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The Democratic Republic of Congo's Infrastructure

A Continental Perspective

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Abstract

The Democratic Republic of Congo (DRC) faces possibly the most daunting infrastructure challenge on the African continent. Conflict has seriously damaged most infrastructure networks. Vast geography, low population density, extensive forestlands, and criss-crossing rivers complicate the development of new networks.

Progress has been made since the return of peace in 2003. A privately funded GSM network now provides mobile telephone signals to two-thirds of the population. External funding has been secured to rebuild the country's road network, and domestic air traffic has grown. Modest investments could harness inland waterways for low-cost transport. Much more substantial investments in hydropower would enable the DRC to meet its own energy demands cheaply while exporting vast quantities of power.

One of the country's most immediate infrastructure challenges is to reform the national power utility and increase power generation and delivery. Capacity must increase by 35 percent over the period 2006–15 to meet domestic demand. The dilapidated condition of both road and rail infrastructure presents another challenge.

To meet the target defined in the report, investment in the country's infrastructure must increase from $700 million to $5.3 billion per year over the next decade, a staggering 75 percent of 2006 GDP. New infrastructure technologies, the elimination of inefficiencies, and cross-border finance (for hydropower development) could cut the annual funding gap in half. Recently, the country secured $4 billion in external finance commitments for infrastructure, enabling increases in budget allocations for public investment.

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Produced by the Research Support Team

The Democratic Republic of Congo's Infrastructure: A Continental Perspective

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The Democratic Republic of Congo (DRC) faces what is probably the most daunting infrastructure challenge on the African continent. As a result of conflict, networks have been seriously damaged or left to deteriorate. Today, about half of existing infrastructure assets are in need of rehabilitation. Even before the conflict, the lack of basic infrastructure made it difficult to knit together the country's disparate economic and population centers. The country's vast geography, low population density, extensive forests, and criss-crossing rivers further complicate the development of infrastructure networks.

Since the return of peace in 2003, there have been promising signs. Notably, a privately funded GSM telephone network now provides a signal to two-thirds of the population at a reasonable cost. Significant external funding has been captured to rebuild the country's road network. There has also been an increase in domestic air routes served, as well as a renewal of the aircraft fleet. The country is endowed with the largest economically exploitable hydropower resources in Africa, giving it the potential to meet its own energy demands and become the continent's largest power exporter. Inland waterways can provide low-cost surface transport, with only relatively modest investments needed to improve navigability.

One of the DRC's most urgent infrastructure challenges is to increase the generation of power and deliver it in a more cost-effective manner. Close to half the existing plants require refurbishment. Capacity must increase by 35 percent over the period 2006–15 to meet domestic demand. Providing reliable public supplies could reduce the (weighted average) price of power to the urban private sector from 23 cents to 4 cents per kilowatt-hour (kWh) and would bring rates of return in excess of 100 percent. Another important part of the solution is to undertake operational and institutional reforms of the national power utility.

Road and rail infrastructure are in dilapidated condition, and the rail network has fallen into disuse. As the country embarks on a massive road investment program, it will be essential to ensure that funds are made available to maintain the network.

To rebuild the country and catch up with the rest of the developing world, the DRC needs to spend $5.3 billion a year over the next decade, a sum equivalent to 75 percent of its 2006 GDP. Of this total, as much as $1.1 billion a year needs to be devoted to maintenance alone. The DRC's recent infrastructure spending of $700 million a year falls far below the level needed to make an impact over the next decade. Significant inefficiencies waste at least $430 million each year, but even if these problems were corrected, an infrastructure funding gap of the order of $4 billion a year would remain.

Judicious choice of infrastructure technologies and creative use of cross-border finance could reduce the funding gap to $2 billion a year. In addition, the country has recently secured more than $4 billion in external finance commitments for infrastructure, and plans are underway to increase both central and provincial budget allocations for public investment. By combining new resources with an improved policy and institutional environment, it should be possible to make substantial progress in funding the infrastructure deficit. Business as usual is not a viable option. Unless spending is increased and efficiency improved, it will take more than a century to redress the country's infrastructure deficit. This is clearly an unacceptable outcome, one that underscores the urgency of action.

The continental perspective

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

This report presents the key AICD findings for the DRC, allowing the country's infrastructure situation to be benchmarked against that of its African peers. Given that the DRC is a fragile state trying to catch up with other low-income countries (LICs) in the region, both fragile-state and LIC African benchmarks will be used to evaluate the DRC's situation. Detailed comparisons will also be made with immediate regional neighbors in Central Africa.

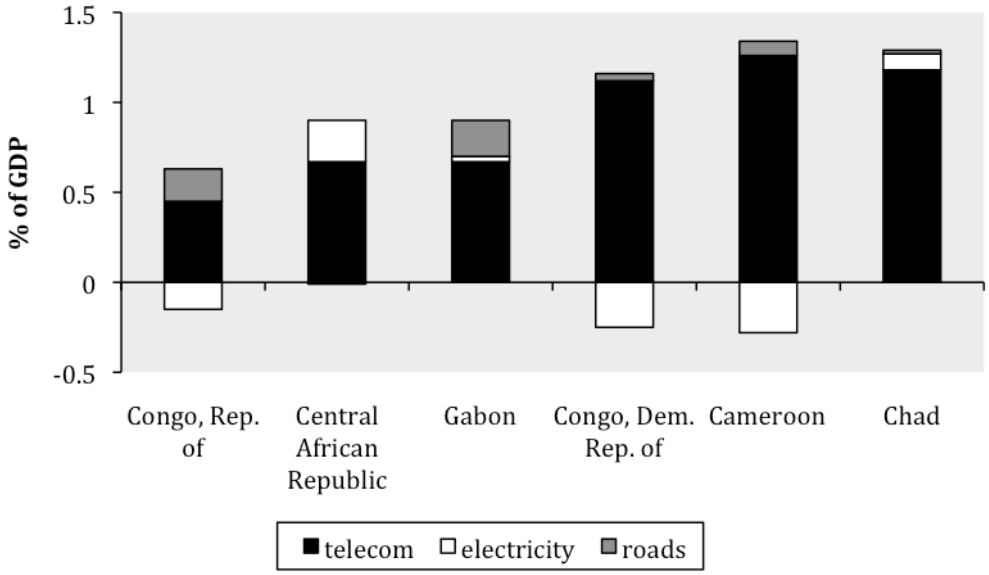
Several methodological issues should be borne in mind. First, because of the cross-country nature of data collection, a time lag is inevitable. The period covered by the AICD runs from 2001 to 2006. Most technical data presented are for 2006 (or the most recent year available), while financial data are typically averaged over the available period to smooth out the effect of short-term fluctuations. Second, in order to make comparisons across countries, indicators had to be standardized to place the analysis on a consistent basis. 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

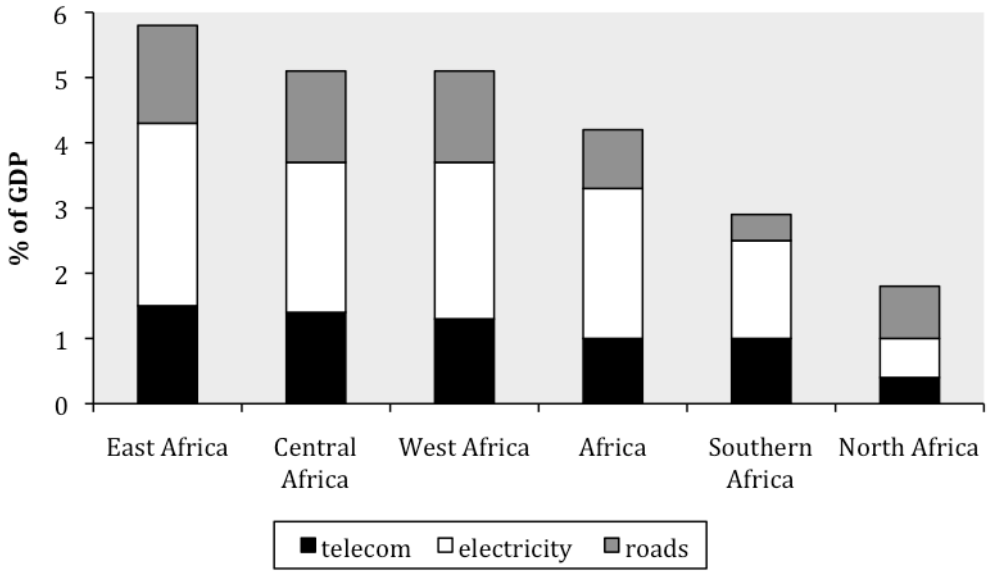
During the period from 2001 to 2005, per capita economic growth in DRC was on average 2.1 percent higher than during the period from 1991 to 1995. Despite this improvement, growth levels, which oscillated between 4 and 8 percent in the early 2000s, still fell short of the sustained 7 percent per year needed to meet the Millennium Development Goals (MDGs). Improved telecommunications infrastructure has been the main driver of this change, contributing 1.1 percentage points to the country's per capita growth rate. Deficiencies in power infrastructure, on the other hand, held back per capita growth by 0.25 percentage point over this period. Simulations suggest that if Central Africa's infrastructure platform could be improved to the level of the African leader, Mauritius, per capita growth rates could increase by as much as 5 percent per year. Almost half of this impact would come from improvements in the power sector alone (figures 1 and 2).

Figure 1. Historic and potential future links between infrastructure and growth

a. Historic changes in growth per capita



b. Potential improvements in growth per capita



Evidence from enterprise surveys suggests that infrastructure constraints throughout the region are responsible for about 40 percent of the productivity handicap faced by Sub-Saharan firms, with the remainder being due to poor governance, bureaucratic red tape, and financing constraints. In many countries, lack of affordable power is the infrastructure constraint that weighs most heavily on firms. While detailed enterprise survey evidence is not available for the DRC, power would likely emerge as a major concern here as well.

The state of the DRC's infrastructure

The DRC's population and economic activity is concentrated in three distinct centers that form a triangle—Kinshasa in the southwest, Lubumbashi in the southeast, and Kisangani in the northeast (figure 3). As illustrated clearly in the maps, there is a marked absence of well-developed infrastructure linking these three cities, particularly with respect to road and rail. Power and ICT infrastructure is somewhat developed along the Kinshasa-Lubumbashi axis, although there is no fiber optic network to speak of and the main power transmission line is in need of major rehabilitation. The rest of the country is almost entirely devoid of power and ICT coverage, although GSM coverage has been recently expanded in the east. With respect to transport infrastructure, many regions of the DRC (notably the southeast and northeast) are better connected with neighboring countries' infrastructure corridors than they are with domestic ones.

This report begins by reviewing the main achievements and challenges in each of the DRC's major infrastructure sectors, with the key findings summarized in table 1. The problem of how to finance the DRC's outstanding infrastructure needs will also be addressed.

