billion annually, or 1.2 percent of GDP.

Table 8. Benchmarking power indicators

	Unit	Resource-rich countries	**Nigeria**		Middle-income countries
			Mid-2000s	**Late 2000s**	
Installed power generation capacity	MW/million people	43.2	**41.7**	**38.1**	798.6
Power consumption	kWh/capita	205.7	**151.9**	**107.6**	4,479.3
Power outages	Day/year	14.5	**321.0**	**—**	5.9
Firms' reliance on own generator	% consumption	44.9	**60.9**	**—**	10.9
Firms' value lost due to power outages	% sales	7.0	**8.9**	**—**	1.6
Access to electricity	% population	46.0	**51.3**	**48.6**	59.9
Urban access to electricity	% population	79.4	**84.0**	**85.0**	85.2
Rural access to electricity	% population	28.0	**34.6**	**31.0**	31.8
Growth access to electricity	% population/year	2.4	**2.8**	**0.6**	1.5
Revenue collection	% billing	81.1	**63.5**	**88.0**	100.0
Distribution losses	% production	25.8	**30.0**	**20.0**	10.1
Cost recovery	% total cost	53.9	**28.0**	**31.0**	100.0
Total hidden costs as % of revenue	%	168.3	**548.2**	**246.6**	0.1

U.S. cents	**Nigeria**		Predominantly thermal generation	Other developing regions
	Mid-2000s	**Late 2000s**		
Average effective power tariff	**4.2**	**4.7**	16.0	5.0–10.0

Source: Eberhard and others 2009; derived from AICD electricity database (http://www.infrastructureafrica.org/aicd/tools/data).

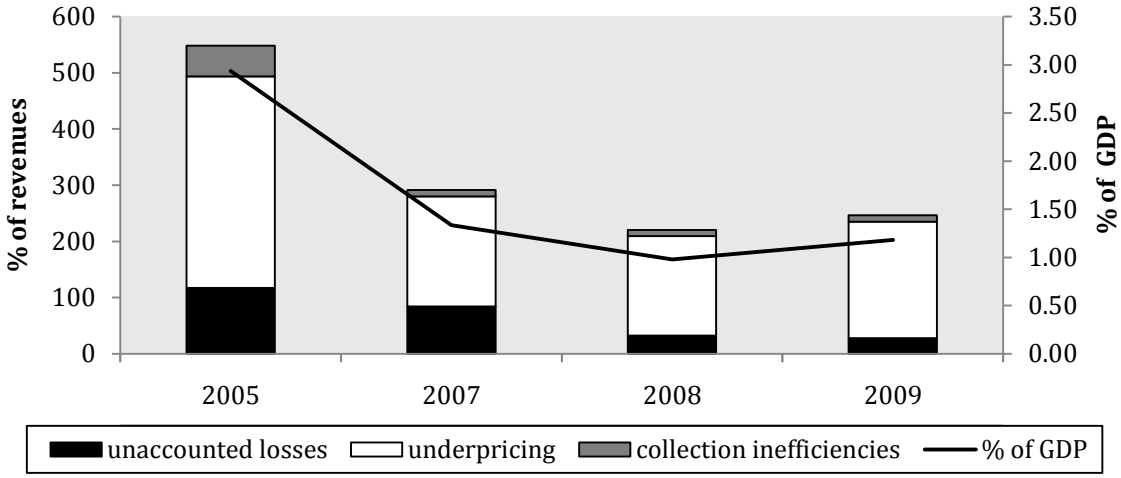
Note: Mid-2000s data are for 2005 in the case of power sector indicators and 2003 in the case of access figures; late 2000s data are for 2009 in the case of power sector indicators and 2008 in the case of access figures.
kWh = kilowatt-hour; MW = megawatts.
— = Not available.

Table 9. Evolution of hidden costs associated with the national power utility

	Load served	System losses	Collection ratio	Average total cost	Average effective tariff	Total hidden costs	Total hidden costs
	(GWh/year)	(%)	(%)	(US$/kWh)	(US$/kWh)	(US$ million/year)	(% revenue)
2005	21,402	30	63.5	0.15	0.042	3,292.6	548
2007	14,901	36	88	0.15	0.048	2,214.4	292
2008	16,712	22	88	0.15	0.051	2,025.7	220
2009	16,652	20	88	0.15	0.047	1,997.7	247

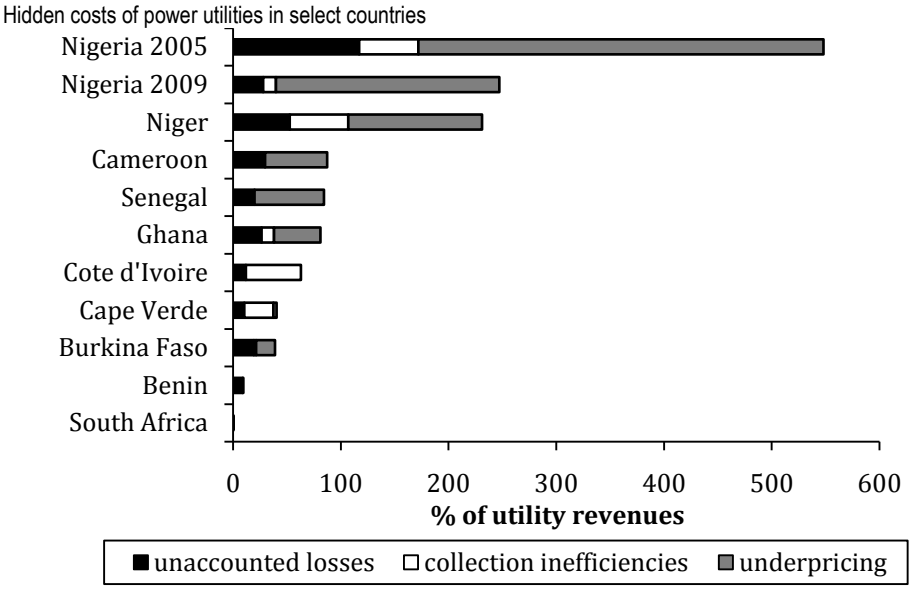
Source: Eberhard and others 2009.
Note: GWh = gigawatt-hour; kWh = kilowatt-hour.

Figure 11. Evolution of hidden costs in Nigeria's power sector



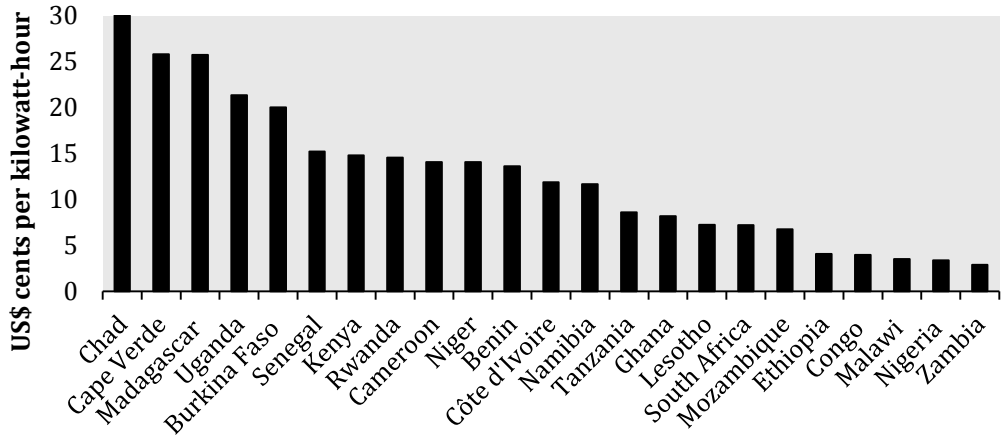
Source: Eberhard and others 2009.
Note: It was not possible to obtain all the relevant parameters for 2006.

