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Policy Research Working Paper 5599

Zambia's Infrastructure

A Continental Perspective

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Abstract

Infrastructure improvements contributed 0.6 percentage points to Zambia's annual per capital GDP growth over the past decade, mostly because of exponential growth in information and communication services. The power sector, by contrast, pulled the growth rate down by more than 0.1 percentage points. Improving Zambia's infrastructure endowment could boost growth by up to 2 percentage points per year.

Zambia's relatively high generation capacity and power consumption are accompanied by fewer power outages than elsewhere in the region. But Zambia's power sector emphasizes the mining industry, while household electrification is about half that in other resource-rich countries. Zambia's power tariffs, among the lowest in Africa, are less than half the level needed to accelerate electrification and keep pace with mining sector demands.

In power as in just about every other aspect of infrastructure, rural Zambians lag well behind their African peers. In a country where 70 percent of the population depends on agriculture for its livelihood, this represents a huge drag on the economy.

Zambia would need to spend an average of $1.6 billion a year over the decade 2006–15 to develop the infrastructure found in the rest of the developing world. This is equivalent to 20 percent of Zambia's GDP and about double the country's rate of investment in recent years.

Closing the country's annual infrastructure funding gap of $500 million requires raising more funds, looking for more cost-effective ways to meet infrastructure targets, and eliminating the inefficiencies that cause the loss of $300 million annually.

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Zambia's Infrastructure: A Continental Perspective

Vivien Foster and Carolina Dominguez

Acknowledgments

This paper draws upon a wide range of contributions from sector specialists from the Africa Infrastructure Country Diagnostic Team; notably, Dick Bullock on railways, Mike Mundy on ports, Heinrich Bofinger on air transport, Maria Shkaratan on power, Elvira Morella on water and sanitation, Michael Minges on information and communication technologies, Nataliya Pushak on public expenditure, and Alvaro Federico Barra on spatial analysis.

The paper is based on data collected by local consultants and benefited greatly from feedback provided by colleagues in the relevant World Bank country teams; notably, Kapil Kapoor (country manager), Boris Enrique Utria (Sector Leader), Gael Raballand (roads), Pierre Pozzo di Borgo and Lucien Andre Aegerter (railways), Diep Nguyen-Van Houtte (power), Midori Makino and Elisabeth Sherwood (water), and Gareth Locksley (ICT).

Contents

Infrastructure improvements contributed 0.6 percentage points to the annual per capita growth of Zambia's gross domestic product (GDP) over the past decade, mostly because of the exponential growth of information and communication technology (ICT) services. Poor performance of the power sector *reduced* the per capita growth rate by 0.1 percentage point. Simulations suggest that if Zambia's infrastructure platform could be improved to the level of the African leader—Mauritius—per capita growth rates could increase by 2 percentage points per year.

Zambia's high generation capacity and relatively high power consumption are accompanied by fewer power outages than its neighbors. But Zambia's power sector is primarily oriented toward the mining industry, while household electrification, at 20 percent, is about half that in other resource-rich countries. Zambia's power tariffs are among the lowest in Africa and are less than half the level needed to accelerate electrification and keep pace with mining sector demands. Meeting future power demands and raising electrification rates will be difficult without increasing power tariffs.

Improving Zambia's infrastructure requires reform of its administrative and regulatory processes (for example, to remove obstacles to regional trade), as well as substantial physical investments. Because of border delays along the north-south corridor (now being tackled by the government) road and rail freight crawls along at a pace of little more than 10 kilometers per hour. Lack of effective regulation also allows Zambia's rail operator to charge exorbitant tariffs while providing lackluster service.

On just about every aspect of infrastructure, rural Zambians lag well behind their African peers. In a country where 70 percent of the population depends on agriculture for its livelihood, this represents a huge drag on the economy.

Zambia would need to spend an average of $1.6 billion a year over the decade 2006–15 to develop the infrastructure found in the rest of the developing world. This is equivalent to 20 percent of Zambia's GDP (similar to what China invested in infrastructure in the mid-2000s), and is about double the country's rate of investment in recent years. The power sector alone accounts for 32 percent of these spending needs.

Inefficiencies cause the loss of $300 million (or 4.3 percent of GDP) a year that could be recouped by suitable policy and institutional reforms. Underpricing of power and related subsidies cost the economy $152 million a year, even though Zambia's relatively low-cost power could be afforded by most of the population at cost-recovery prices. Distribution losses and low rates of collection by water utilities represent a further $52 million, while low rates of execution of capital budgets in the road transport sector mean that $39 million of budgeted resources are not spent within the financial year.

Zambia's infrastructure funding gap of $500 million a year (6.5 percent of GDP) could be largely offset by strategic policy choices. Closing the gap requires raising more funds and looking for more cost-effective ways to meet infrastructure targets. Adopting lower-cost solutions (such as standposts, boreholes, improved latrines) to meet the Millennium Development Goals for water supply and sanitation could save $218 million a year. Participation in the regional power market could save $160 million. And eliminating overengineering in the road sector could save $60 million. Reallocation of disbursements that exceed requirements could make an additional $90 million available for more productive uses each year.

If current levels of inefficiency are allowed to persist, and in the absence of additional funding, it will take at least 30 years to meet Zambia's infrastructure targets at today's spending levels. With efficiency gains, Zambia could reach the targets within 15 years.

Zambia's infrastructure situation is more hopeful than that of many other African countries. Infrastructure spending needs—though large—are not beyond the realm of possibility, and Zambia's resource wealth and relatively well-off population provide a more solid financing basis than is available to many other countries. Zambia's infrastructure funding gap—though substantial—can be dramatically reduced through measures to stem inefficiencies and lower costs.

The continental perspective

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

This report presents the key AICD findings for Zambia, allowing the country's infrastructure situation to be benchmarked against that of its African peers. Given that Zambia's economy is dependent on mining, it will be benchmarked against other resource-rich economies in Africa, as well as against other African low-income countries. Detailed comparisons will also be made with immediate regional neighbors in the Southern Africa Development Community (SADC).