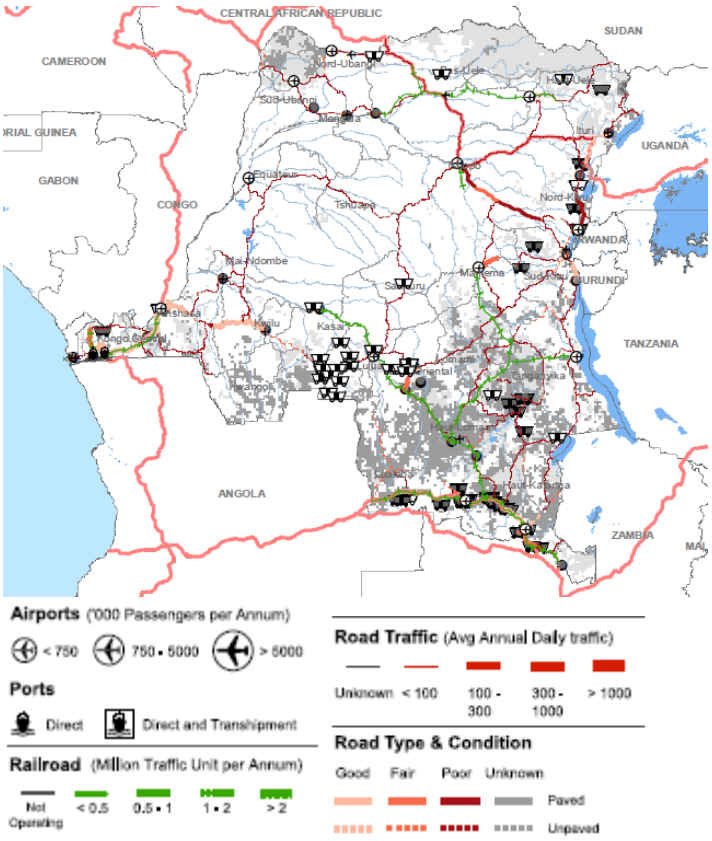
Table 1. Overview of achievements and challenges in the DRC's infrastructure sectors

	Achievements	Challenges
Air transport	Increased domestic connectivity and renewal of aircraft fleet	Strengthen regulation to improve dismal air transport safety record
ICT	High level of GSM signal coverage at reasonable cost	Increase mobile phone penetration Develop links to submarine cables
Ports	Port of Matadi available to service Kinshasa area	In short run, improve service at Matadi In long run, secure access to deepwater port
Power	Vast low-cost hydropower resources and potential to become major exporter	Invest heavily in power generation Improve performance of utility
Railways	Strategic networks available to support timber and mineral exports	Improve infrastructure and quality of service to regain market share from road transport
Roads	Progress in mobilizing external finance for network reconstruction	Provide for road network maintenance Modernize regulatory framework for trucking Give due attention to river navigation
Water and sanitation	Rapidly expanding access to unimproved latrines	Accelerate access to improved water and sanitation Improve performance of utility

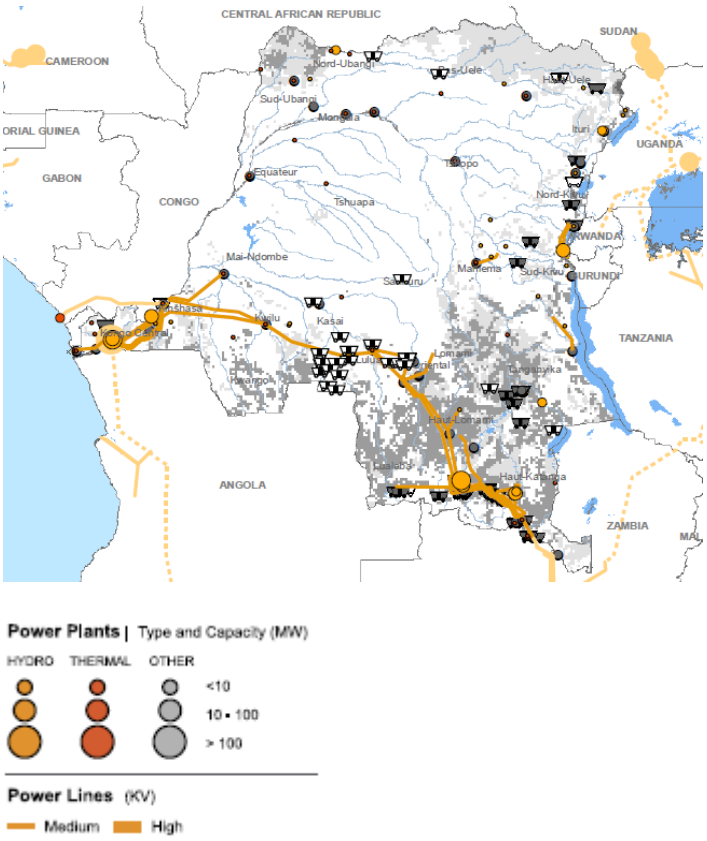
Source: Authors' elaboration based on findings of this report.

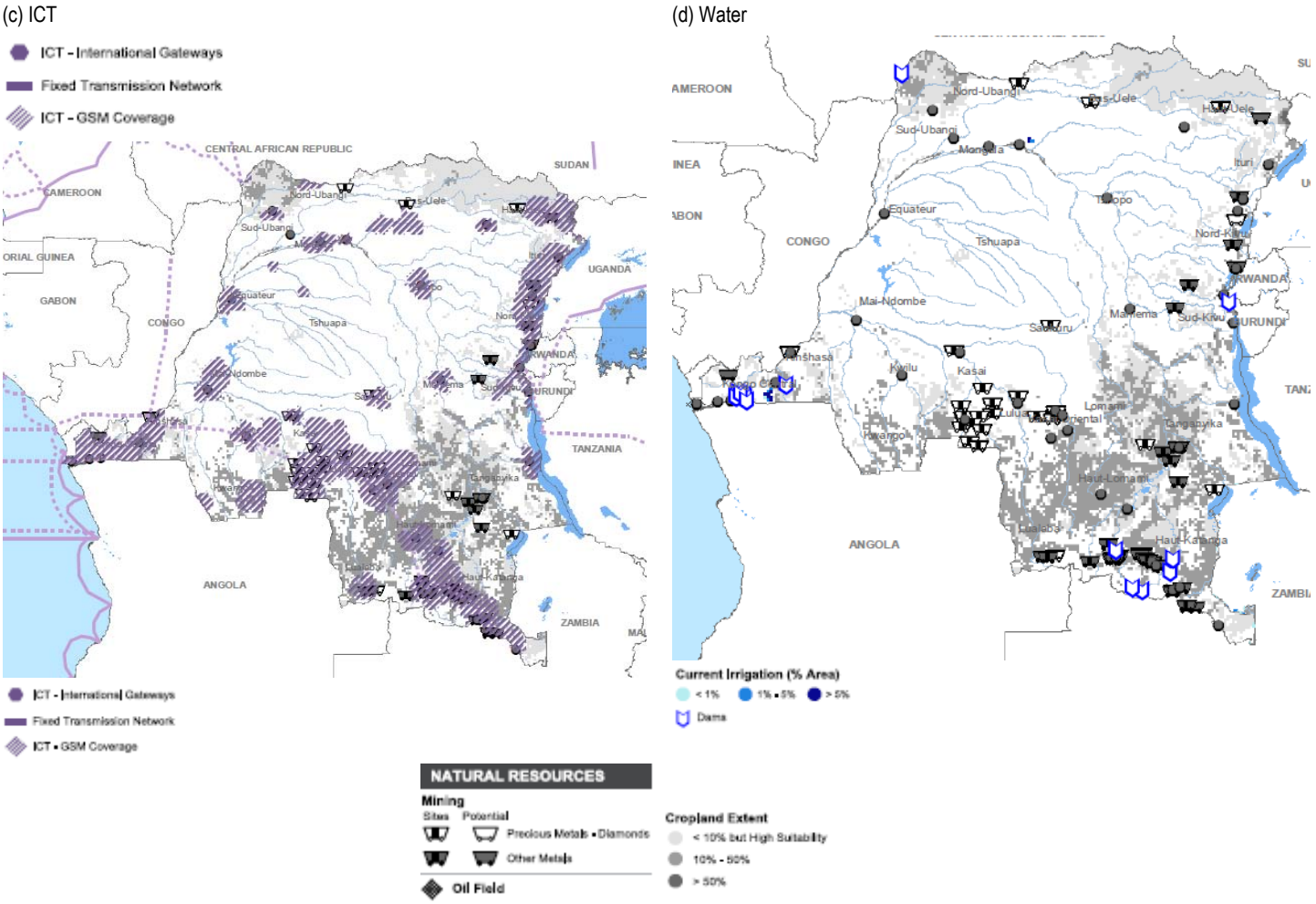
Figure 2. The DRC's infrastructure backbones have yet to form a national network

a. Transport



b. Power





Source: AICD Interactive Infrastructure Atlas for Democratic Republic of Congo downloadable from http://www.infrastructureafrica.org/aicd/system/files/drc_new_ALL.pdf

Power

Achievements

The DRC boasts the largest and most cost-effective hydropower potential on the continent. Due to the immense hydropower resources associated with the Inga Falls on the Congo River, the DRC could potentially produce an estimated 100,000 megawatts (MW) of power. (As a point of comparison, the entire installed capacity of Sub-Saharan Africa today is only 48,000 MW.) Moreover, these hydro resources are likely the most cost-effective on the continent, with the long-run marginal cost of power generation estimated at 1.4 cents per kWh. (By contrast, the long-run marginal costs of hydropower generation are 6.9 cents per kWh in Ethiopia and 5.8 cents per kWh in Guinea.)

The country has the potential to become Africa's largest power exporter. The DRC already exports a modest amount of power to Zambia, Zimbabwe, and South Africa. But if the country's hydro resources were fully developed, it could become Africa's largest power exporter (table 2). Assuming that power were able to flow freely around the Southern African Power Pool (SAPP), it would be economically

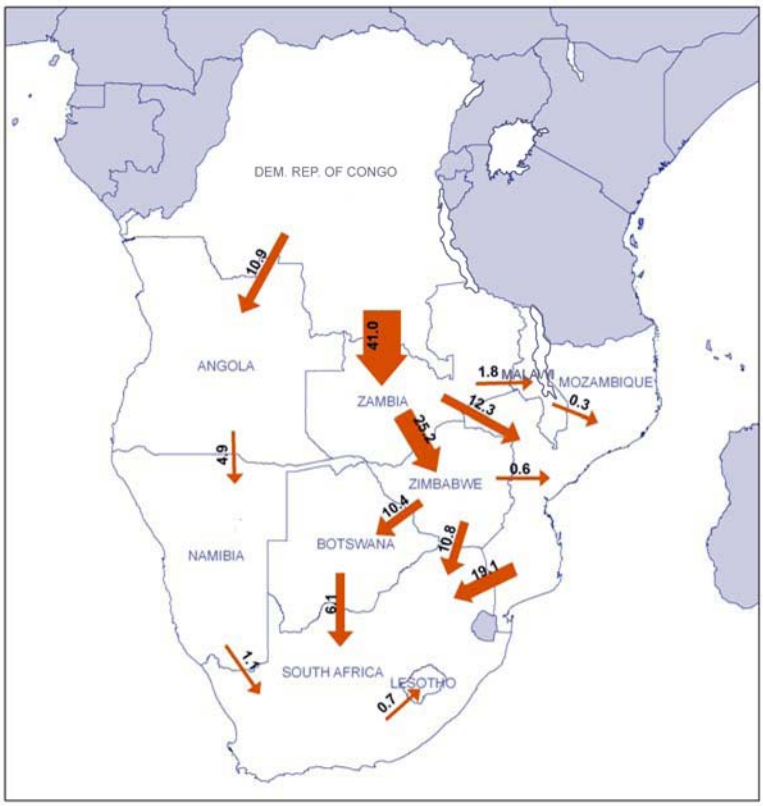
optimal for the DRC to export 51.9 terrawatt-hours (TWh) of power, thereby supplying more than 15 percent of total consumption in the SAPP area. This power would flow along three different routes southward toward South Africa (through Angola, Zimbabwe, and Mozambique), making a net contribution to the power consumption of most of the countries along the way before eventually meeting 10 percent of the needs of the largest regional market: South Africa (figure 3). Assuming a (purely illustrative) profit margin of 1 cent per kWh, power exports would contribute in excess of 5 percent of the DRC's GDP.