Figure 12. Nigeria's power sector presents high hidden costs



Source: Eberhard and others 2009.

Figure 13. Comparison of electricity tariffs across Africa



Source: Derived from Eberhard and others 2009.

Water resources

Achievements

Nigeria has made some progress toward developing an institutional framework suitable for irrigation development. The country has adopted a water policy, together with an irrigation strategy and action plan. There are specialized agencies for basin-level management, and water-user associations have been empowered. Nevertheless, there is still no specialized entity dedicated to the development of irrigation infrastructure.

Challenges

Even compared to its African peers, Nigeria's water storage capacity is low. It stands at 339 m^3 per capita, compared with 838 m^3 per capita for Sub-Saharan Africa as a whole.

Nigeria has just under 300,000 hectares equipped for irrigation today. This is less than 1 percent of the country's cultivated area, although a further 2 percent of the cultivated area is subject to some degree of water management, falling short of irrigation. The existing irrigated area is thinly spread across the national territory, most of it in narrow strips flanking the nation's rivers (recall figure 3d). Even in the areas where some irrigation is taking place, the level of intensity is low; only a fraction is being irrigated. Furthermore, of the limited area equipped for irrigation, only 75 percent is actually operating. The 1 percent of land that is irrigated produces 4.4 percent of the value of Nigeria's agricultural produce.

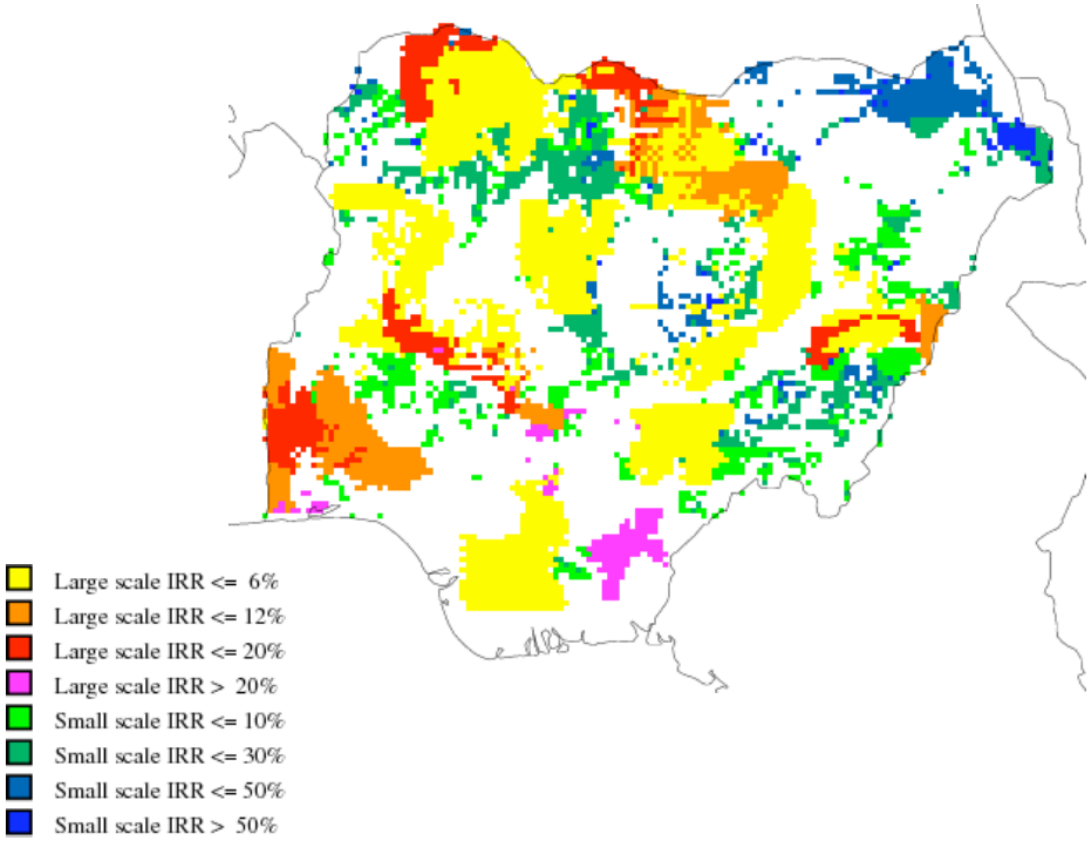
The rate of expansion of irrigated area, though historically slow, has been picking up in recent years. Over the period 1973 to 2003, irrigated area expanded slowly, by only 1.2 percent each year—about half the pace of Sub-Saharan Africa. Since 2003, however, the rate of expansion has increased to 3.1 percent annually, more than twice as high as in the rest of Sub-Saharan Africa.

Nigeria has huge unexploited potential for economically attractive irrigation schemes. A simulation exercise exploring the economic viability of further expanding large- and small-scale irrigation schemes concluded that Nigeria has by far the best prospects for irrigation development of any country in Sub-Saharan Africa (table 10). If all land with a positive rate of return is considered, the potential is as high as 5.7 million hectares—which is almost as much as the total irrigated land in Sub-Saharan Africa today. About half of the potential lies in large-scale schemes. Nevertheless, the internal rate of return on the large-scale schemes, at 7 percent, is not even one-third the estimated 22 percent return on small-scale schemes.

The viable area for irrigation is highly sensitive to the hurdle rate of return used. As the hurdle rate is increased beyond zero, the number of viable hectares shrinks dramatically to just over 2 million for hurdle rates in the 6–12 percent range. Moreover, the composition of viable schemes shifts markedly toward smaller-scale projects that offer higher rates of return overall. The overall internal rate of return for surviving projects rises to around 30 percent. If the hurdle rate is raised further to 24 percent, the number of viable hectares shrinks to 0.8 million, almost all of them for small-scale schemes. More generally, it has been found that the viability of irrigation schemes depends on crops—mainly cash crops and horticulture—that are capable of generating in excess of $2,000 per hectare.

Figure 14. Irrigation schemes are viable across much of the country, with pockets of higher returns

Areas viable for irrigation



Source: You and others 2009.

Table 10. Sensitivity of irrigation potential to thresholds for economic return

	Potential ('000s hectares)			Investment needs (US$ million)			Average IRR (%)		
	Large scale	Small scale	Total	Large scale	Small scale	Total	Large scale	Small scale	Total
IRR >0%	3,169	2,505	5,674	6,185	12,942	19,127	7.1	22.0	17.2
IRR >6%	370	1,945	2,315	723	10,048	10,771	23.8	29.0	28.6
IRR >12%	609	1,538	2,147	1,188	7,948	9,136	18.4	36.0	33.7
IRR >24%	34	788	822	66	4,070	4,137	32.5	54.0	53.7

Source: You and others 2009.