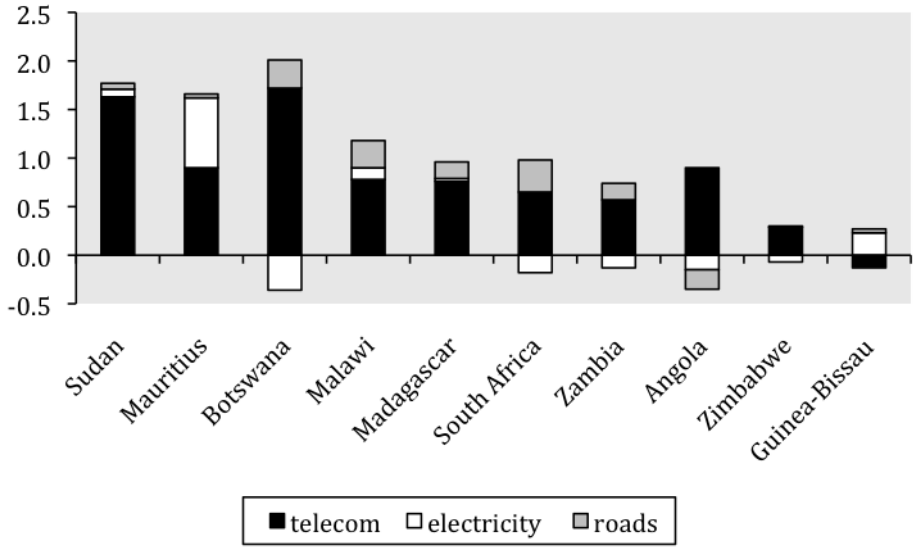
Several methodological issues should be borne in mind. First, because of the cross-country nature of data collection, a time lag is inevitable. The period covered by the AICD runs from 2001 to 2006. Most technical data presented are for 2006 (or the most recent year available), while financial data are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

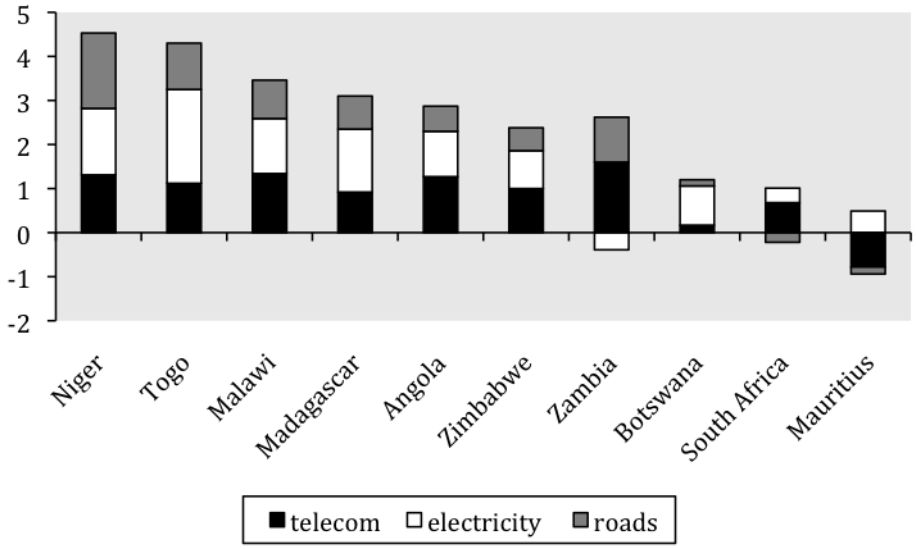
During the five years 2003–07, Zambia's economic performance was relatively strong; by 2007 it had neared the 7 percent growth rate needed to make a significant impact on poverty reduction. The overall contribution of infrastructure to improved growth in Zambia in the early 2000s was 0.6 percentage points, substantially less than for other countries in the region (figure 1). Zambia's ICT sector was responsible for most of this growth as it added 0.47 percentage points to the per capita growth rate, while the power sector reduced per capita growth by 0.13 percentage points. If Zambia could improve its infrastructure to the level of middle-income countries in the region, performance could grow by as much as 2.6 percent per capita.

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

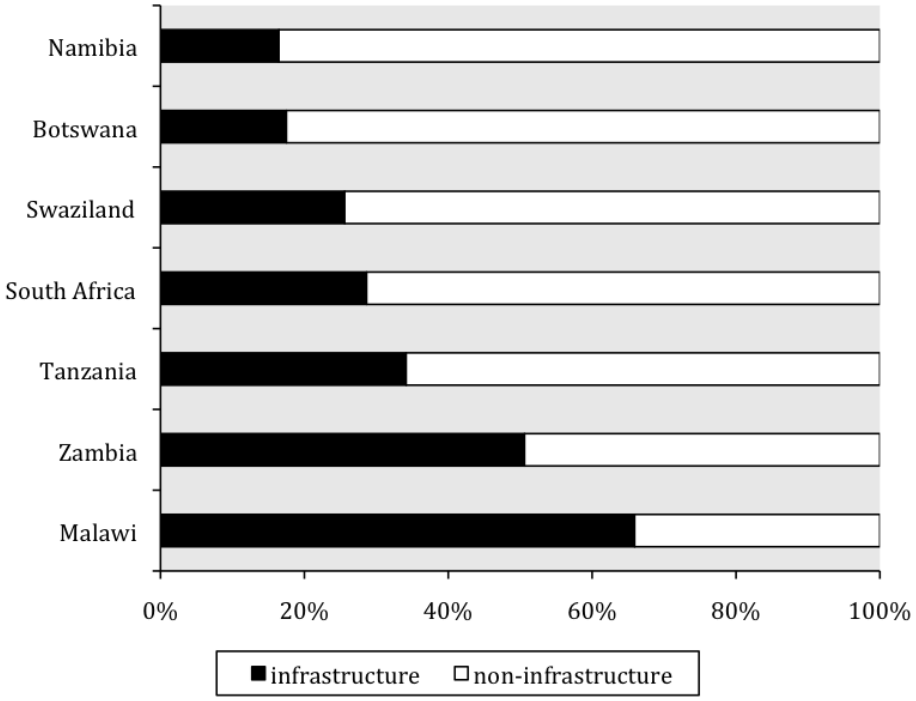


Source: Calderon, 2009.

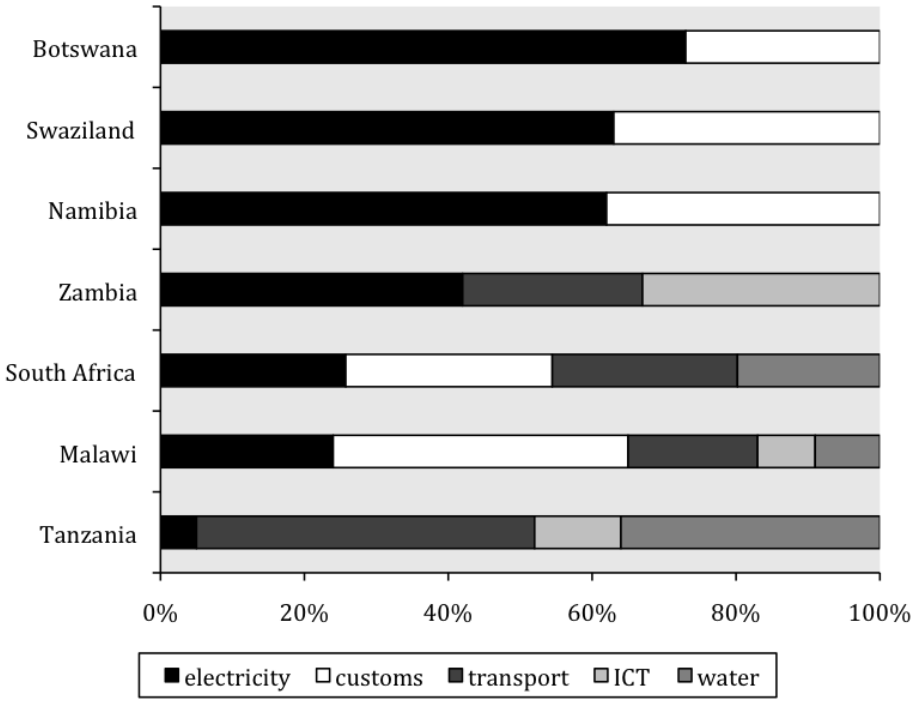
Evidence from enterprise surveys suggests that infrastructure constraints are responsible for about 50 percent of the productivity handicap faced by Zambian firms, with the remainder being due to poor governance, red tape, and financing constraints (figure 2). Power is the infrastructure constraint that weighs most heavily on Zambian firms, followed by ICT and transport.