Table 2. Profile of top six potential power-exporting countries

	Potential net exports	Net revenues		Required investment	
Country	**(TWh per year)**	(millions / year)	(% GDP)	(millions / year)	(% GDP)
Congo, Dem. Rep. of	51.9	519	6.1	749	8.8
Ethiopia	26.3	263	2.0	1,003	7.5
Guinea	17.4	174	5.2	786	23.7
Sudan	13.1	131	0.3	1,032	2.7
Cameroon	6.8	68	0.4	267	1.5
Mozambique	5.9	59	0.8	216	2.8

Source: Rosnes and Vennemo 2008.

Figure 3. Fiscally optimal power trade pattern, the SAPP



Challenges

Only a tiny fraction of the DRC's hydropower potential is developed, and much of that has fallen into disrepair. Only 2,540 MW of the 100,000 MW potential has actually been developed as installed capacity, and only 1,100 MW of this meager capacity is actually in functioning order. There are two interconnected power systems in the country. This first connects the Inga site in Bas Congo to Kinshasa and Brazzaville, as well as to Katanga and on to Zambia. The second interconnects the two Kivu Provinces with Rwanda and Burundi. Both systems are dilapidated and need extensive rehabilitation.

As a result, power supply is heavily constrained and subject to blackouts, placing major limitations on private sector activity. About 40 percent of firms in the DRC own and operate their own backstop generator to shield themselves from frequent power interruptions, which cause significant production losses. This is one of the higher percentages of generator ownership in Africa (although the ratio exceeds 80 percent in Nigeria). The Platt's power generation database indicates that almost half of the installed generation capacity in the DRC is owned and operated by private companies for the purpose of self-supply—one of the highest ratios anywhere in Africa. Timber mills in the Kinshasa area spend up to 63 cents per kWh to run diesel-powered backup generators when needed. This represents a major constraint in the conversion of logs to higher-value timber products for export. In the Katanga region, mining companies depend primarily on power from the Inga hydro plant, but due to dilapidated infrastructure, supplies are highly unreliable, with 19 interruptions reported on average per month. Overall, the Katanga region is estimated to have a power supply deficit of 900 MW. Due to these deficiencies, mining companies have developed their own local hydroelectric schemes at a cost of around of 10 cents per kWh, compared with an estimated long-run marginal cost for grid electricity of less than 4 cents per kWh.

To turn this situation around, huge investments in new generation and transmission capacity are needed. Just meeting the country's domestic power demands for the coming decade calls for the refurbishment of the entire existing generation stock, plus a 35 percent expansion of installed generation capacity, to reach about 3,000 MW overall. Developing the DRC's export potential would call for the installation of a further 7,600 MW. As shown in table 2, just to develop its potential as a power exporter, the DRC would need to invest some $750 million per year over the next decade, tying up 8.8 percent of GDP—a formidable proposition.

Furthermore, the weak financial performance of the power utility SNEL has led to a hemorrhage of resources in the sector. Compared with other African power utilities, SNEL displays very high levels of inefficiency (table 3), though its performance is typical for fragile states. Distribution losses are 40 percent compared with a best-practice benchmark of 12 percent. At the same time, only 40 percent of revenues billed are collected by the utility, and government institutions are particularly guilty of nonpayment. As a result, SNEL faces exceptionally high hidden costs of 595 percent of revenues, meaning that the utility has at its disposal barely 20 percent of the revenues that it should. Due to the relatively low cost of power production, cost-recovery does not appear to be a major issue for the utility, even though DRC's tariffs are among the lowest in Africa. But the fact that the leading institution in the sector is in such a weak financial condition is evidently holding back the implementation of urgently needed investments in power generation capacity and the realization of the country's potential as a power exporter.

Table 3. Benchmarking power indicators

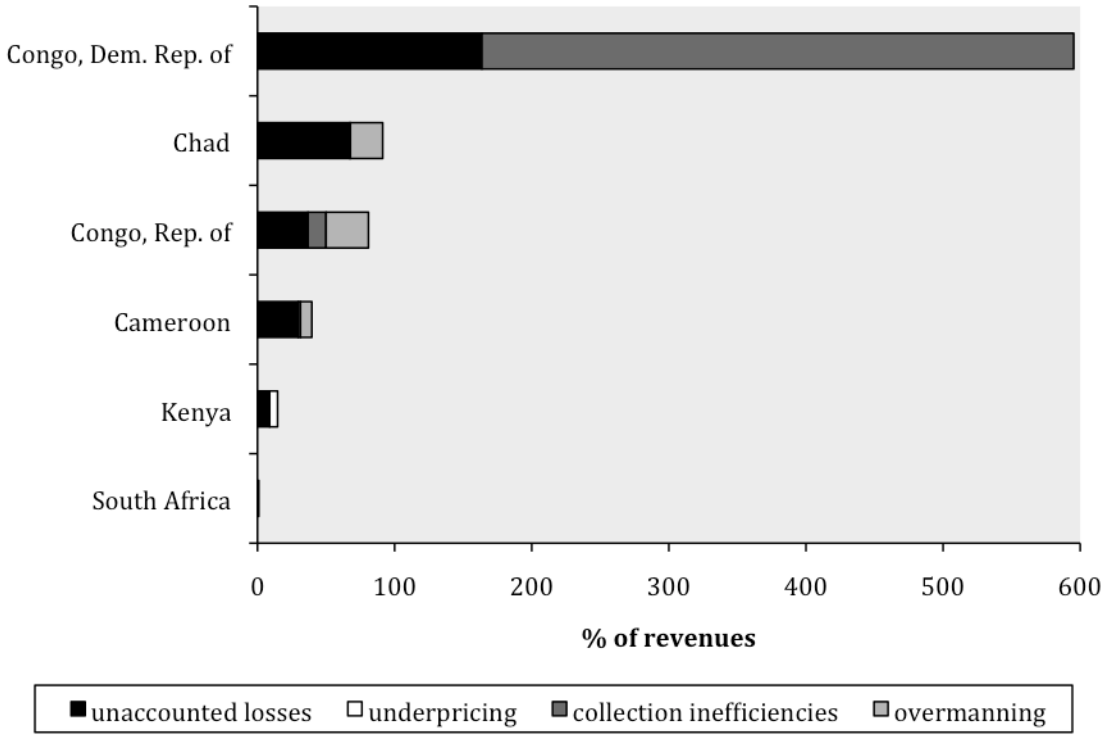
	Unit	Low-income countries	**DRC**	Fragile states
Installed power-generation capacity	MW/mil. people	20.2	**41.6**	45.7
Power consumption	kWh/capita	107.4	**122.5**	165.3
Power outages	Day/year	10.4	**213.5**	11.1
Firms' reliance on own generator	% consumption	21.2	**17.1**	16.2
Firms' value lost due to power outages	% sales	6.5	**5.6**	5.4
Access to electricity	% population	15.0	**6**	49.7
Urban access to electricity	% population	57.6	**30**	89.7
Rural access to electricity	% population	3.9	**1**	26.6
Growth access to electricity	% population/year	0.8	–	3.3
Revenue collection	% billings	93.1	**41.8**	33.6
Distribution losses	% production	23.7	**40.0**	40.0
Cost recovery	% total cost	84.4	**100.0**	100.0
Total hidden costs	% of revenue	68.8	**595.3**	442.5

U.S. cents	**DRC**	Predominantly hydrogeneration	Other developing regions
Power tariff (residential at 75 kWh)	**4.0**	10.27	5.0–10.0
Power tariff (commercial at 900 kWh)	**11.0**	11.73	
Power tariff (industrial at 50,000 kWh)	**14.6**	11.39	

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

— = data not available.

Figure 4. Hidden costs of power utilities



Source: Eberhard and others 2009

Roads

Achievements

The DRC has made significant progress in mobilizing external resources to support the reconstruction of the road network. Following years of armed conflict, the DRC's road network fell into disrepair, and road connectivity between the country's economic and demographic centers was seriously compromised. In the years since the conflict's end, reconstructing the road network has been a top priority, and to this end the country has secured major financial commitments from multilateral and bilateral donors, as well as from China. These funds cover many of the country's major road corridors linking Kinshasa and Lubumbashi, as well as roads along the eastern side of the country. As a result, recent road quality indicators suggest that the state of the country's limited paved network (fewer than 3,000 km) has improved considerably and is now comparable with those of other LICs in the region. Nevertheless, the unpaved roads—which at more than 30,000 km still represent the vast majority of the network—are in serious disrepair, with only 42 percent in good or fair condition.

Table 4. Benchmarking road indicators

	Unit	LIC	DRC	Fragile states
Paved road density	km/1,000 km^2 of land	16	1	21
Unpaved road density	km/1,000 km^2 of land	68	14	75
Geographic information system (GIS) rural accessibility	% of rural population within 2 km of all-season road	21.7	29.3	—
Paved road traffic	Average annual daily traffic	1,027	257	843
Unpaved road traffic	Average annual daily traffic	55	20	55
Paved network condition	% in good or fair condition	75	70	69
Unpaved network condition	% in good or fair condition	58	42	55
Perceived transport quality	% firms identifying as major business constraint	23	30	—

Source: Gwillliam and others 2009, derived from AICD national database downloadable from http://www.infrastructureafrica.org/aicd/tools/data.
— = data not available.

Challenges

The DRC's vast landmass (equivalent to the size of Western Europe), low population density, and extensive river network makes road development particularly challenging. A large share of the land area is covered by dense tropical forest and crisscrossed by rivers that complicate road construction and maintenance due to the numerous bridges needed. For all these reasons, it is not entirely surprising that the DRC should have such a low road network density compared with other LICs in Africa (table 4).

A key issue going forward will be not only to reconstruct the road network but to create a sustainable basis for funding road maintenance. The DRC's immediate focus has been to reconstruct roads that had fallen into disrepair and disuse during the conflict period, with a view to reestablishing connectivity. Once this is accomplished, something must be done to ensure that the reconstructed roads are adequately maintained. *Given the vast geographical expanse of the network, the DRC needs to spend almost $400 million a year just to keep its transport infrastructure in usable condition*. Not only does this represent more than 5 percent of GDP, but it is also several times higher than the entire public investment budget of the country over the past few years. Securing resources for maintenance clearly represents a huge challenge, as does spending those funds effectively. As of 2010, an important step toward the sustainability of the road network has been taken with the creation of a road fund.