Notes: Simulations based on assumptions that large-scale irrigation can be developed at a cost of $3,000 per hectare and small-scale irrigation can be developed at a cost of $2,000 per hectare. Should these costs be significantly exceeded, the number of viable hectares falls sharply. IRR = internal rate of return.

Results are also highly sensitive to the costs of irrigation development. The results presented are based on unit-cost assumptions of $3,000 per hectare for large-scale schemes and $2,000 per hectare for small-scale schemes. These represent best-practice cost benchmarks, though actual development costs experienced in West Africa might be substantially higher, which would dramatically reduce the estimated

number of viable hectares. Based on these cost assumptions, the required one-time investment to develop all viable schemes (based on a hurdle rate of 12 percent) would be on the order of $9.1 billion.

Information and communications technologies

Achievements

In common with the rest of Africa, Nigeria has made good progress in expanding GSM signal coverage. The percentage of Nigeria's population living within range of a GSM signal has expanded rapidly, reaching some 60 percent in 2006 and nearly 70 percent in 2009. Nigeria has attracted over half the $28 billion in private capital that has gone into the development of new mobile networks across Africa.[2]

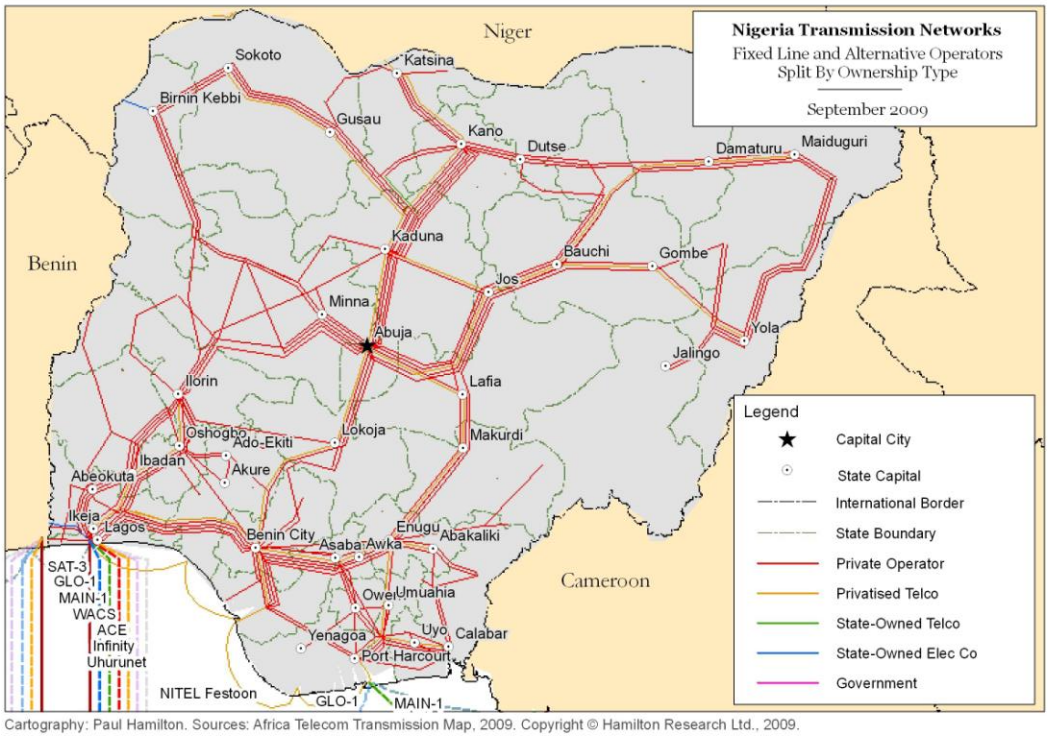
Nigeria stands out among African countries for its creation of a competitive fixed-line sector. The key reason for this is market liberalization: there were 30 active, fixed-wireless operators as of December 2009 (NCC 2010). Most are providing service using fixed-wireless technology (with four fixed-wireless operators competing head on with GSM operators by providing full mobility functionality). As a result, only a minority of fixed-line subscribers are associated with the stagnating national incumbent Nigerian Telecommunications Limited (NITEL), which, as of 2009, remained unprivatized (IHS Global Insight 2008).

Intense competition in the mobile and fixed-line segments has driven prices down. Nevertheless, the 2009 prices of a monthly fixed-line subscription ($9) and prepaid mobile subscription ($11) were only average compared with other Sub-Saharan African countries. As of 2010 significant tariff reductions were following the lower interconnection rates introduced by the regulator. This, combined with the depreciation of the naira, should make ICT services more affordable.

Nigeria has also made great progress in the development of a national fiber-optic network by harnessing private sector investment. Many African countries have pursued publicly sponsored national fiber-optic backbone networks, some of them quite expensive and of relatively low quality. Nigeria, on the other hand, has taken full advantage of the scale of its market. By liberalizing the market for fiber-optic infrastructure, the country has seen substantial private sector investment in this area, leading to the development of a solid backbone network interconnecting the major cities (figure 15). Multiple parallel cables have been laid on the highest-traffic routes, which has resulted in intense competition and a decrease in costs. Evidently the private sector will not of its own accord extend cables into smaller towns and rural areas, where a business case does not exist. But by first allowing the private sector to develop the major components of the backbone, the government can limit the use of public funds to areas where no other solution is possible, thereby saving significant fiscal resources.

[2] Over the past decade, some $16 billion has been invested in projects related to mobile services in Nigeria. See Pyramid Research (2010).