Figure 2. Infrastructure's contribution to firms' productivity handicap

a. Overall contribution of infrastructure



b. Contribution of infrastructure by sector



Source: Escribano and others, 2009

The state of Zambia's infrastructure

Zambia's economic activity and population are heavily concentrated along the central copper belt running from Lusaka in the south up to Ndola in the north on the Congolese border. Zambia's poverty rates show poverty incidence of less than 40 percent around the main population centers of the copper belt, rising to greater than 70 percent for all other regions of the country. Zambia's power and ICT networks mirror this economic geography, with clear north-south backbones and very limited east-west spurs (figures 3b and 3c). The road network provides a broader coverage of the country, but the outlying segments in the far east and west of the country tend to be those in the poorest condition (figure 3a), with traffic flows heavily concentrated on the north-south axis. Zambia is one of the more urbanized countries in Sub-Saharan Africa, with an urbanization rate of over 50 percent.

This report begins by reviewing the main achievements and challenges in each of Zambia's major infrastructure sectors, with the key findings summarized in table 1. Thereafter, attention will turn to the problem of how to finance Zambia's outstanding infrastructure needs.

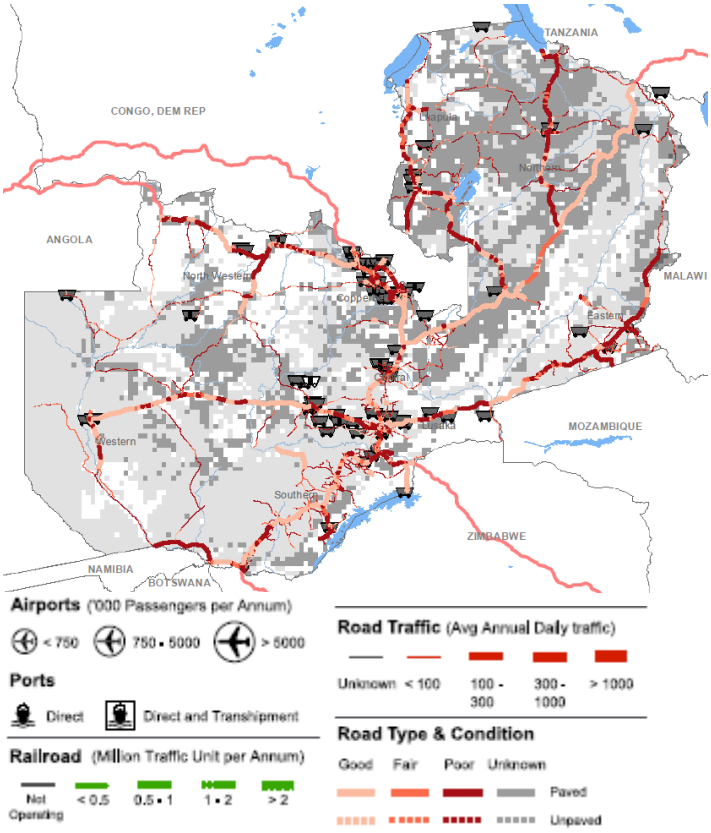
Table 1. Achievements and challenges in Zambia's infrastructure sectors

	Achievements	Challenges
Air transport	Lusaka plays a significant role in regional air transportation	
ICT		Increase GSM coverage by addressing regulatory hurdles responsible for market-efficiency gap Secure competitive access to new East African submarine cables
Power	Substantial and reliable power-generation capacity relative to peers	Raise tariffs to allow for longer-term sustainability of the sector
Railways	Rail network built to serve needs of mining sector	Address underperforming rail concession and major border delays for transit traffic
Roads	Trunk network in good condition and maintenance adequately funded	Shift resources away from overengineered trunk roads toward neglected rural networks Address major delays at border crossings by embracing trade facilitation agenda
Water resources		Expand irrigated area to cover land with high economic potential
WSS	Relatively high access to piped water and flush toilets	Reduce hidden costs of water utilities Reverse increased reliance on surface water and practice of open defecation

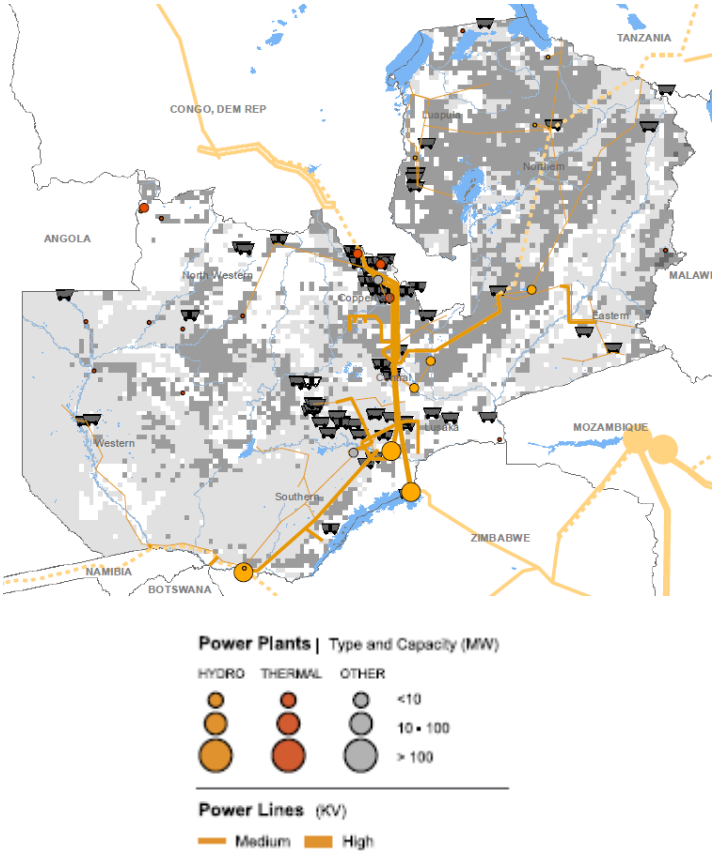
Source: Own elaboration based on findings of the report