Beyond road infrastructure itself, the cost of road freight transportation is very high by African standards. From a broader economic perspective, the key transport variable is the price of surface freight haulage. While a detailed study of road freight tariffs in the DRC has not yet been undertaken, the available anecdotal evidence indicates that these costs are very high (even by African standards) and can easily amount to 15 cents per tonne-kilometer (tonne-km), compared to 5 cents per tonne-km in southern Africa. In theory, improvements in road infrastructure should reduce road haulage costs and lead to lower tariffs, but in much of Central Africa the presence of trucking cartels and tour-de-role regulations (whereby government allocates freight to companies based on a queuing system) lead to major profit

markups and prevent the benefits of improved infrastructure from being passed on to businesses in the form of lower freight tariffs. This underscores the importance of addressing not only the physical infrastructure constraints of the road network but also the regulatory framework governing the trucking industry.

Rail

Achievements

The DRC has two separate rail systems of strategic significance for the country: Chemin de Fer Matadi-Kinshasa (CFMK) and the Société Nationale des Chemins de Fer du Congo (SNCC). CFMK operates the 366-km rail link from Kinshasa to the port of Matadi. This is a single-track route with road access at four major junctions. This rail link is the natural transport mode for timber exports and other bulk traffic that is not time sensitive, including imports to the city of Kinshasa. The current track is only 30 years old and is in reasonable condition. SNCC operates an extensive network centered in the southeast of the country. The most important branch of this network connects Kolwezi to Sakania on the Zambian border, and westward to Ilebo. The SNCC network is the natural transport mode for copper exports leaving the DRC for the port of Durban, and will eventually also offer the opportunity to export copper through Lobito in Angola via the Benguela Railway, which is currently under reconstruction. Although the CFMK and SNCC networks are not interconnected, through-transport from Kinshasa to Lubumbashi has historically been achieved using the river link from Kinshasa to Ilebo, where the SNCC network begins.

Challenges

Both Congolese rail networks have seen their traffic decline sharply due to deficient service and strong intermodal competition, so neither is playing its historic role. Despite the relatively good condition of CFMK's track, its rolling stock has deteriorated and its quality of service has declined. The recent rehabilitation of the road corridor parallel to the track has led many businesses to send their bulk freight by road rather than rail. The SNCC network is in poor condition, with commercial speed limits of as low as 10km per hour. Deficiencies in rail service (as well as discriminatory pricing toward Congolese copper by the Zambian rail operator) have meant that the bulk of copper traffic is currently traveling by road. As a result, neither railway is playing its natural role in the Congolese economy, and rail traffic levels have declined to a fraction of those found on neighboring (and already lightly used) Central African rail networks (table 5).

In addition, the networks suffer from very poor efficiency and relatively high tariffs (table 5). Efficiency parameters are only a fraction of those found on neighboring systems in Angola, Cameroon, Congo, and Gabon. Freight tariffs at $0.15–$0.20 per tonne-km are almost three times the rates found elsewhere in southern Africa. For all these reasons, traffic densities on Congolese railways are very low: less than half of those found in neighboring countries.

Table 5. Benchmarking railway indicators, 2000–05

	CFMK (DRC)	SNCC (DRC)	CFCO (Congo)	SETRAG (Gabon)	CFM (Angola)	CAMRAIL (Cameroon)	South Africa (SPOORNET)
Concessioned (1)/ State run (0)	0	0	0	1	0	1	0
Traffic density, freight, 1,000 tonne-km/km	172	214	428	504	469	1,092	5,319
Efficiency							
Staff: 1,000 unit tariff (UT) per staff	18	38	221	1,778	580	603	3,037
Coaches: 1,000 passenger-km per coach	64	275	3,212	1,891	4,045	4,738	596
Cars: 1,000 tonne-km per wagon	257	317	300	902	950	868	925
Locomotive availability in %	10	4	27	39	30	26	—
Tariffs							
Average UT, passenger, U.S. cents/passenger-km	4.2	3.1	5.6	8.6	—	2.2	—
Average UT, freight, U.S. cents/tonne-km	13.7	12.5	10.7	2.5	—	5.2	—

— = data not available.

River

Achievements

While it is important to reconstruct the road and rail networks, the very valuable role that can be played by river transportation should not be overlooked. The vast Congo River traverses the DRC, linking two of its main cities (Kinshasa and Kisangani), while its innumerable tributaries crisscross much of the country.

Challenges

About 15,000 km of the Congo River and its tributaries are navigable, or potentially so with a certain amount of regular dredging and relatively modest investments in quays and signaling. The capital and maintenance costs per kilometer of navigable waterway are a fraction of those per kilometer of road. Even under today's less than ideal navigation conditions, the cost of moving freight along the Congo River—around 5 cents per tonne-km—is only a third of the cost of moving freight by road or rail. Although the river network does not cover all routes of interest, and river transport is comparatively slow, it has clear economic advantages and the potential to recover its historically large role in the DRC's transport network.

Ports

Achievements

The Port of Matadi plays a critical role in the national economy. Matadi is a feeder port servicing Kinshasa and the southwest area of the country. It has a capacity of 2.5 million tonnes per year but operates at only 2 million tonnes per year at present. The Port of Matadi is physically constrained by its overall cargo-handling capacity and by the depth of the river, which has a draught of only 6.5 meters. Matadi therefore cannot take direct calls from major international shipping lines; instead, it relies on transshipment from Pointe Noire using smaller vessels. Other ports on the estuary of the Congo River are Boma (farther inland) and Banana (closer to the mouth of the river). But these ports are presently less significant than Matadi and face the same problem of limited draught.

The rest of the DRC relies on other regional ports as far afield as Durban, Dar es Salaam, and Mombasa. The Port of Matadi is important to only the southwest part of the country. Because of the high internal transport costs and large distances involved, trade from southeast DRC is channeled mainly through Durban and to a lesser extent through Dar es Salaam. Even with improvements to the infrastructure corridors across the south of the country and the potential reopening of the Benguela Railway into Angola, it would be difficult for ports on the western side of the continent to compete with the transport system in southern Africa. Accordingly, this pattern of trade is unlikely to change in the foreseeable future. Mombasa remains the key port for Kisangani and the northeast part of the country. But improvements in the navigability of the Congo River corridor could potentially serve to deflect some of this trade toward ports on the western side of the continent.

Challenges

Port services at Matadi are costly and inefficient by regional and global standards (table 6). Compared to neighboring Central African ports, the Port of Matadi's performance is very poor, and it appears even worse next to leading African ports such as Durban. Container dwell times average 25 days, or more than five times the regional best practice. Truck cycle times average 18 hours, or more than three times the regional best practice. Crane productivity is also only a fraction of that found elsewhere. Not only is the quality of service poor, but port-handling charges for general cargo, at $10 per tonne, are significantly higher than they are elsewhere. In addition, river sedimentation is further reducing the draught of the port, so routine dredging is needed to maintain navigability.

Improving port performance will require concerted institutional and management reform. Globally, the traditional service port model, in which the state owns and operates all services, has been giving way to a landlord model, in which the state owns the port and operates the large-scale civil infrastructure while the private sector provides superstructure (such as terminals and cranes) as well as port services. Within Africa, only Ghana and Nigeria have so far adopted the landlord approach, but more than 20 ports have already incorporated private sector participation, generally into container terminal operations, with discernible favorable effects on performance. This experience may be of interest to the DRC as it considers institutional options that could help to improve the performance of the Port of Matadi.

Table 6. Benchmarking port indicators

	Matadi (DRC)	Boma (DRC)	Luanda (Angola)	Douala (Cameroon)	Pointe Noire (Congo)	Apapa (Nigeria)	Durban (South Africa)
Traffic							
Container cargo throughput (TEU/year)	—	10,000	377,208	190,700	—	336,308	1,899,065
Container-handling capacity (TEU/year)	200,000	—	400,000	270,000	150,000	500,000	1,450,000
General cargo throughput (tonnes/year)	—	—	4,000,000	3,800,000	3,300,000	3,400,000	—
General cargo-handling capacity (tonnes/year)	1,700,000	500,000	4,000,000	6,500,000	5,000,000	4,000,000	7,900,000
Efficiency							
Average container dwell time in terminal (days)	25.0	—	12.0	11.5	18.0	42.0	4.0
Average truck-processing time for receipt and delivery of cargo (hours)	18.0	—	14.0	12.0	12.0	6.0	5.0
Average container crane productivity (containers loaded-unloaded per crane hour)	6.5	—	6.5	18.5	6.5	12.0	15.0
Average general cargo crane productivity (tonnes loaded-unloaded per crane working hour)	6.0	5.0	16.0	12.0	7.5	9.0	25.0
Tariffs							
Container-handling charge, ship to gate ($/TEU)	120	—	320	220	140	155	258
Average general cargo-handling charge, ship to gate ($/tonne)	10.0	10.0	8.5	6.5	5.5	8.0	8.4

Source: Mundy and Penfold 2008.

— = data not available.

In the longer term, the DRC will need to secure access to a deep-sea port. While an improved Port of Matadi will be able to service the southwest DRC for some years to come, in the longer term additional capacity will need to be found. The DRC would probably also benefit from having direct land access to a deepwater port that receives direct calls from major international shipping lines. To achieve this goal, the DRC faces two strategic options.

One option is to further develop the Port of Banana and (by means of major dredging works) convert it into a deep-sea port. The establishment of such a port, however, would cost around $2 billion and take 10 years to complete. Even once established, it is not clear whether the port would handle the kind of traffic volumes needed to attract direct calls from major shipping lines, or whether it would continue to rely on transshipment services from Pointe Noire.

The other option involves strengthening land links with the Republic of Congo to facilitate access to the Port of Pointe Noire. The poor quality of service provided by the Congolese rail operator Chemin de Fer Congo-Ocean (CFCO) and the total deterioration of the road corridor from Brazzaville to Pointe Noire have essentially ruled out this option at present. But there are efforts underway in the Republic of Congo to rebuild the road corridor and concession both the railway and container port terminal. Once

these improvements are made, the Kinshasa–Pointe Noire route may become economically attractive for Congolese trade, particularly if a road and rail bridge were built to connect Brazzaville and Kinshasa. The main concern about this option relates to issues of sovereignty, but these are not insuperable: some West African countries have developed shared sovereignty agreements that reserve quays and terminal capacity for stakeholder countries, for example.

Air transport

Achievements

Since 2000 the number of domestic air transport routes served has dramatically increased, and the aircraft fleet has undergone renewal. Given the vast size of the DRC, its disparate population centers, and the deficiencies of the surface transport network, the air transportation system has an important role to play in passenger travel. Overall air transport capacity in the country was static over the period 2001–07, at around 1 million seats. But connectivity has grown sharply over the same period, with the number of city pairs served rising from 13 in 2001 to 24 in 2007. Eight airports and 14 airlines now have scheduled, advertised services. There has also been a substantial renewal of the aircraft fleet over this same period, with the percentage of seat-kilometers flown in aircraft of recent vintage rising from 40 percent in 2001 to 74 percent in 2007. By far the largest airline serving the country is Hewa Bora, which has 42 percent of market share.

Challenges

The DRC's domestic air transport services have a worrisome safety record, one that urgently needs to be addressed. Given the recent renewal of the fleet, this poor record has as much to do with lax oversight of airline companies and human error as with aging aircraft. One of the consequences of the problem has been to divert a significant volume of domestic air transport outside of the country to avoid using domestic air services, meaning that domestic trips are often undertaken via an outside transit country. Thus, the most urgent issue facing the air transport sector is to strengthen regulatory oversight in order to improve the safety of domestic flights.