Figure 15. Private sector investment in Nigeria's national fiber-optic backbone



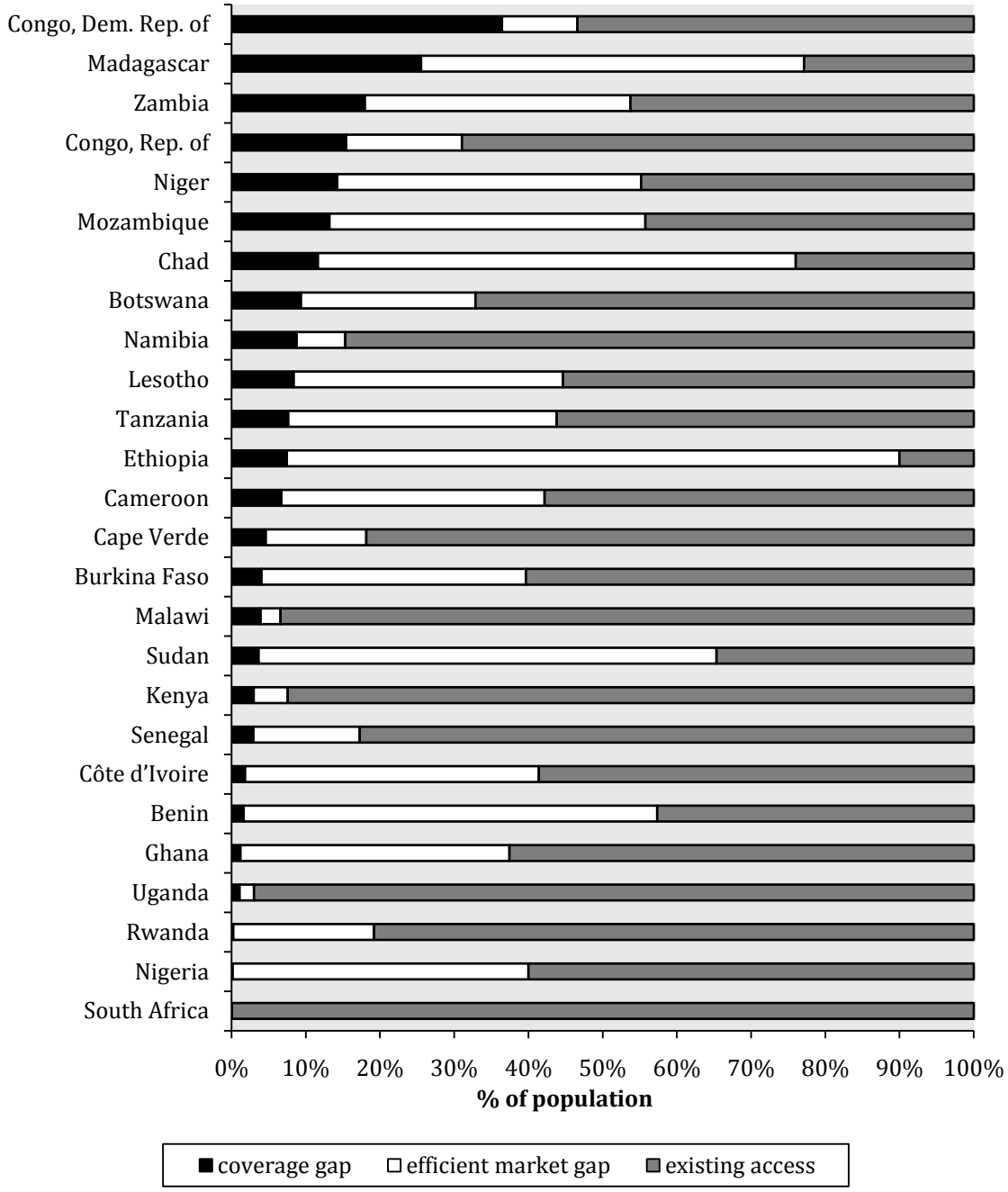
Cartography: Paul Hamilton. Sources: Africa Telecom Transmission Map, 2009. Copyright © Hamilton Research Ltd., 2009.

Challenges

Nigeria still faces a substantial market-efficiency gap in the mobile market. While Nigeria's existing level of GSM signal coverage is impressive—practically all urban areas are fully covered and around half of the rural population is within reach of a signal—simulations suggest that the GSM signal might profitably be extended to 100 percent of the national population (figure 12). It is puzzling that coverage is not greater, given that with nine mobile operators, Nigeria arguably has the most competitive mobile market on the continent. But the price of mobile licenses, coupled with the challenge of extending infrastructure in a large country, pushes up operators' costs. Another bottleneck is a lack of electricity in rural areas, which further inflates the costs of network rollout (Mayer 2010). Only around one-third of rural households had electricity in 2008, about the same fraction as rural households with a mobile telephone (NPC and ICF Macro 2009).

The price of Internet access remains high, but can be expected to fall with the arrival of new submarine cables. Internet access is relatively expensive considering that Nigeria has access to the SAT-3 submarine cable. But NITEL has had a *de facto* monopoly over the international gateway. The launch of the Main One undersea fiber-optic cable in 2010, with landing stations in Nigeria and Ghana, was forecast to reduce wholesale prices by 50 percent (TradeInvestNigeria 2010). As of 2010, the imminent arrival of additional submarine cable projects along the West African coast has already placed downward pressure on costs. If costs effectively fall, Nigeria could emerge as a leading regional bandwidth supplier (Business Day 2010). Evidence from across Africa suggests that only when there is competitive access to submarine cable infrastructure are the full cost advantages felt by consumers (table 11).

Figure 16. Nigeria still has a substantial efficient-market gap for GSM coverage



Source: Mayer and others 2008.

Note: Gray = the percentage of the population covered by voice infrastructure as of the third quarter of 2006.

White = the efficient-market gap—the percentage of the population for whom voice telecommunications services are commercially viable, given efficient and competitive markets.

Black = the coverage gap—the percentage of the population for whom services are not viable without a subsidy.

Table 11. High international call charges driven both by technology and market power

US$

	Percent cases (%)	Call within Sub-Saharan Africa	Call to the United States	Internet dial-up	Internet ADSL
Without submarine cable	67	1.34	0.86	68	283
With submarine cable	33	0.57	0.48	47	111
Monopoly on international gateway	16	0.70	0.72	37	120
Competitive international gateway	16	0.48	0.23	37	98

Source: Mayer and others 2008.
ADSL = asymmetric digital subscriber line.

Table 12. Benchmarking ICT indicators

		2006	2008			2009
	Unit	Nigeria	Nigeria	Lower-middle-income group	Sub-Saharan Africa	Nigeria
GSM coverage	% population	61.8	61.8	77	56	68.7
International bandwidth	Bits/second/person	1.1	5	153	34	—
Internet	Users/100 people	10.5	4.5	13.9	6.5	17.3
Landline	Subscribers/100 people	1.2	0.9	34.8	1.5	0.9
Mobile phone	Subscribers/100 people	23.1	42.6	30.6	33.3	48.1

	2006	2008			2009
US$	Nigeria	Nigeria	Lower-middle-income group	Sub-Saharan Africa	Nigeria
Price of monthly mobile basket	12.2	14.3	8.4	11.8	11.5
Price of monthly fixed-line basket	7.8	8.3	4.8	11.6	9.1
Price of monthly fixed broadband	—	54.1	31.4	100.1	43.1
Price of a call to the United States (peak minute)	0.42	0.31	n.a.	0.88	0.27
Price of inter-Africa calls (peak minute)	0.70	0.31	n.a.	1.02	0.27

Sources: World Bank, ICT At-a-Glance, and AICD database.
Note: GSM = global system for mobile communications.
— = Not available; n.a. = not applicable; * = mean.

Financing Nigeria's infrastructure

To meet its most pressing infrastructure needs and to catch up with developing countries in other parts of the world, Nigeria needs to expand its infrastructure assets in key areas (table 13). The targets outlined in table 13 are purely illustrative, but they represent a level of aspiration that is not unreasonable. Developed in a standardized way across African countries, the standardized targets allow for cross-country comparisons of their affordability. The targets can be modified or delayed as needed to achieve financial balance.