Figure 3. Zambia's infrastructure networks follow natural resources

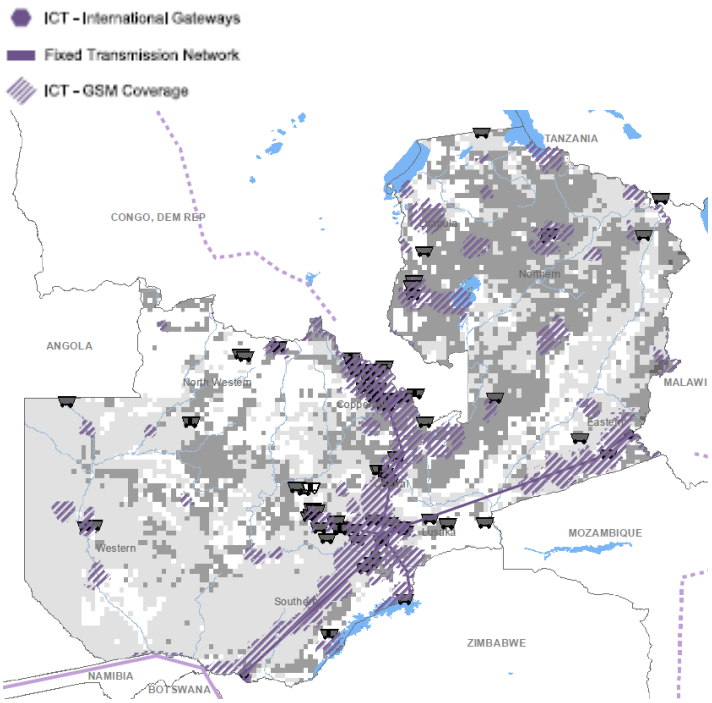
a. Roads



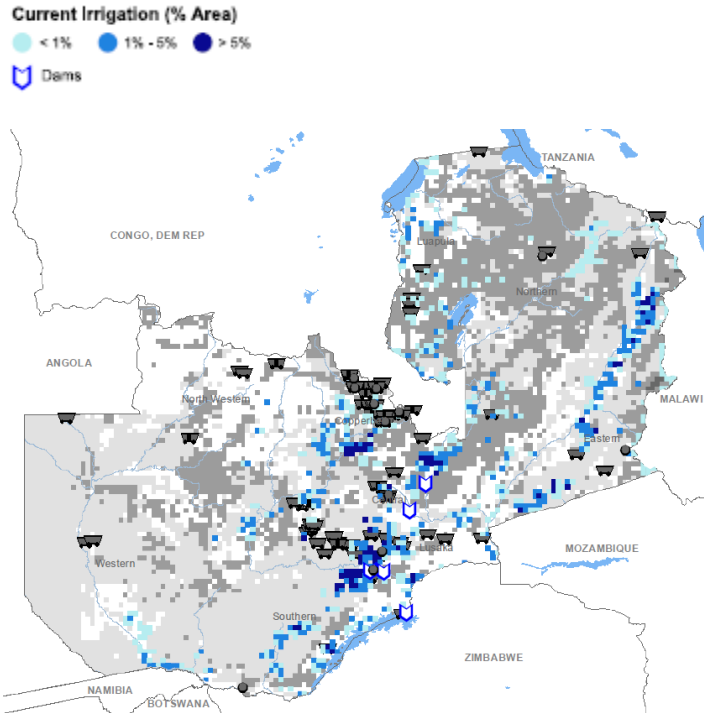
b. Power



c. ICT



d. Irrigation



Source: AICD Interactive Infrastructure Atlas for Zambia downloadable from http://www.infrastructureafrica.org/aicd/system/files/zmb_new_ALL.pdf

Roads

Achievements

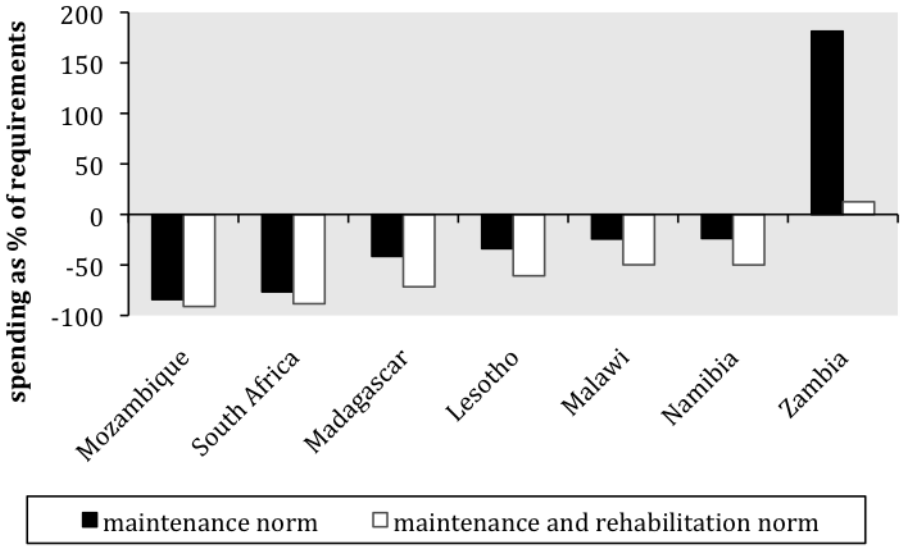
Zambia has made major progress with its main trunk road network. Despite relatively low road densities, analysis suggests Zambia's primary and secondary networks provide basic regional and national connectivity, linking the provincial capitals to Lusaka, and Lusaka to the main international border crossings. More than 80 percent of Zambia's paved road networks are in good or fair condition, on par with its middle-income neighbors and well ahead of the typical performance of resource-rich countries in Africa (table 2). The establishment of a second-generation road fund in the country resulted in a stable allocation of resources to the sector. Zambia is one of the few countries in the region with a road sector budget in excess of what is needed to maintain the main road network, and adequate to address the rehabilitation backlog (figure 4). During the early 2000s, Zambia spent 3 percent of GDP on the roads sector on average—a relatively high allocation.

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

	Unit	Resource rich	**Zambia**	Middle-income countries
Paved road density	km/1,000 km^2 of arable land	97.6	**56.3**	146.8
Unpaved road density	km/1,000 km^2 of arable land	128.2	**95.0**	257.8
GIS rural accessibility	% of rural pop within 2 km from all-season road	19.7	**16.8**	22.9
Overengineering of network	% of main road network paved despite low traffic volumes	15.0	**65.0**	20.0
Paved road traffic	Average annual daily traffic	1,408.2	**736.6**	2,558.3
Unpaved road traffic	Average annual daily traffic	54.2	**45.2**	14.9
Paved network condition	% in good or fair condition	67.9	**83.0**	82.0
Unpaved network condition	% in good or fair condition	61.4	**25.0**	57.6
Perceived transport quality	% firms identifying as major business constraint	27.4	**10.6**	4.8

Source: Gwilliam and others 2008, derived from AICD national database downloadable from http://www.infrastructureafrica/aicd/tools/data
Note: GIS = geographic information system.