Information and communication technology

Achievements

Despite difficult economic conditions, the DRC has reached a relatively high level of GSM signal coverage at prices comparable to those elsewhere in Sub-Saharan Africa (table 7). By 2006, 65 percent of the population lived within range of a GSM signal, which is substantially higher than the average for LICs in Africa. As illustrated above, all the major population centers have essentially been covered (figure 2c). Moreover, prices for mobile services are on par with those found in other parts of Africa and the developing world. This has been achieved thanks to a relatively buoyant competitive market with four active operators. Moreover, with sales in the sector second only to those of the mining sector, and with a 13 percent value added tax (VAT) charged on mobile telephone calls, ICT tax revenues now account for *one-third* of budget revenues. But although GSM coverage is high, subscriber penetration remains low by African standards.

Table 7. Benchmarking ICT indicators

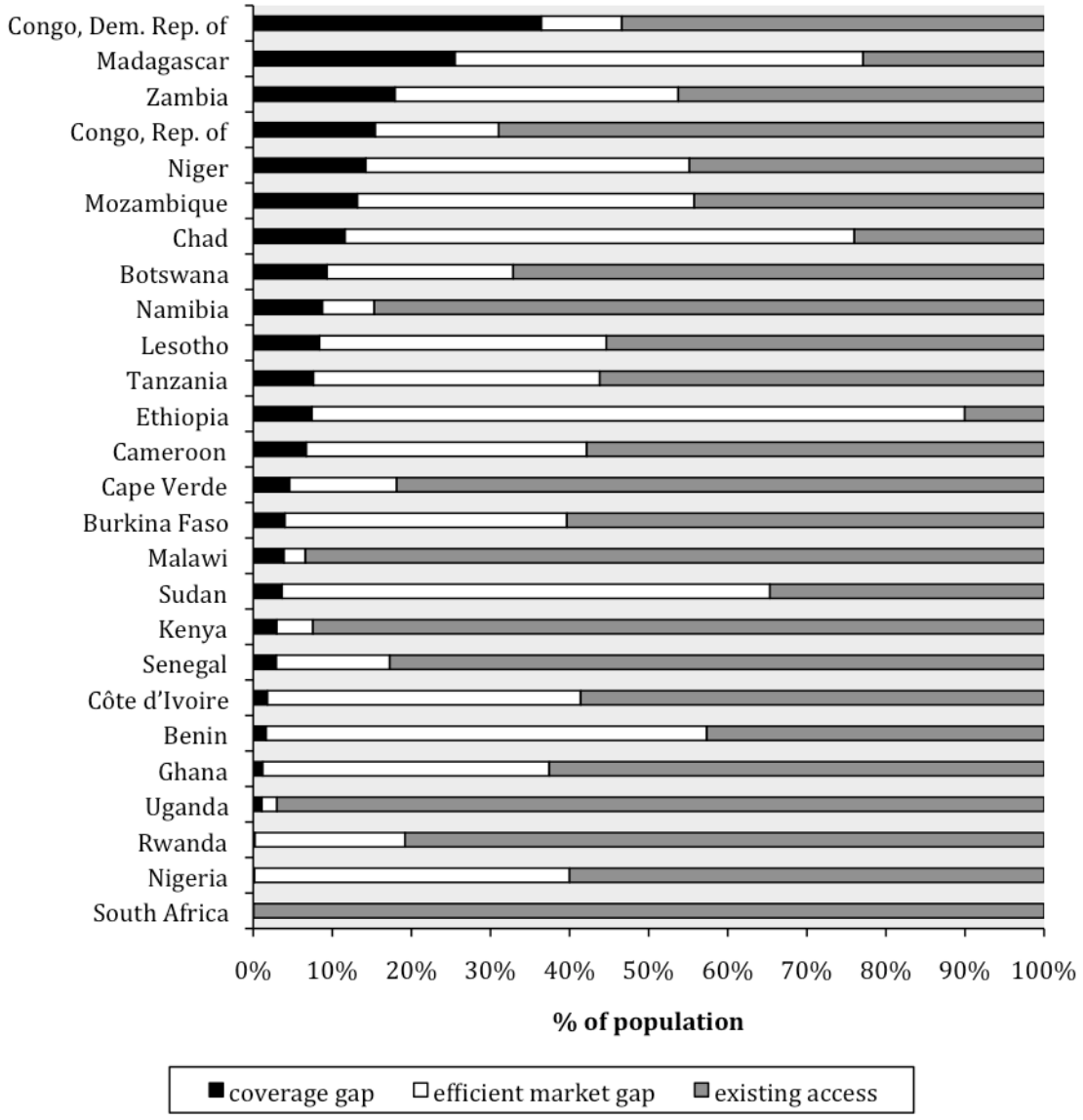
	Unit	Low-income countries	**DRC**	Fragile states
GSM coverage	% population	42.42	**65.00**	62.55
International bandwidth	Mbps/capita	3.01	**0.19**	0.88
Internet	subscribers/100 people	0.13	**0.03**	0.07
Landline	subscribers/100 people	7.47	**3.90**	8.99
Mobile phone	subscribers/100 people	6.44	**3.88**	8.01
US$		**DRC**	Without submarine cable	Other developing regions
Price of monthly mobile basket		**11.0**	11.12	9.9
Price of monthly fixed-line basket		**28.17**	13.58	—
Price of monthly 20-hour Internet package		**74.00**	67.95	11.0
Price of international call to U.S., per minute		**0.33**	0.86	0.67
Price of inter-Africa calls per minute, mean		**0.52**	0.72	—

Source: Minges and others 2009, derived from AICD national database downloadable from http://www.infrastructureafrica.org/aicd/tools/data.
Note: Mbps = megabits per second; — = data not available.

Challenges

Completing the expansion of GSM network coverage is particularly challenging because of the spatial characteristics of the country. Analysis done around 2006 suggested that up to 80 percent of the population could be reached on a commercially viable basis, but the remaining 20 percent are dispersed across remote areas that cannot be covered without some degree of public subsidy. This "coverage gap" is among the largest found for any country in Africa (figure 5). As of 2010, a number of further developments are jeopardizing the further expansion of mobile coverage. A vigorous price war between mobile operators had pushed prices below economic levels to under US$0.04 per minute. In order to stem losses, operators have stopped coverage rollout and indeed reduced are coverage in some cases.

Figure 5. Relatively good progress in expanding GSM coverage



Source: Mayer and others 2008.

The DRC lags far behind in Internet usage, and would benefit from access to submarine cables. Internet penetration is extremely low in the DRC (even by African standards), and available bandwidth is a fraction of what is found elsewhere in Africa. This is partly explained by the very high cost of Internet access—$74 per month, which is typical for a country lacking access to submarine cables. This situation is unlikely to improve significantly until the country develops links to the submarine cables along the West African coast. As the experience of other countries has shown, once such links are made, it is essential that this infrastructure be competitively provided; otherwise, consumers will not benefit from lower prices (table 8). Recent estimates suggest that the benefits of broadband expansion in DRC could be considerable on both economic growth and employment.

Table 8. High international call charges, driven by technology and market power

$	% 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: Minges and others 2009.
Note: ADSL = asymmetric digital subscriber line.

Water supply and sanitation

Achievements

Access to improved water and sanitation in the DRC is comparable to that of similar countries. In particular, about 30 percent of the DRC's population has access to piped water or standposts. Coverage of traditional latrines is also relatively high.

Challenges

Nevertheless, trends in water access rates are extremely worrisome, with a fast-growing dependency on surface water (figure 6). Access to piped water in the DRC is either steady or in slight decline, while there has been a marked fall in the usage of wells and boreholes. The only encouraging sign is the relatively strong expansion of public standposts, with just over 1 percent of the population gaining access each year. But the most striking trend is the rapid acceleration of reliance on surface water, which is affecting an additional 7.5 percent of the population each year, in particular in rural areas, where the number is as high as 10 percent of the population each year.

Access trends for sanitation are more encouraging, even if the share of the population practicing open defecation is still on the rise (figure 7). Although access to improved sanitation modes is expanding only very slowly, there is a very rapid expansion of traditional latrines underway. These are generally built by households, with about 3.6 percent of the population gaining access each year, well above the regional average. Nevertheless, reliance on open defecation continues to increase by 0.5 percent of the population each year.

Finally, the deficient operation of the water utility, Régie de distribution d'eau (REGIDESO), creates major financial losses in the sector. REGIDESO performs far less efficiently than its African peers. Revenue collection stands at only 70 percent, compared to over 95 percent elsewhere, with nonpayment by government institutions being an important contributor. Annual revenues cover only 64.4 percent of operating costs, much below the operating cost coverage ratio of fragile states, which is 82.3. Distribution losses stand at 41 percent, about double the best-practice level of 20 percent. Tariff levels are about a tenth of those found in other African countries, and nonresidential tariffs are particularly low. Overall, the hidden costs of inefficiency amount to a large share of sector revenues. While this is by no means the worst case in Africa (figure 8), the sector is capturing only half of the revenues that it should. This kind of financial hemorrhage limits the funds available for investment and slows the rate of access expansion.

REGIDESO is currently in the process of implementing a management contract that aims to improve operational performance.

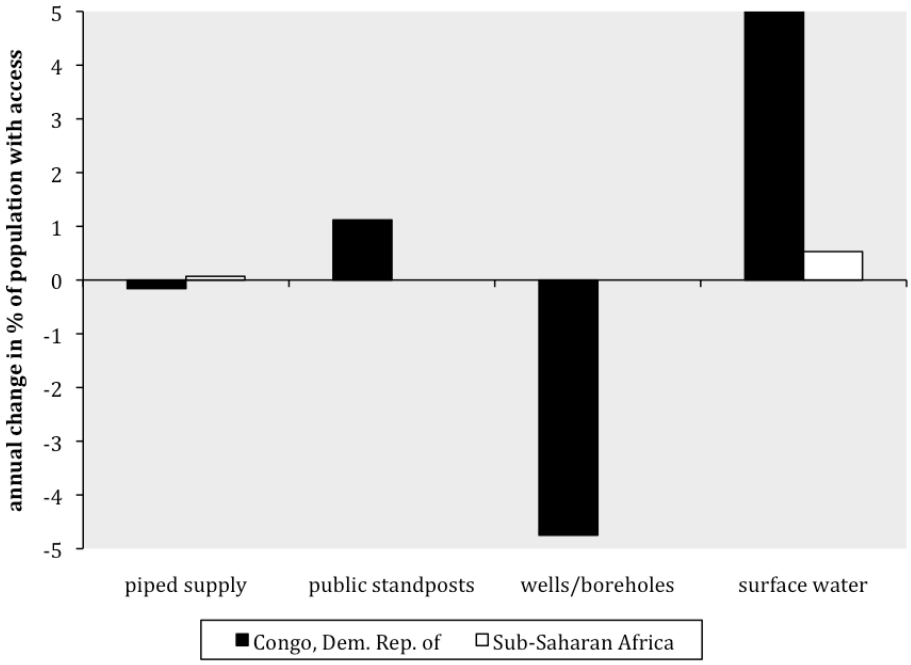
Table 9. Benchmarking water and sanitation indicators