Table 13. Potential investment targets for infrastructure in Nigeria

	Economic target	Social target
ICT	Fiber-optic links to neighboring capitals and submarine cables.	Universal access to GSM signal and public broadband facilities.
Irrigation	Develop 608,755 hectares of large-scale irrigation and 1,538,121 hectares of small-scale irrigation.	n.a.
Power	10,828 MW new generation and 366 MW interconnectors.	Electricity coverage of 82% (100% urban and 49% rural).
Transport	Regional connectivity by good-quality 2-lane paved road. National connectivity by good-quality 1-lane paved road.	Rural network giving access to 47% agricultural production. Urban population within 500 meters paved road.
WSS	n.a.	Sustain MDG target for water and sanitation, and clear sector rehabilitation backlog.

Sources: Mayer and others 2008; Rosnes and Vennemo 2009; Carruthers and others 2009; You and others 2009.
Note: GSM = global system for mobile communications; ICT = information and communications technology; MW = megawatts; WSS = water supply and sanitation; MDG = Millennium Development Goals.
n.a. = Not applicable.

Meeting these illustrative infrastructure targets for Nigeria would cost $14.2 billion annually through 2015, most of it for federal infrastructure (table 13). Since the AICD project was only able to collect information on federal infrastructure spending, the analysis in this section will focus exclusively on federal infrastructure financing. The total spending requirement, therefore, needs to be estimated across jurisdictions. For this purpose, it is assumed that the federal government takes responsibility for ICT, large-scale irrigation, power, primary roads, railways, ports, and airports. The bulk of the identified spending requirements—some $10.5 billion annually in all—relates to these federal infrastructure assets. The remaining areas of infrastructure, including water and sanitation, secondary and tertiary road networks, and small-scale irrigation, are assumed to be state- or municipal-level responsibilities. The total price tag for infrastructure in these spheres amounts to $3.7 billion a year, and will not be further considered in this section.

Federal infrastructure spending needs are strongly skewed toward capital investment, and heavily dominated by the power sector. Capital expenditure accounts for 71 percent of total federal spending requirements. The highest price tag is associated with the power sector and is on the order of $7.6 billion annually, which is about as much as the other four sectors put together. Spending in the power sector would go toward providing 10,828 MW of new generation capacity to meet demands over the next decade, as well as toward boosting electrification to 82 percent (table 14).

Table 14. Indicative infrastructure spending needs in Nigeria for 2006 to 2015

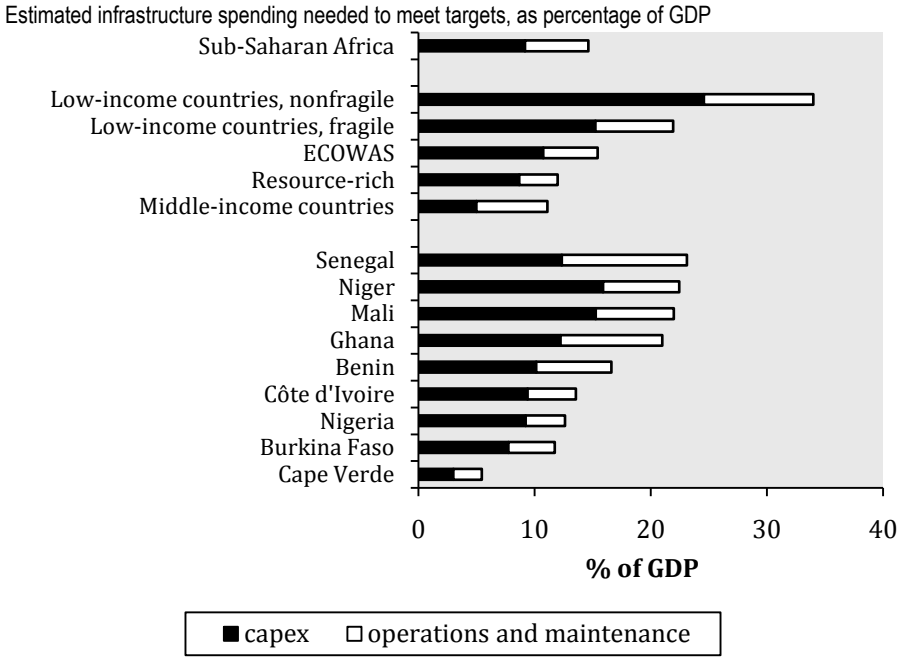
US$ million per year

Sector	Federal needs			National needs
	Capital expenditure	O&M	Total	Total
ICT	1,960	103	2,063	2,063
Irrigation	145	0	145	939
Power	4,903	2,690	7,593	7,593
Transport	404	256	661	1,222
WSS	0	0	0	2,340
Total	7,412	3,050	10,462	14,158

Sources: Mayer and other 2008; Rosnes and Vennemo 2009; Carruthers and others 2009; and You and others 2009.
Derived from models that are available online at http://www.infrastructureafrica.org/aicd/tools/models.
Note: O&M = operations and maintenance; ICT = information and communications technology; WSS = water supply and sanitation.

Nigeria's infrastructure spending needs are not unmanageable when viewed against the size of the national economy. The country's overall spending needs would absorb 12 percent of GDP, while federal spending needs alone amount to 9 percent of GDP. This GDP share is similar to what is found for other resource-rich African economies, but substantially lower than the burden for low-income states that lack natural resource endowments (figure 12). Overall *investment* needs for infrastructure would amount to about 9 percent of GDP. This is well below the 15 percent that China invested in its infrastructure during the early to mid-2000s.

Figure 17. Nigeria's infrastructure spending needs are substantial relative to GDP



Source: Foster and Briceño-Garmendia 2009.

Note: ECOWAS = Economic Community of West African States; SSA = Sub-Saharan Africa; GDP = gross domestic product; O&M = operations and maintenance.

At present, Nigeria is spending only $5.9 billion on federal infrastructure needs (table 15). As much as 90 percent of the total is allocated to capital expenditure and 10 percent to operating expenditure. Operating expenditure is entirely covered from budgetary resources and user charges, and is strikingly low in the case of the transport and irrigation sectors. By far the largest source of investment finance is the private sector, which has been contributing $2.5 billion a year. Although heavily skewed toward ICT, the private sector has also made significant contributions to the funding of power and transport infrastructure. Public investment is in second place, at $1.7 billion per annum. Non-OECD finance comes third, at $0.9 billion a year, mainly in the power and transport sectors. Official development assistance (ODA) of Nigeria's federal infrastructure is negligible.

Federal infrastructure spending absorbs about 5 percent of Nigeria's GDP. This level of effort is relatively small compared to the Sub-Saharan average of around 8 percent of GDP (figure 13). Nevertheless, since it excludes subnational spending, it is very much a lower bound. The sources of infrastructure investment finance in Nigeria differ somewhat from the peer group (figure 14). Particularly noticeable is the limited role of ODA in the transport sector, as well as the absence of public investment in ICT.