Figure 4. Provision for maintenance and rehabilitation



Source: Gwilliam and others 2008

Challenges

There is evidence of overinvestment in Zambia's main road network. About three-quarters of the primary and secondary road network is paved, one of the highest ratios among Africa's low-income countries. Traffic density on Zambia's paved roads is comparatively low—at 736 vehicles per day it is about half of the average for resource-rich countries. Indeed, analysis suggests that 65 percent of the main road network does not have the traffic levels that warrant paving (meaning fewer than 300 vehicles use it per day).

The rural road networks appear to be neglected. Zambia's rural road accessibility is poor compared to it peers. While 70 percent of Zambians depend on agriculture for their livelihood, only 17 percent of this population lives within 2 km of an all-season road—about half the African average. The condition of the existing rural networks is exceptionally poor, with only 21 percent in good or fair condition, compared with around 60 percent in the relevant peer groups. There may thus be a case for shifting attention and resources to the rural networks in the future.

Zambia has a significant trade facilitation agenda to improve the flow of goods along the north-south corridor. Zambia's strategic location on the north-south corridor makes it an important transit country for goods traveling to and from Central Africa and the Port of Durban. The Chirundu border post in the south between Zambia and Zimbabwe has been the cause of notorious delays of transit traffic and has contributed to keeping transit speeds along the corridor at a pace of not much more than 10 km per hour. The government began to address this issue only recently and will open southern Africa's first one-stop border post at Chirundu to help improve the situation.

Rail

Achievements

Zambia's rail sector is critical to its mineral-based economy. Rail transport continues to be the most competitive for large bulk, time-insensitive commodities, such as Zambia's copper production. The country's rail network has two operators: (i) the Railway Systems of Zambia (RSZ) serves the north-south corridor and connects with the Zimbabwean rail operator for onward service to the Port of Durban; (ii) the Tanzania and Zambia Railway Authority (TAZARA) operates an eastward route from the copper belt into Tanzania and on to Dar es Salaam. The first of these is an awarded concession, while the second continues to be operated directly by the state.

Table 3. Railway indicators for Zambia and select countries, 2000–05

	CFM (Angola)	BRC (Botswana)	CEAR (Malawi)	RSZ (Zambia)	Spoornet (South Africa)	TAZARA (Tanzania-Zambia)	TransNamib (Namibia)	NRZ (Zimbabwe)
Concessioned (1)/ state run (0)	0	0	1	1	0	0	0	0
Traffic density, freight, 1,000 tonne-km/km	469.0	827.0	90.1	406.1	2,426.9	461.3	475.3	901.8
Passenger density, 1,000 passenger-kms/km			38.0	91.9	60.3	147.0	32.7	165.6
Efficiency								
Labor productivity (1,000 traffic units per employee)	121.0	722.1		502.0	3,308.1			
Carriage productivity (1,000 passenger-km per carriage)			1,176.5	3,285.7				
Locomotive productivity (million traffic units per locomotive)				25.1				
Wagon productivity (1,000 net tonne-km per wagon)				376.5				
Tariffs								
Average unit tariff (UT), freight, U.S. cents/tonne-km	3.0		5.8	3.9				
Average UT, passenger, U.S. cents/passenger-km	1.0		1.0	0.8				

Source: Bullock 2009, derived from AICD railways database downloadable at http://www.infrastructureafrica.org/aicd/tools/data
Empty cells denote that data not available.

Challenges

Zambian railways' low traffic densities are well below the viability threshold of at least 2 million tons per kilometer for railways of this kind, making it difficult to capture the revenues needed to maintain assets. Also, performance for the RSZ is mixed, while TAZARA performance data is largely unavailable (table 3).

Low traffic volumes complicate the financial viability of any concession arrangement. In the case of the RSZ, the lack of a clear regulatory framework or administrative capacity to supervise the contract has made it difficult for the government to provide clear oversight. For example, the RSZ practices discriminatory pricing against transit traffic from the Democratic Republic of Congo (DRC) to Dar es Salaam, charging $2.00 per tonne-km versus the normal tariff of around $0.05 per tonne-km. These tariffs reflect an abuse of monopoly power aimed at diverting trade flows from the DRC away from Dar es Salaam and toward Durban, with the same concessionaire operating the Zambian rail network and the Beit Bridge border crossing from Zimbabwe into South Africa. The high level of these tariffs has a distortionary effect on traffic flows and investment decisions along the entire corridor. For example, copper exports from the DRC are currently going by road in order to avoid these charges, even though they are more suited to rail transportation. Resolving this situation is not simple, and would probably require a major renegotiation of the rail concession contract, combined with careful tariff regulation thereafter.

The lack of reciprocal access rights delays rail transit through Zambia and along the entire north-south corridor. A rail freight journey of 3,000 km from Kolwezi on the DRC border to the port of Durban takes 38 days to complete—9 days of travel time and 29 days associated with customs clearance and loading and interchange. Freight moves no more than 4 km per hour on average, and the aggregate costs of delays along the corridor have been estimated at $120 million per year. The Zambian rail network contributes to these delays. Access from one rail system to another is restricted for technical reasons or connecting rail operators simply do not have the necessary traction capacity to service existing traffic. Poor traffic planning causes undue delays, and operators are not incentivized to provide reliable interconnection services. Reducing these delays requires revision of the contractual relationships and access rights linking these railways to ensure transparency and fairness in reciprocal track access rights.

Air transport

Achievements

Zambia's overall air traffic doubled between 2001 and 2007. By the standards of its neighbors, Zambia is handling a relatively high volume of such traffic, at 1.46 million seats per year. Its domestic air transport sector remains modest and is a fraction of that found in Angola, Mozambique, and Tanzania. This may reflect the fact that the most economically significant cities are relatively close together and well connected by road and rail.

Challenges

Even as overall traffic has increased, connectivity (measured by the number of city pairs served) has declined from 35 to 25 in recent years, typical across Africa over this period. Lusaka has relatively good intra-African connectivity compared to many other capitals in the region. But the aging aircraft fleet in Zambia presents another challenge, and its renewal is slower than in neighboring countries.

The recent collapse of Zambian Airways puts the future of the domestic market in question. Experience from neighboring Tanzania may be relevant in this respect. Following the demise of Air Tanzania, a joint venture was set up to form the private airline Precision Air, with 51 percent ownership by Tanzanian interests and 49 percent by Kenyan Airways. The airline has grown substantially, and

Tanzania now has one of the most vibrant domestic air transport markets in Africa, offering competing services on all routes.

Table 4. Air transport

Country	Angola	Zambia	Tanzania	Botswana	Namibia	Zimbabwe	Mozam-bique
TRAFFIC (2007)							
Domestic seats (millions per year)	1.20	0.44	1.87	0.24	0.08	0.24	1.14
Seats for international travel within Africa (millions per year)	0.48	1.46	1.27	—	—	1.11	0.58
Seats for intercontinental travel (millions per year)	0.59	0.11	0.59	—	0.24	0.18	0.09
Seats available per capita	0.13	0.17	0.9	—	—	0.11	0.09
QUALITY							
% of seat-km in older aircraft	0.1	19.8	17.1	0	1.1	15.5	16.3
% of seat-km in newer aircraft	59.6	63.8	79.3	100	79	71.4	57.0
% of seat-km in aircraft of unknown age	40.2	16.4	3.6	0	19.9	13.0	26.7

Source: Bofinger, 2009. Derived from AICD air transport database downloadable from http://www.infrastructureafrica.org/aicd/tools/data
— = data not available.