	Unit	Low-income countries	**DRC**	Fragile states
Access to piped water	% pop	8.4	**21.0**	27.0
Access to standposts	% pop	13.1	**7.1**	17.5
Access to wells/boreholes	% pop	34.4	**49.0**	61.5
Access to surface water	% pop	51.4	**22.4**	30.8
Access to flush toilets	% pop	2.7	**1.6**	7.1
Access to improved latrines	% pop	5.3	**10.8**	20.3
Access to traditional latrines	% pop	44.5	**71.2**	56.9
Open defecation	% pop	58.4	**16.4**	51.6
Domestic water consumption	liter/capita served/day	76.3	**51.3**	53.5
Urban water assets in need of rehabilitation	%	36.1	**42.0**	36.7
Revenue collection	% sales	97.2	**70.0**	100.2
Distribution losses	% production	33.8	**40.8**	32.8
Cost recovery	% operating expenses covered by revenues	107.3	**64.4**	82.3
Total hidden costs	% of revenue	112.9		202.3

U.S. cents per m^3 at 10 m^3	**DRC**	Fragile states	Other developing regions
Residential tariff	4.6	42.0	3.0–60.0
Nonresidential tariff	0.6	150.0	

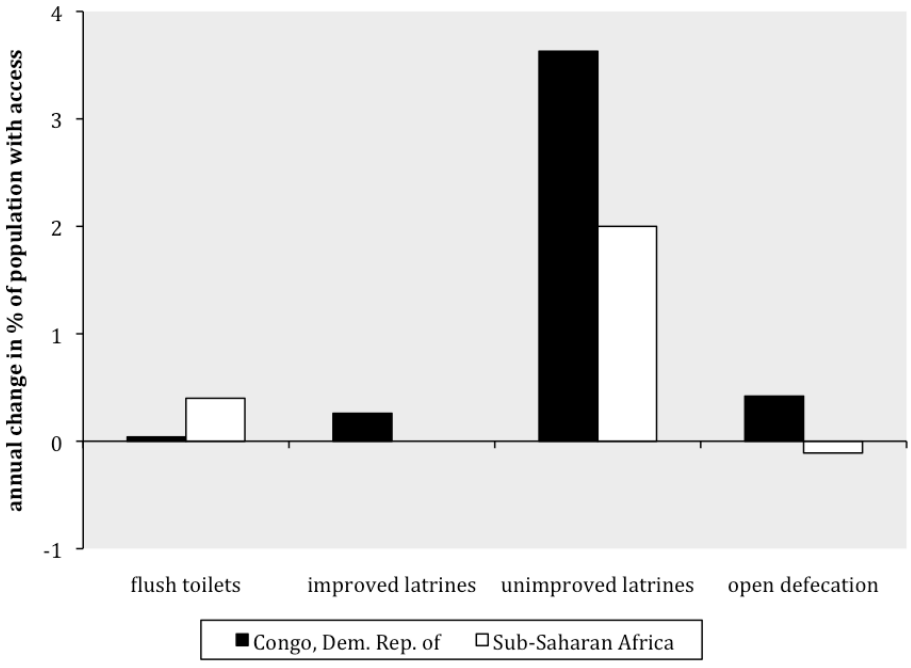
Source: Banerjee and others 2009; Morella and others 2009, derived from AICD water and sanitation utilities database downloadable from http://www.infrastructureafrica.org/aicd/tools/data.

Figure 6. Access trends for different modalities of water supply



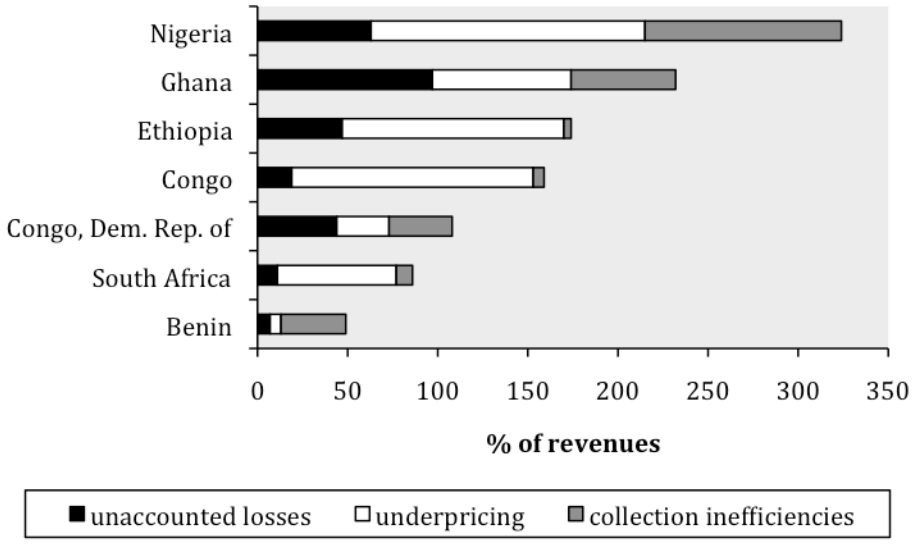
Source: Banerjee and others 2009.
Note: SSA = Sub-Saharan Africa.

Figure 7. Access trends for different modalities of sanitation



Source: Morella and others 2009

Figure 8. Hidden costs of water utilities



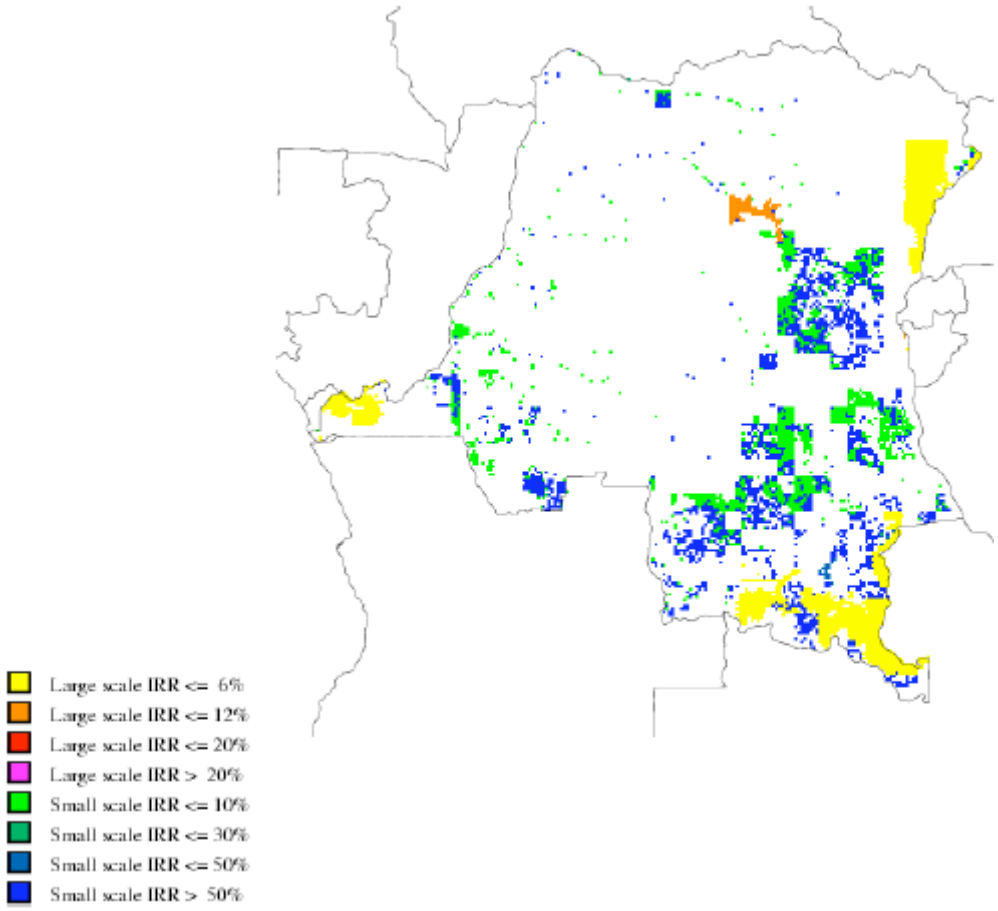
Source: Banerjee and others 2009.

Irrigation

Irrigation is almost nonexistent in the DRC today (figure 2d). Currently, the DRC irrigates only 73,000 hectares of its agricultural land, or 0.1 percent of cultivated land—well below the African average of 5 percent. The country's water withdrawals are negligible relative to the total amount of renewable water available. Although the DRC has a water policy, none of the other components of the institutional framework for irrigation are in place.

There seems to be substantial potential to expand small-scale irrigation, particularly in the east and southeast (figure 9). A simulation exercise conducted as part of the AICD considered both agroecological and economic factors to determine areas viable for large- and small-scale irrigation development. While a few potential large-scale irrigation schemes were identified, the associated returns were typically quite low (less than 6 percent). A much greater potential was found for small-scale irrigation, with 138,000 hectares capable of yielding rates of more than 12 percent, and a much larger area yielding positive returns. The most promising areas are located in the east and southeast regions of the country.

Figure 9. The DRC's irrigation development potential



Source: You and others 2009.

Financing the DRC's infrastructure

The DRC needs to implement an ambitious infrastructure investment agenda. In order to meet its most pressing infrastructure needs and to catch up with developing countries in other parts of the world, the DRC needs to expand its infrastructure assets in a number of key areas. The targets outlined in table 10 are purely illustrative in nature, but they represent reasonable aspirations. They have been developed in a way that is standardized across African countries and thus allows for a cross-country comparison of their affordability. Ultimately, the targets can be modified or delayed as financially necessary. In some cases (such as the development of the Inga site) the targets identified may not be technically feasible, even if they are economically desirable.

Meeting these illustrative infrastructure targets for the DRC would cost close to $5.2 billion per year for the next decade, *including over $1 billion for maintenance*. Capital expenditure would account for 80 percent of this overall requirement. The power, transport, and water supply and sanitation (WSS) sectors would each demand sustained spending of $1.5 billion per year; needs for the ICT sector are substantially lower (table 11). What is particularly striking is that, going forward, the DRC needs to allocate over $1

billion a year to preventive maintenance of its network infrastructures in order to ensure their long-term sustainability.

Table 10. Illustrative investment targets for infrastructure in the DRC

	Economic target	Social target
ICT	Fiber-optic links to neighboring capitals and submarine cable	Universal access to GSM signal and public broadband facilities
Power	Develop 8,400 MW of new generation capacity (800 MW domestic, 7,600 MW for export), 6,000 MW of interconnectors	Raise electrification to 19% (38% urban and 8% rural)
Transport	Achieve regional (national) connectivity with good quality 2-lane (1-lane) paved road	Provide rural road access to 80% highest-value agricultural land, and urban road access within 500 m
WSS		Achieve MDGs

Sources: Mayer and others 2008; Rosnes and Vennemo 2009; Carruthers and others 2009; You and others 2009.