Table 15. Financial flows to Nigeria's infrastructure, average 2001 to 2006

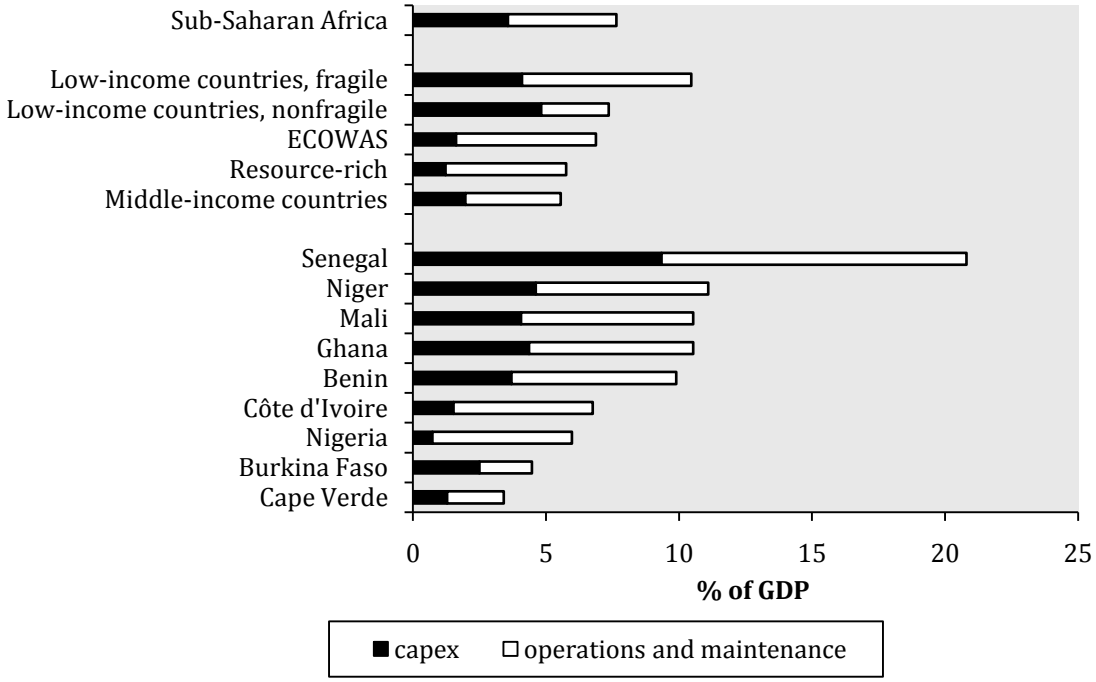
US$ millions per year

		Capital expenditure					
	O&M (public sector)	Public sector	ODA	Non-OECD financiers	PPI	Total CAPEX	Total spending
ICT	9	15	2	56	1,867	1,940	1,949
Irrigation	0	160	0	0	0	160	160
Power	685	716	35	309	209	1,269	1,954
Transport	112	780	26	537	422	1,765	1,877
Total	806	1,671	63	902	2,498	5,134	5,940

Source: Derived from Foster and Briceño-Garmendia (2009).

Note: O&M = operations and maintenance; ODA = official development assistance; PPI = private participation in infrastructure; CAPEX = capital expenditure; OECD = Organisation for Economic Co-operation and Development.

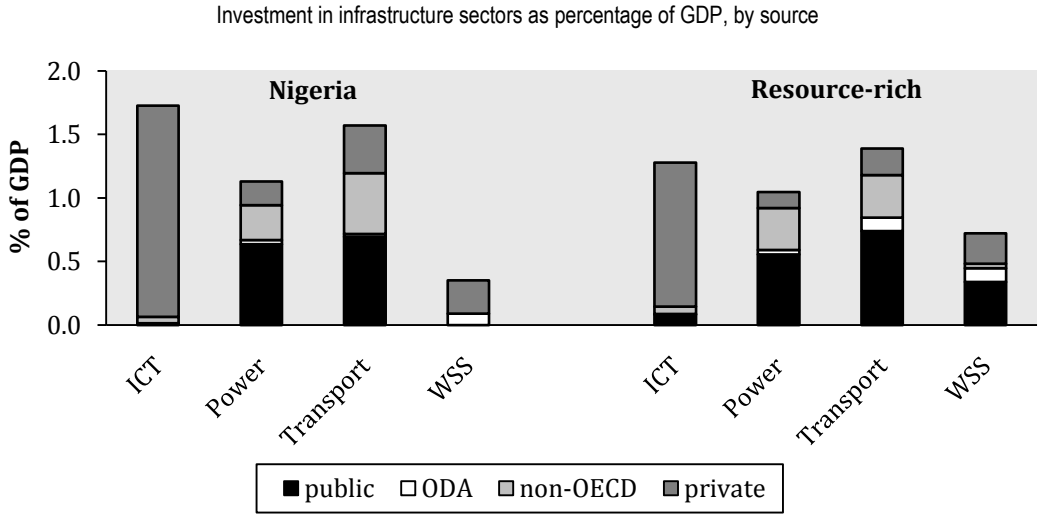
Figure 18. Nigeria's infrastructure spending is not high for the region



Source: Foster and Briceño-Garmendia 2009.

Note: GDP = gross domestic product; CAPEX = capital expenditure; ECOWAS = Economic Community of West African States.

Figure 19. Nigeria's pattern of capital investment in infrastructure differs from that of comparator countries



Source: Derived from Briceño-Garmendia, Smits, and Foster (2009).

Note: Private investment includes self-financing by households. OECD = Organisation for Economic Co-operation and Development; ICT = information and communications technology; WSS = water supply and sanitation; ODA = official development assistance (from OECD countries).

How much more can be done within the existing resource envelope?

About $2.5 billion of additional resources could be recovered each year by improving efficiency (table 16). Due to various kinds of inefficiencies, resources currently in the system are remaining uncaptured for frontline infrastructure provision. The cost of this waste amounts to $2.5 billion a year, almost all of it associated with the power sector. Within the power sector, the largest source of inefficiency lies in the underrecovery of costs, followed by distribution losses and undercollection. Across the board, there also appears to be a systematic problem of low capital budget execution that each year prevents some $0.5 billion of resources allocated to infrastructure from being spent. This problem is equally significant in the power and transport sectors, and also substantially affects the irrigation sector.

Table 16. Potential gains from greater operational efficiency

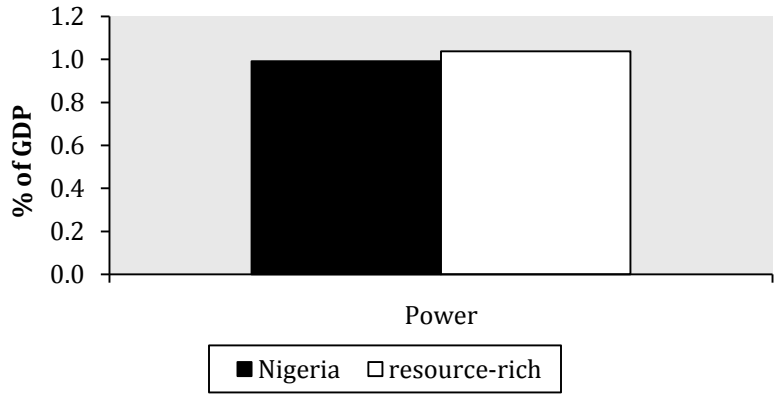
	ICT	Irrigation	Power	Transport	Total
Underrecovery of costs	—	n.a.	1,677	n.a.	1,677
Overstaffing	n.a.	—	n.a.	—	0
Distribution losses	—	—	226	—	226
Undercollection	—	n.a.	94	n.a.	94
Low budget execution	3	55	173	224	455
Total	3	55	2,171	224	2,453

Source: Derived from Foster and Briceño-Garmendia (2009).
Note: ICT = information and communications technology.
— = Not available; n.a. = not applicable.