Water supply and sanitation

Achievements

Zambia already has relatively good access to high-end water and sanitation solutions (table 5). About 34 percent of Zambia's population has access to utility water, whether from private taps or standposts; compared with only 24 percent in other resource-rich countries of Africa. Access to septic tanks, at 18 percent, is far ahead of peer countries.

As for trends in recent years, Zambia – along with other African countries – is moving fastest with intermediate options (figures 5 and 6). The real action in WSS has been in expanding access to wells or boreholes and traditional latrines, for an additional 1 percent of the population each year. By contrast, coverage of high-end solutions such as piped water and flush toilets has declined slightly in Zambia, while growth in standposts and improved latrines has been modest. This pattern is consistent with elsewhere in Sub-Saharan Africa.

Table 5. Benchmarking water and sanitation indicators

	Unit	Resource rich	**Zambia**	Middle-income countries
Access to piped water	% pop	12.0	**18.3**	52.1
Access to standposts	% pop	12.6	**15.6**	18.9
Access to wells/boreholes	% pop	49.0	**46.9**	6.0
Access to surface water	% pop	23.7	**19.0**	13.0
Access to septic tanks	% pop	1.6	**18.1**	40.8
Access to improved latrines	% pop	6.4	**1.6**	1.4
Access to traditional latrines	% pop	54.8	**53.1**	30.4
Open defecation	% pop	27.6	**27.0**	14.3
Domestic water consumption	liter/capita/day	90.3	**80.7**	187.6
Urban water assets in need of rehabilitation	%	42.0	**42.0**	25.0
Revenue collection	% sales	69.7	**68***	100
Distribution losses	% production	43.6	**44.9**	27.4
Cost recovery	% total costs	55.6	**65.4**	80.6
Total hidden costs as % of revenue	%	270.4	**236.4**	855.2
US cents per m^3	**Zambia**	Scarce water resources		Other developing regions
Residential tariff	**48**	60		3.0–60.0
Nonresidential tariff	**59**	120		

Source: Banerjee and others 2008. Derived from AICD water and sanitation utilities database downloadable from http://www.infrastructureafrica.org/aicd/tools/data

Note: *Average of three largest utilities.

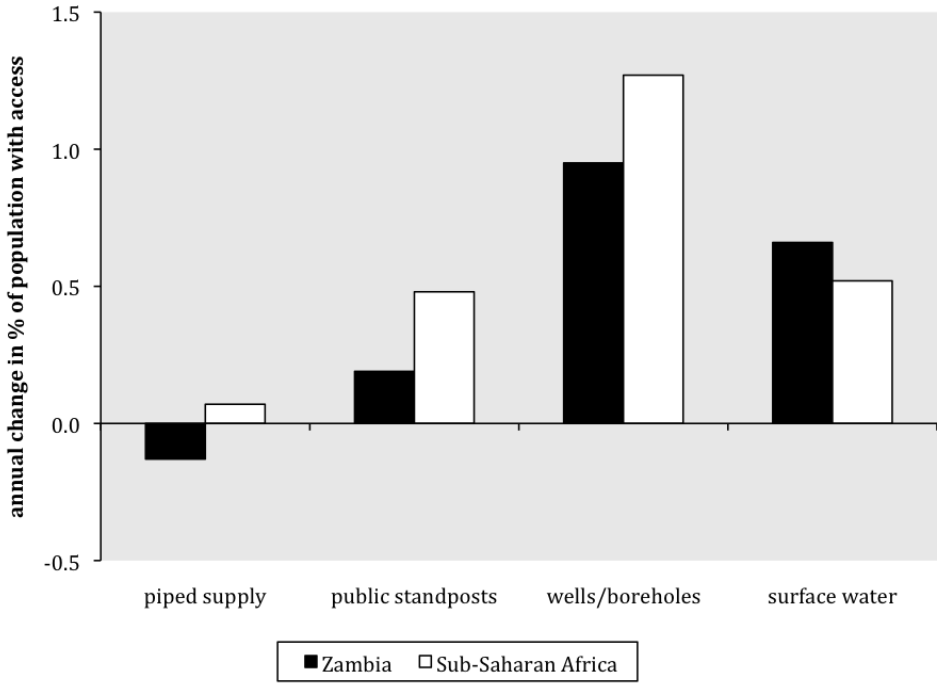
Challenges

The share of the population without access to safe solutions is increasing over time (figures 5 and 6). Despite doing well at the high end of the coverage spectrum, Zambia does not fare much better than its peers when it comes to the percentage of the population relying on surface water or practicing open defecation. A full 19 percent of Zambia's population continues to rely on surface water and as much as 27 percent of the population continues to practice open defecation. Moreover, trends in household access to WSS services from successive household surveys show that the share of the population living in these insanitary conditions continues to increase. An additional 0.8 percent of the population each year relies on surface water and an additional 0.4 percent of the population practices open defecation. The high health risk associated with these practices makes this a very troubling finding.

Zambia's water utilities have relatively high levels of hidden costs due to inefficiencies (figure 7). First, utilities recover only about two-thirds of the total cost of service provision (when full capital costs are taken into account). Second, utilities are collecting only about 70 percent of the revenues owed by their customers. Third, about 45 percent of water produced is lost in distribution due to technical and nontechnical factors. This poor performance is not atypical of water utilities in other resource-rich countries in Africa, even if it lags far behind the performance of middle-income countries in the region.

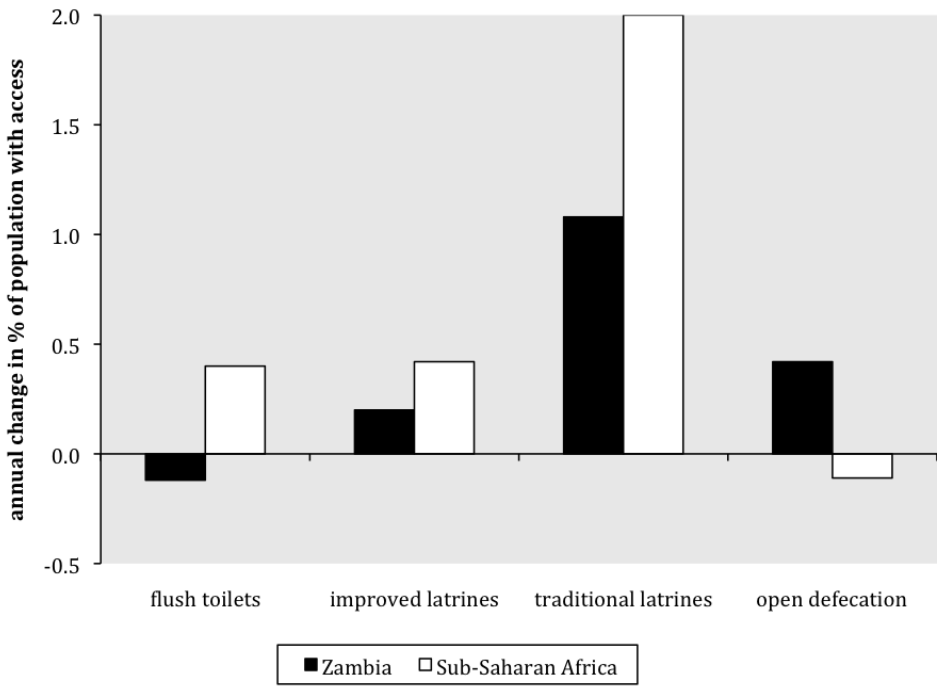
The financial value of all these losses, expressed as a percentage of utility revenues, indicates that losses are more than twice as high as current sector revenues (236 percent of revenues).