Table 11. Indicative infrastructure spending needs in the DRC, 2006–15

	$ million per year		
Sector	CAPEX	O&M	Total needs
ICT	246	242	487
Power (trade)	1,424	49	1,473
Transport (basic)	1,082	391	1,474
WSS	1,278	431	1,709
Total	4,045	1,112	5,157

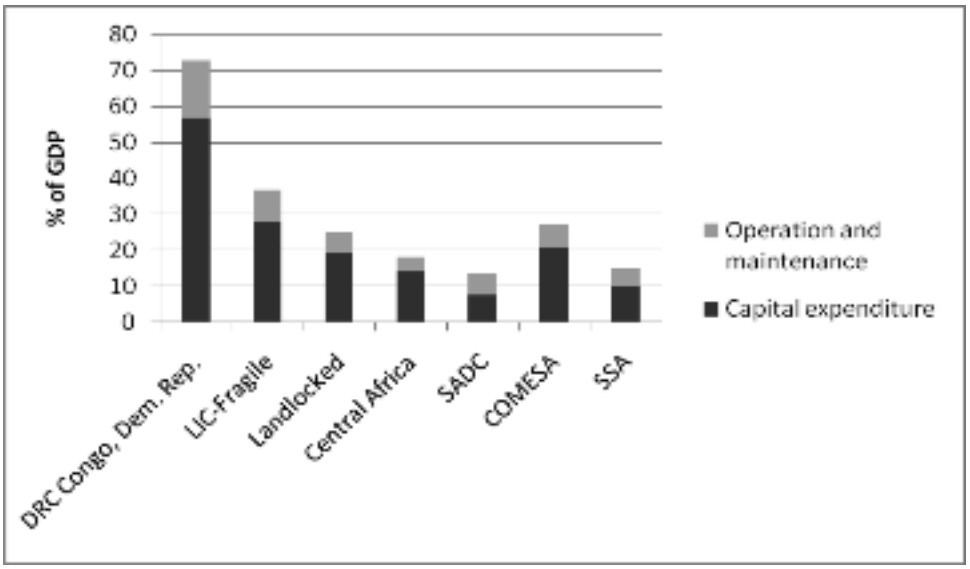
Sources: Mayer and others 2008; Rosnes and Vennemo 2009; Carruthers and others 2009; You and others 2009.

Note: Figures refer to investments (except those in the public sector) that also include recurrent spending. Public sector covers general government and nonfinancial enterprises.

O&M = operations and maintenance; CAPEX = capital expenditure

This total spending requirement is high in absolute terms and even more so relative to GDP (figure 10). At close to $5.2 billion, in absolute terms, the spending need for infrastructure is among the highest in Africa. Relative to the size of the DRC's economy, the spending amounts to a staggering 75 percent of 2006 GDP. This is by far the highest burden of infrastructure spending for any African country, and is substantially higher than the average of low-income, fragile states. Investment alone would absorb around 57 percent of GDP. To put this in perspective, one of the highest levels of infrastructure investment observed in recent economic history has been in China which dedicated 15 percent of GDP to infrastructure investment during the mid-2000s.

Figure 10. The burden of infrastructure needs by country type



Source: Foster and Briceño-Garmendia 2009.

Given such large spending needs, a key question is how much the country is already spending on infrastructure. For the baseline period leading up to 2006, it was not possible to obtain a detailed breakdown of government spending on infrastructure. But some information was available regarding off-budget spending on power, transport, and water, as well as investment financed through official development assistance (ODA), as well as from countries outside the Organisation of Economic Co-operation and Development (OECD) and private sector sources. In addition, the total amount of public investment undertaken across all (infrastructure and noninfrastructure) sectors in 2006 was also available, and provided an upper limit to the potential level of public investment in infrastructure.

Notwithstanding the incomplete data, it is clear that as of 2006 the DRC's spending on infrastructure covered little more than 10 percent of its needs. In the period leading up to 2006, the DRC's infrastructure spending from all sources appears to have been very low—likely no more than $700 million per year, or a small fraction of the amount needed to reach the illustrative infrastructure targets given earlier. Moreover, a significant share of this total—as much as $188 million per year—came from outside the public sector, including significant investments by private telecommunications companies in the rollout of mobile telephone networks and by households in developing on-site sanitation facilities. On the other hand, official external finance for infrastructure—whether from OECD or non-OECD sources—amounted to no more than $62 million per year over this period. Overall public investment for all (infrastructure and noninfrastructure) sectors was no more than $100 million in 2006 and increased only modestly in 2007 and 2008.

The relatively modest figure of $700 million a year nonetheless represents a substantial 10 percent share of the country's 2006 GDP. Although spending looks small relative to the country's infrastructure needs, when expressed as a percentage of GDP it is actually close to the average spending on

infrastructure that is observed across Sub-Saharan Africa. The problem, however, is that the DRC's infrastructure needs are substantially greater than those of other African countries.

Table 12. Incomplete overview of spending on infrastructure in the DRC

Sector	$m per year, average 2001–06						
	O&M	Capital expenditure					
	Public sector	Public sector	ODA	Non-OECD financiers	PPI / household self-finance	Total CAPEX	Total spending
ICT	0	—	0	1	127	128	128
Power (trade)	≈50	—	4	0	0	4	54
Transport (basic)	300	—	55	2	0	57	357
WSS	—	—	0	0	62	>62	>62
Total	≈350	<100*	60	2	188	≈350	≈700

Source: Derived from Foster and Briceño-Garmendia 2009 and additional data supplied by World Bank, 2010.

Note: *A detailed breakdown of public investment in infrastructure for the period 2001–06 by sector is not available. The number given is the estimated total public investment for all sectors in 2006.

PPI = private participation in infrastructure; — = data not available.

Since 2006, there has been a large upswing in external financing commitments from OECD and non-OECD partners, with commitments of around $4.1 billion secured. As the DRC has emerged from the immediate aftermath of conflict, the country has been able to capture an increasing amount of external finance for infrastructure—for example, ODA from multilateral and bilateral sources reached $1.6 billion by 2009. About half of this total was for the transport sector—mainly roads—and the other half for energy, including major rehabilitation efforts at the Inga power plant and associated high-voltage transmission line to the southeast. In addition, a major new financing agreement signed with the People's Republic of China promises $3 billion, primarily for road and urban infrastructure projects (plus other funds for projects outside the infrastructure sectors).

Overall, public investment (including infrastructure and other areas) is projected to jump to a much higher level from 2010 onwards. From a base of around $200 million a year in 2007 and 2008, public investment is projected to reach and sustain much higher levels over the medium term, . This would be primarily attributable to the surge in external finance, though parallel increases in domestically funded national and provincial public investment budgets are also anticipated. While not all of these resources will be allocated to infrastructure, future public investment promises to move closer to requisite levels. Much less clear, however, is where DRC will find the $1 billion needed annually to sustain maintenance of infrastructure networks.

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

There is evidence that additional resources worth at least $430 million could be recovered each year by improving efficiency (table 13), in particular by increasing revenue collection and reducing distribution losses. The power sector has the highest operational inefficiencies.

Table 13. Potential gains from greater operational efficiency

	ICT	Power	Transport	WSS	Total
Underrecovery of costs	—	0	—	26	26
Overmanning	—	—	—	—	—
Distribution losses	—	92	—	39	131
Undercollection	—	243	—	31	274
Undermaintenance	—	—	—	—	—
Low budget execution	—	—	—	—	>0*
Total	—	335	—	96	>431

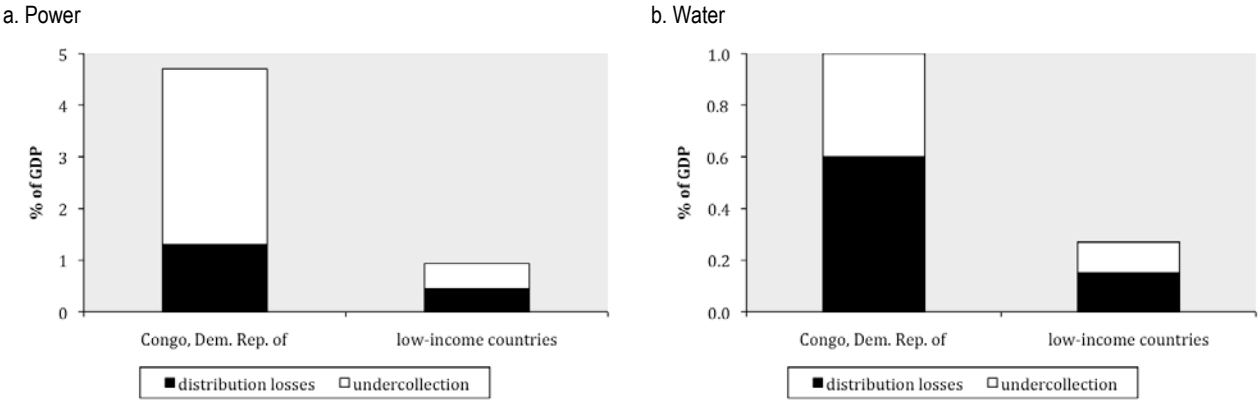
Source: Derived from Foster and Briceño-Garmendia 2009.

Note: *Although an exact estimate for low budget execution is not available, there is evidence of major underexecution of public investment budgets particularly at the provincial level.

— = data not available.

Operational inefficiencies of power and water utilities are costing the country a staggering $405 million a year, or as much as 5.7 percent of GDP (figure 11). As noted above, both SNEL and REGIDESO present serious operational deficiencies, including high distribution losses of power and water (both technical and nontechnical in nature) and missed revenue due to undercollection from their customer base. For the power sector missed revenue is the more serious of the two issues, whereas for the water sector distribution losses represent a larger financial drain. Although the magnitude of the operational inefficiencies is similar across power and water, the larger financial scale of the power sector means that these inefficiencies are almost five times as large in financial terms. On this scale, the operational inefficiency of the utilities (and of SNEL in particular) becomes more than just a sectoral concern but a significant macroeconomic issue. While the operating inefficiencies of utilities are a significant problem across Africa, the benchmarking exercise indicates that they are substantially worse in the DRC than elsewhere.

Figure 11. Hidden costs of the power and water sectors due to inefficiencies

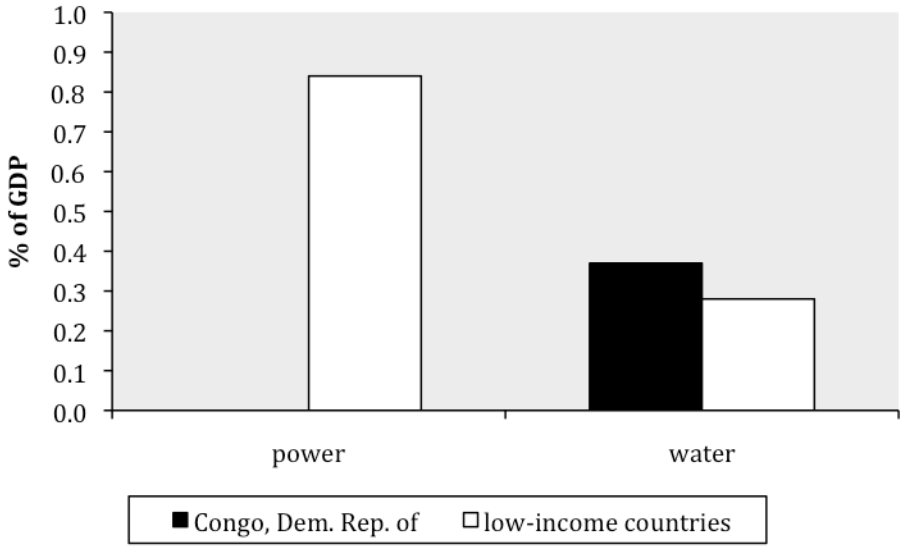


Source: Derived from Briceño-Garmendia and others 2009.