As noted above, undercharging for power is the largest source of inefficiency; resources worth $1.7 billion fail to be captured each year, a hemorrhage equivalent to 1 percent of GDP. Nigeria's average effective tariff, as of 2009, was just under $0.05 per kWh, barely one-third of the total historic cost of producing power in the country, which was estimated to be around $0.15 per kWh. As a result, the power utility was barely covering its operating costs, leaving most of the capital investment unfunded. The associated financial burden was a staggering 1 percent of GDP (figure 15).

Figure 20. Underpricing of power and water in Nigeria is relatively burdensome

Financial burden of underpricing in 2006, as percentage of GDP

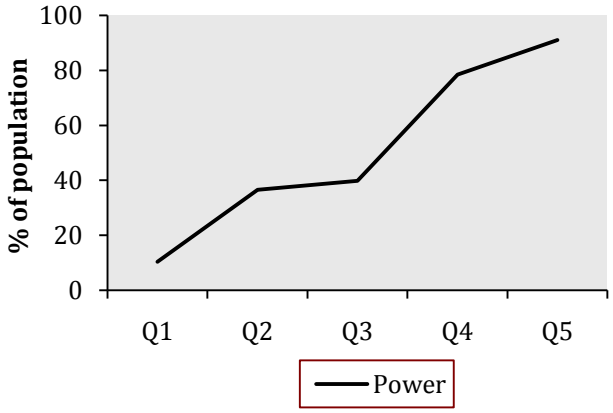


Source: Derived from Briceño-Garmendia, Smits, and Foster (2009).

Because of the inequitable access to power in Nigeria, subsidized tariffs are highly regressive. About three-quarters of those with electricity connections belong to the top 40 percent of the expenditure distribution; connections are extremely rare among poor households (figure 16). This highly inequitable distribution of connections virtually guarantees that any price subsidy for these services will be extremely regressive.

The affordability of cost-recovery infrastructure tariffs can be assessed by looking at the distribution of household budgets in Nigeria. A standard infrastructure affordability threshold of 5 percent of the budget is used. Relative to other low-income countries in Africa, the purchasing power of Nigeria's households is somewhat higher, making any particular level of the monthly utility bill affordable to a higher share of households (figure 17). Monthly bills of up to $4 are affordable to the vast majority of households, while those over $12 can be afforded by only a few.

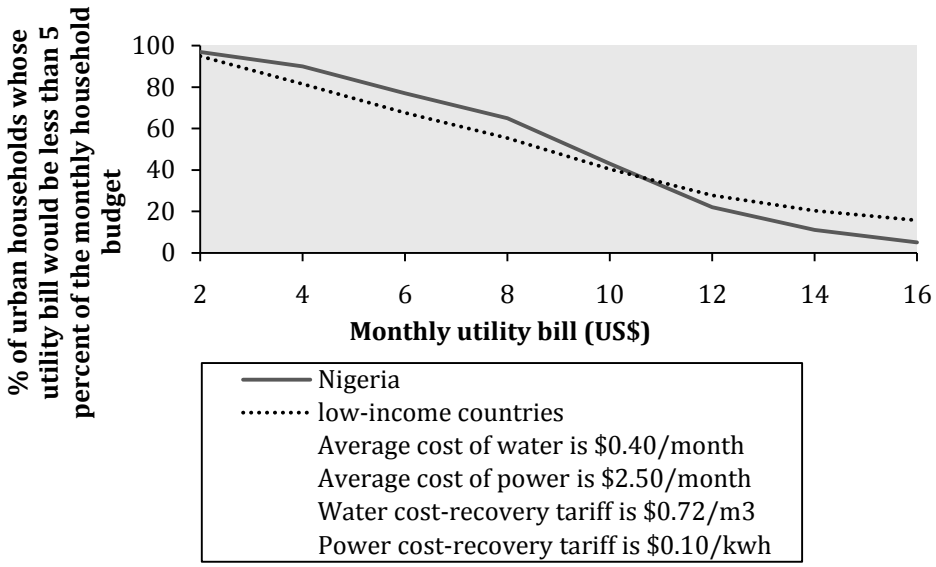
Figure 21. Access to power in Nigeria is highly inequitable



Source: Banerjee and others 2009.
Note: Q1 = first budget quintile, Q2 = second budget quintile, and so on.

Cost-recovery tariffs are affordable for most Nigerian households, and in particular those that have access to power today. The monthly bill that would result from cost-recovery pricing by the utilities can be estimated using the cost-recovery benchmark tariff and applying it to a subsistence level of household consumption. A cost-recovery tariff of $0.15/kWh for power and a subsistence consumption of 50 kWh per month—which is enough to power two 100-watt light bulbs for eight hours a day—amounts to a monthly power bill of $7.50, which would be affordable for two-thirds of Nigeria's population (figure 17). Given that as of today only 50 percent of households have access to power, and that these tend to be from the upper end of the income distribution, there does not seem to be any serious affordability problem among existing customers. Indeed, electrification rates would have to increase significantly across the lower-income groups before affordability became a serious issue. This is still some way ahead.

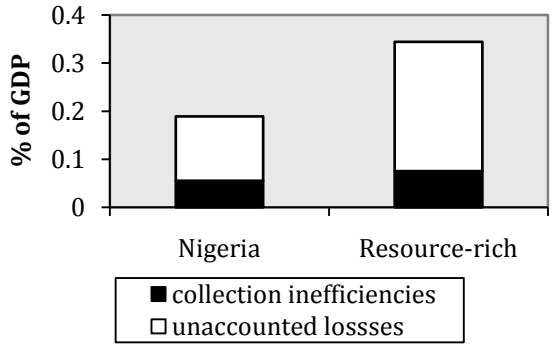
Figure 22. Affordability of utility bills



Source: Banerjee and others 2009.

The operational inefficiencies of the power sector are costing Nigeria $0.3 billion a year, or almost 0.2 percent of GDP (figure 18). About two-thirds of these hidden costs come from distribution losses and the remainder from undercollection of revenues. Indeed, despite recent improvements, Nigeria's power sector presents distribution losses of 20 percent (twice that of best-practice levels) and collects only 88 percent of its revenue (compared to best-practice levels of 100 percent). As a result, Nigeria's power utilities generate hidden costs for the economy equivalent to 0.2 percent of GDP. These findings are not atypical of other resource-rich countries in Africa.

Figure 23. The burden of inefficiency in Nigeria's power sector



Source: Derived from Briceño-Garmendia, Smits, and Foster (2009).

Annual funding gap

Nigeria's funding gap for federal infrastructure alone amounts to $3.6 billion per year, or about 3 percent of GDP. Almost the entire funding gap relates to the power sector (table 17). There is a small

shortfall for the ICT sector, while transport shows a surplus of capital spending even when some is reallocated within the sector toward maintenance.