Figure 5. Growing reliance on surface water



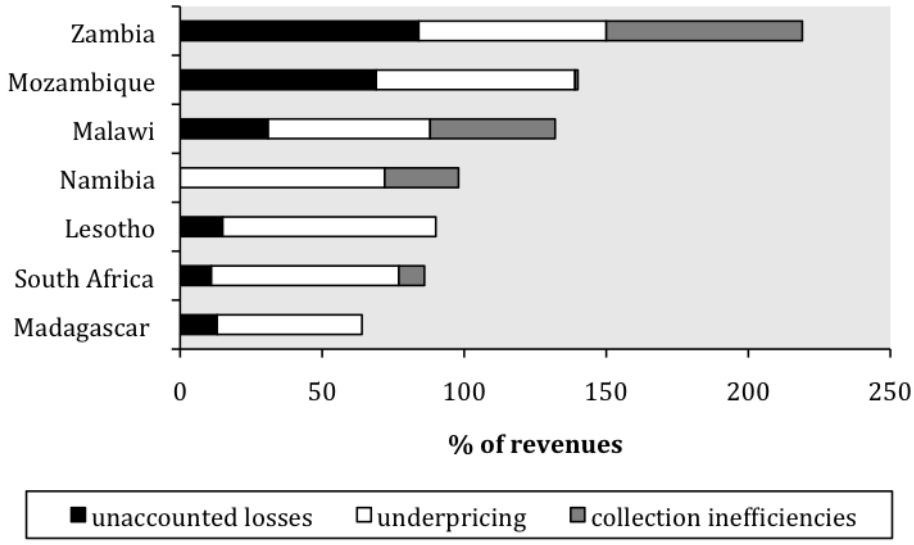
Source: Banerjee and others 2008.

Figure 6. Progress in traditional latrines, but an increase in open defecation



Source: Morella and others, 2008

Figure 7. Hidden costs of water utilities



Source: Banerjee and others, 2008

Power

Achievements

Zambia is endowed with a relatively large amount of cost-effective hydropower. In terms of electricity supply, Zambia enjoys a much more favorable position than many of its neighbors (table 6). Due to the demands of its large-scale mining sector, Zambia has a relatively large generation capacity and power consumption per capita, several times higher than that of other resource-rich countries in Africa. Abundant hydro resources allow Zambia to produce electricity at around $0.08 per kilowatt-hour (kWh), about half the average cost of electricity production in Africa.

The national utility Zambian Electricity Supply Company Ltd. (ZESCO) also performs relatively well in terms of operational efficiency. In the two key indicators of operational performance, revenue collection and distribution losses, ZESCO performs well relative to the resource-rich peer group and near the level of the middle-income peer group (table 6).

Table 6. Benchmarking power indicators

	Unit	Resource rich	**Zambia**	Middle-income countries
Installed power-generation capacity	MW/mill. people	43.2	**154.9**	798.6
Power consumption	kWh/capita	205.7	**771.0**	4,479.3
Power outages	Day/year	14.5	**49.8**	5.9
Firms' reliance on own generator	% consumption	44.9	**19.5**	10.9
Firms' value lost due to power outages	% sales	7.0	**3.7**	1.6
Access to electricity	% population	46.1	**20.1**	59.9
Urban access to electricity	% population	79.4	**50.0**	85.2
Rural access to electricity	% population	28.0	**3.5**	31.8
Growth access to electricity	% population/year	2.4	**0.3**	1.5
Revenue collection	% billings	81.1	**96.5**	100.0
Distribution losses	% production	25.8	**12.0**	10.1
Cost recovery	% total cost	53.9	**39.1**	100.0
Total hidden costs as % of revenue	%	168.3	**93.3**	0.1

U.S. cents	**Zambia**	Predominantly hydro generation	Other developing regions
Power tariff (residential at 75 kWh)	**2.9**	10.3	5.0–10.0
Power tariff (commercial at 900 kWh)	**4.4**	11.7	
Power tariff (industrial at 50,000 kWh)	**2.9**	11.4	

Source: Eberhard and others, 2008 Derived from data downloadable at AICD on-line power utilities database http://www.infrastructureafrica.org/aicd/tools/data

Note: MW = megawatt.