Undercharging for water services is costing the DRC about $26 million per year, or 0.4 percent of GDP (but does not appear to be an issue in the power sector). In GDP terms this is substantially higher than what is found in other African countries (figure 12). The loss of $26 million per year is equivalent to

an ongoing capital subsidy to the sector, and the main beneficiaries of this subsidy are those with private piped-water connections.

Figure 12. Underpricing in the power and water sectors



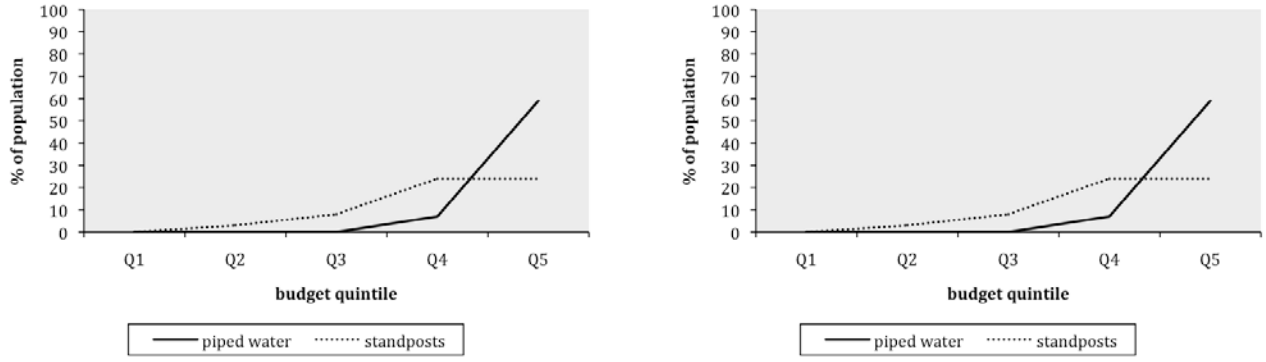
Source: Derived from Briceño-Garmendia and others 2009

The DRC's inequitable access to piped water (and power) makes any sector subsidies highly regressive. In the water sector, 90 percent of those with access to piped water belong to the wealthiest quintile of the population and are the main beneficiaries of any subsidy to private piped-water supply (figure 13). In the power sector, access is somewhat more broadly distributed, but even so 60 percent of customers belong to the top two budget quintiles. As a result, any capital subsidies to these sectors are highly regressive in distributional incidence.

Figure 13. Access to infrastructure services by budget quintile

a. Water supply

b. Power



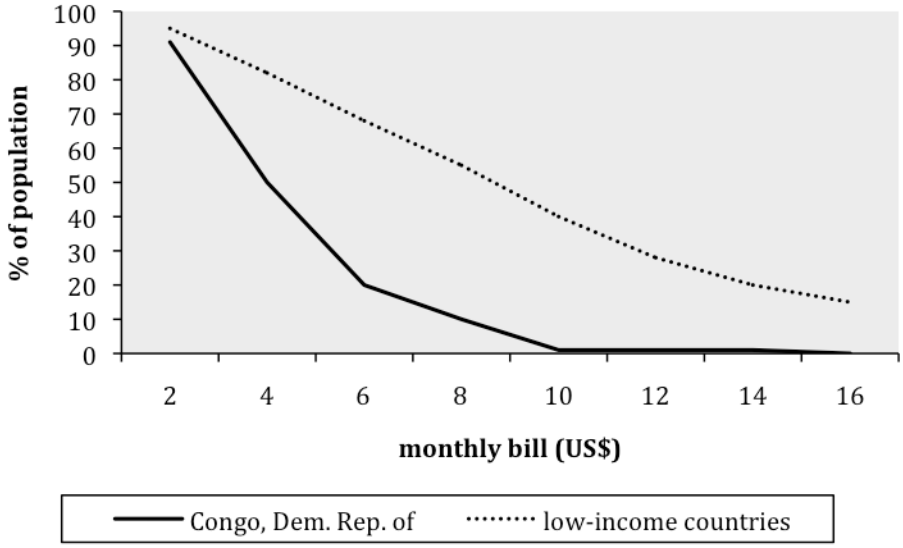
Legend: Q1 – first budget quintile, Q2 – second budget quintile, etc.
Source: Banerjee and others 2009.

Owing to the very limited means of the population, affordability of utility bills is substantially lower in the DRC than in other LICs in Africa. To evaluate the social feasibility of raising tariffs toward cost-recovery levels, an affordability threshold of 5 percent of the household budget is used. On this basis, and

using data on the magnitude of family budgets, figure 14 illustrates the percentage of Congolese households that would be able to afford monthly utility bills of different amounts. Note that for any particular monthly utility bill, affordability rates are substantially lower in the DRC than in Africa's LICs on average. For example, a utility bill of $6 per month would be affordable for 70 percent of households in Africa's LICs, but for only 20 percent of Congolese households. This finding illustrates that the purchasing power of Congolese households is very low, even by African standards, raising significant social concerns about utility pricing.

Cost-recovery bills may just be affordable for existing (relatively affluent customers) but would not be affordable for the vast majority of the population. With existing tariffs of around $0.65 per cubic meter ($m^3$), an absolute subsistence consumption of 4 m^3 per month would cost $2.60 per month. Bills at this level are affordable for around 80 percent of Congolese households. A cost-recovery tariff of closer to $1 per m^3 would lead to a utility bill of $4 per month, affordable for 50 percent of Congolese households. But given that as of today only the wealthiest 20 percent of the population has access to piped water, utility bills that cover the costs of basic consumption are unlikely to be affordable for the majority of the population.

Figure 14. Affordability of utility bills



Source: AICD.

Furthermore, there is evidence that low rates of execution of the capital budget will be a growing source of inefficiency. Budget execution ratios in the central government's public investment program have fluctuated in recent years, from a high of 169 percent in 2006 to a low of 48 percent in 2007. In addition, there is evidence that public investments at the provincial level have a particularly low budget execution ratio, ranging from 12 percent to 169 percent across provinces and averaging 21 percent overall. At today's relatively low levels of public investment, this may not seem to be an important issue. But as public investment—both at the central and provincial levels—increases in coming years, low capital budget execution could become a major bottleneck in the country's infrastructure investment program, leading to substantial inefficiencies and unused resources. Moreover, whatever institutional

issues are holding back the implementation of today's relatively small investment programs will likely only be exacerbated as investment volumes increase.

What else can be done to close the funding gap?

As of 2006, the DRC faced an infrastructure funding gap of $4 billion, or 60 percent of GDP (table 14). Of total spending needs—estimated at $5 billion—around $700 million was already spent as of 2006, and at least $400 million more was being wasted through various inefficiencies. The aggregate value of these inefficiencies is large in relation to historic spending, suggesting that the spending envelope would increase substantially if these resources could be recaptured. Nevertheless, the value of both historic spending and the inefficiencies is small in relation to the country's overall spending needs. Hence, even if all the inefficiencies could be captured overnight, a substantial funding gap would remain. Estimating the funding gap by sector is much more difficult, given the data available. Nevertheless, it appears likely that the largest funding gap is for WSS infrastructure, followed by transport, then power, then ICT. In any case, the funding gaps for power, transport, and WSS each appear to be in excess of $1 billion.

Table 14. Funding gaps by sector

	ICT	Power	Transport	WSS	Total
Spending needs	(487)	(1,437)	(1,474)	(1,709)	(5,157)
Existing spending	—	—	—	—	≈700
Efficiency gains	—	335	—	96	431
Funding gap	—	—	—	—	≈(4,026)

— = data not available.

The funding gap could be cut by a further $1.4 billion per year if lower-cost technologies were adopted to meet the policy goals for transport and WSS. The cost of meeting a given policy goal for infrastructure is highly sensitive to technology. Given the DRC's large infrastructure funding gap, it will be important to make smart technology choices in order to contain costs. In the case of the WSS sector, for example, $830 million could be shaved off spending needs each year if the MDG targets were met entirely by using low-cost service options—such as standposts, boreholes, and improved latrines—instead of following the same technology mix that the DRC has chosen for WSS provision in the past. In the case of the transport sector, close to $600 million a year could be saved by adopting a more pragmatic set of road construction standards to meet connectivity goal—for example, by using single-surface treatments instead of asphalt, and maintaining the network in fair rather than good condition. While these examples are purely illustrative, they demonstrate the extent of the savings available from optimizing technology choice.

The funding gap could be reduced by a further $750 million annually if cross-border financing mechanisms could be found to develop the DRC's power export potential. As noted above, about half of the DRC's power sector spending needs are associated with the development of infrastructure intended purely for export. In such a case, the DRC has the option of developing the generation capacity itself and then selling the power at a full-cost recovery price, or inviting others to make up-front capital contributions to fund capacity development, and then discounting these contributions in the power export

price. Given the country's large infrastructure funding gap, it will be important to explore the potential for cross-border finance arrangements that could potentially cover these costs. If such arrangements could be implemented, the infrastructure funding gap would narrow by a further $750 million.

While the DRC's infrastructure challenge appears daunting today, there are reasons for hope. True, the analysis has shown that the DRC faces one of the most formidable infrastructure challenges in Africa. The financing needed to rebuild the country's basic infrastructure to a level consistent with the rest of the developing world is very large both in absolute ($5.3 billion) and in relative terms (75 percent of GDP). Moreover, the DRC's recent infrastructure spending—though significant relative to GDP—is little more than 10 percent of that needed to make an impact over the next decade. Even if the country could address the significant inefficiencies that are currently wasting at least $430 million each year, an infrastructure funding gap of about $4 billion would remain. Nevertheless, intelligent technology choices and creative use of cross-border finance could squeeze the funding gap to $2 billion a year. Furthermore, the public resource envelope is projected to grow significantly in the medium term. Therefore, by combining new resources with an improved policy and institutional environment, it should be possible to make substantial progress toward redressing and reversing the DRC's serious infrastructure deficits.

In any case, given the magnitude of the challenges and the difficulties of completely closing the funding gap, DRC will need to have a clear basis for prioritizing infrastructure spending over the coming years. A recent World Bank 2009 study provided a framework for this prioritization based on a spatial analysis of the impacts of infrastructure investments on the broader economy, including the mining, forestry, agriculture and manufacturing sectors. The study found that by far the single highest impact infrastructure investments for DRC relate to rehabilitating and expanding power infrastructure so as to increase the availability and reduce the price of power on the domestic market; bringing an internal rate of return of some 120 percent. In the transport sector, the highest impact single intervention is the rehabilitation of the CFMK rail link; with an internal rate of return of 80 percent. More generally, returns to transport investments are highest when these are packaged together in such a way as to promote mobility along key economic corridors in the country.

Business as usual is certainly not a tenable option. Simulations indicate that if the DRC were to maintain recent infrastructure spending levels and not improve its policy environment, the country would take more than a century to meet the infrastructure policy goals identified here. This is clearly an unacceptable outcome and underscores the urgency of action in this area.

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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 in the table below.

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AICD
AFRICA INFRASTRUCTURE
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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 communication 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 include as many as possible of the additional African countries.

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.