Table 17. Funding gaps by sector

US$ millions

	ICT	Irrigation	Power	Transport	Total
Spending needs	(2,063)	(145)	(7,593)	(661)	(10,462)
Existing spending	1,949	145	1,954	516	4,564
Reallocation potential within sectors	0	0	0	145	145
Efficiency gains	3	55	2,171	224	2,453
Funding gap	**(112)**		**(3,468)**		**(3,580)**

Source: Derived from Foster and Briceño-Garmendia (2009).

Note: Potential overspending across sectors is not included in the calculation of the funding gap, because it cannot be assumed that it would be applied toward other infrastructure sectors. ICT = information and communications technology.

— = Not available.

What else can be done?

Raising additional public funds for infrastructure should be relatively straightforward for Nigeria, given its sizeable resource rents. With its abundant petroleum revenues Nigeria is better placed than many of its African neighbors to increase the share of fiscal resources going to infrastructure. Nevertheless, evidence suggests that in the recent past, resource-rich countries—such as Nigeria—have not tended to allocate incremental resource royalties toward infrastructure. Instead, huge debt repayments more than fully absorbed the fiscal windfalls in these countries. As a result, budgetary spending actually contracted by 3.7 percent of GDP even during a period of high oil prices in the early 2000s, with infrastructure investment bearing much of that and falling by almost 1.5 percent of GDP.

Another potential source for infrastructure finance, in an economy as large and solvent as Nigeria's, are the domestic capital markets. Yet the country's domestic capital markets function far below their potential. The outstanding stock of bank loans, government and corporate bonds, and equity issues channeled toward infrastructure is still only a fraction of what can be found in South Africa. The total outstanding value of the stock stood at no more than $2.5 billion in 2006 (table 18).

Table 18. Local capital market finance for infrastructure in Africa

Outstanding stock, US$ millions

	Bank loans	Government bonds	Corporate bonds	Equity issues	Total
Nigeria	**2,444**	**47**	**0**	**106**	**2,596**
South Africa	6,275	763	6,841	48,148	62,028
Other Sub-Saharan Africa	2,564	93	548	7,691	10,896
Total	11,283	903	7,389	55,945	75,520

Source: Derived from Foster and Briceño-Garmendia (2009).

Note: Potential overspending across sectors is not included in the calculation of the funding gap because it cannot be assumed that it would be applied toward other infrastructure sectors.

— = Not available.

* Traced to needs.

** Assuming complete fungibility across sectors.

Nigeria has proved to be an attractive destination for non-OECD financiers such as China, and could potentially do more to leverage interest. China's commitment to financing Nigerian infrastructure has been apparent in recent years. But a number of major projects identified for Chinese funding have been dropped. This is a missed opportunity and points to the importance of lining up Chinese projects with national development priorities.

Finally, if all else fails, it may be necessary to extend the time horizon for meeting the infrastructure targets beyond the illustrative 10-year period considered here. Simulations suggest that even if Nigeria is unable to raise additional finance, but if inefficiencies can be addressed, the identified infrastructure targets could be achieved within a 16-year horizon. But unless inefficiencies are eliminated, the existing resource envelope will not suffice to meet infrastructure targets in the medium term.

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This country report draws upon a wide range of papers, databases, models, and maps that were created as part of the Africa Infrastructure Country Diagnostic. All of these can be downloaded from the project website: www.infrastructureafrica.org. For papers go to the document page (http://www.infrastructureafrica.org/aicd/documents), for databases to the data page (http://www.infrastructureafrica.org/aicd/tools/data), for models go to the models page (http://www.infrastructureafrica.org/aicd/tools/models), and for maps to the map page (http://www.infrastructureafrica.org/aicd/tools/maps). The references for the papers that were used to compile this country report are provided below.

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AICD
AFRICA INFRASTRUCTURE
COUNTRY DIAGNOSTIC

About AICD and its country reports

This study is a product of the Africa Infrastructure Country Diagnostic (AICD), a project designed to expand the world's knowledge of physical infrastructure in Africa. The AICD provides a baseline against which future improvements in infrastructure services can be measured, making it possible to monitor the results achieved from donor support. It also offers a solid empirical foundation for prioritizing investments and designing policy reforms in Africa's infrastructure sectors.

The AICD is based on an unprecedented effort to collect detailed economic and technical data on African infrastructure. The project has produced a series of original reports on public expenditure, spending needs, and sector performance in each of the main infrastructure sectors, including energy, information and communications technologies, irrigation, transport, and water and sanitation. *Africa's Infrastructure—A Time for Transformation*, published by the World Bank and the Agence Française de Développement in November 2009, synthesized the most significant findings of those reports.

The focus of the AICD country reports is on benchmarking sector performance and quantifying the main financing and efficiency gaps at the country level. These reports are particularly relevant to national policy makers and development partners working on specific countries.

The AICD was commissioned by the Infrastructure Consortium for Africa following the 2005 G8 (Group of Eight) summit at Gleneagles, Scotland, which flagged the importance of scaling up donor finance for infrastructure in support of Africa's development.

The first phase of the AICD focused on 24 countries that together account for 85 percent of the gross domestic product, population, and infrastructure aid flows of Sub-Saharan Africa. The countries are: Benin, Burkina Faso, Cape Verde, Cameroon, Chad, Côte d'Ivoire, the Democratic Republic of Congo, Ethiopia, Ghana, Kenya, Lesotho, Madagascar, Malawi, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, South Africa, Sudan, Tanzania, Uganda, and Zambia. Under a second phase of the project, coverage was expanded to as many of the remaining African countries as possible.

Consistent with the genesis of the project, the main focus is on the 48 countries south of the Sahara that face the most severe infrastructure challenges. Some components of the study also cover North African countries so as to provide a broader point of reference. Unless otherwise stated, therefore, the term *Africa* is used throughout this report as a shorthand for *Sub-Saharan Africa.*

The World Bank has implemented the AICD with the guidance of a steering committee that represents the African Union, the New Partnership for Africa's Development (NEPAD), Africa's regional economic communities, the African Development Bank (AfDB), the Development Bank of Southern Africa (DBSA), and major infrastructure donors.

Financing for the AICD is provided by a multidonor trust fund to which the main contributors are the United Kingdom's Department for International Development (DFID), the Public Private Infrastructure Advisory Facility (PPIAF), Agence Française de Développement (AFD), the European Commission, and Germany's Entwicklungsbank (KfW). A group of distinguished peer reviewers from policy-making and academic circles in Africa and beyond reviewed all of the major outputs of the study to ensure the technical quality of the work. The Sub-Saharan Africa Transport Policy Program and the Water and Sanitation Program provided technical support on data collection and analysis pertaining to their respective sectors.

The data underlying AICD's reports, as well as the reports themselves, are available to the public through an interactive Web site, www.infrastructureafrica.org, that allows users to download customized data reports and perform various simulations. Many AICD outputs will appear in the World Bank's Policy Research Working Papers series.

Inquiries concerning the availability of data sets should be directed to the volume editors at the World Bank in Washington, DC.