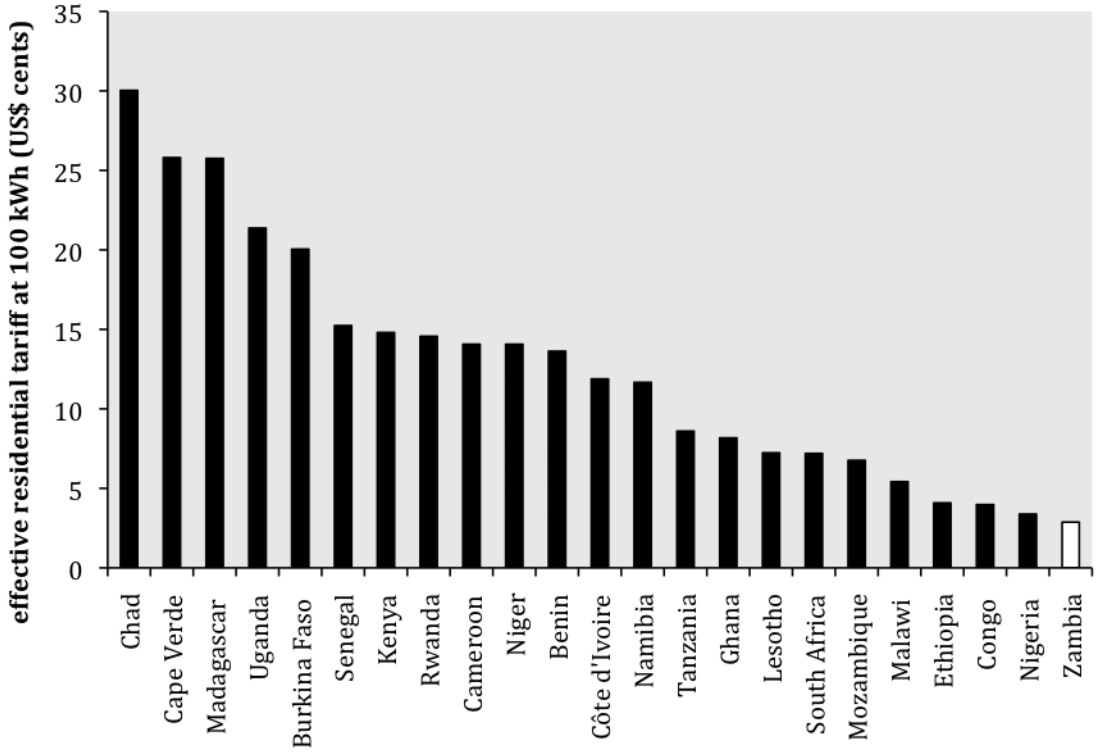
Challenges

Access to electricity is only 20 percent in Zambia, less than half of what is found among the relevant African peer groups. Power access lags behind in both urban and rural areas, but the gap for rural electrification is particularly large—more than 3 percent in Zambia versus 30 percent in the peer groups. Not only is access low, but it has also been stagnant over time. Only 0.5 percent of the Zambian population is newly electrified each year, compared with 2 percent in the peer groups. While power is relatively abundant in Zambia, much of that power is going to the mining sector, leaving relatively little for domestic consumption.

Low power tariffs undermine the sustainability of the power sector. At $0.03–$0.04 per kWh, Zambia has some of the lowest power tariffs in Africa (figure 8). Looking across the developing world, Zambia's power tariffs fall below the typical price range of $0.05–$0.10 per kWh. While Zambia's power production costs are low, tariffs are lower. Both historic and long-run marginal costs are close to the mark of $0.08 per kWh (figure 9). Tariffs are capturing only about 40 percent of historic costs, and the power sector today is living on the investments of the past without making provision for the future. South Africa's recent power shortages demonstrate the dangers of putting off change for too long. Underpricing of power creates hidden costs that are as large as the overall level of revenues (figure 10). Given the relatively low costs of power in absolute terms, it should be feasible for Zambian consumers to pay full-cost recovery tariffs. A stronger cash flow for the ZESCO would help to finance the needed expansions in generation capacity to keep pace with growing demand and to accelerate the pace of electrification.

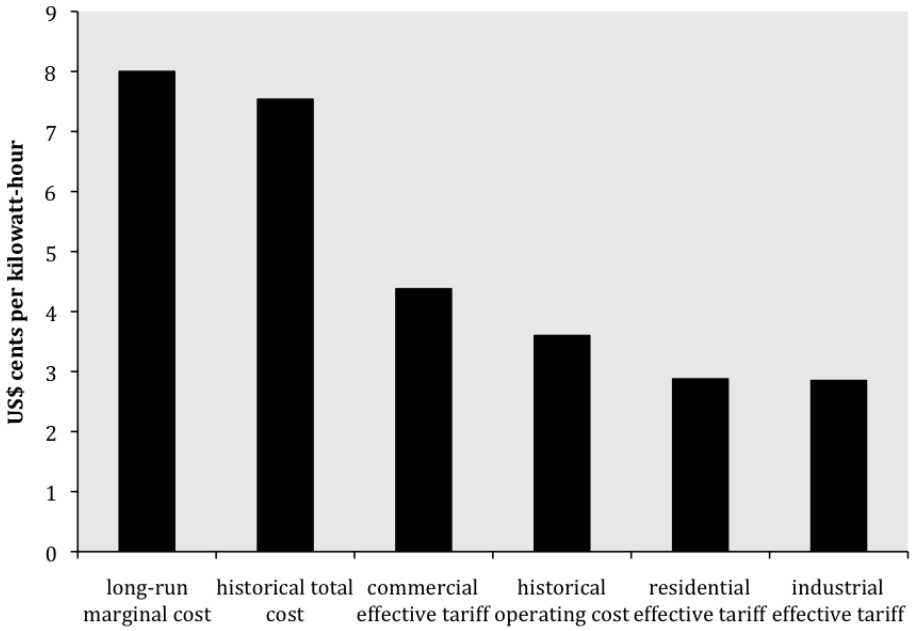
Zambia's long-term power supply options could be affected by the evolution of regional power trade in the framework of the Southern African Power Pool (SAPP). Zambia already imports a relatively small amount of power from neighboring DRC. Plans to further develop the Inga hydropower site in the DRC could lead to a large expansion in low-cost hydropower for the DRC, available for export to countries such as Zambia. While Zambia has attractive hydropower resources of its own, the long-run marginal cost of hydropower generation in the DRC, at around $0.014 per kWh, is about half the equivalent cost in Zambia. In the medium term, therefore, Zambia will face a strategic choice between developing more domestic hydropower resources versus strengthening its cross-border interconnectors with the DRC. Adopting a regional approach could save Zambia $160 million a year in power-supply costs in the long term.

Figure 8. Comparison of electricity tariffs across Africa



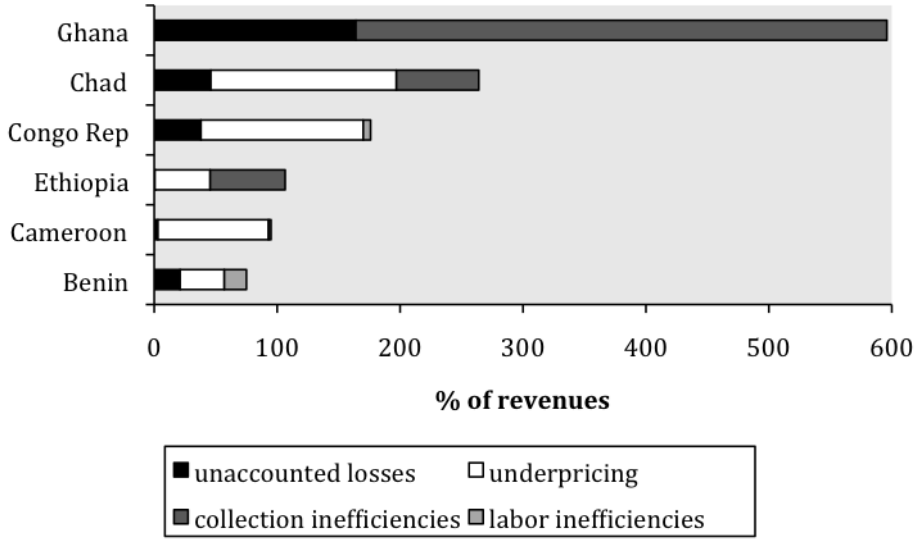
Source: Eberhard and others, 2008.

Figure 9. Comparison of Zambia's power tariffs against various cost benchmarks



Source: Eberhard and others, 2008; Rosnes and Vennemo, 2008

Figure 10. Hidden costs of power utilities



Source: Eberhard and others, 2008

Water resources[1]

Achievements

By African standards Zambia is relatively well endowed with water and water storage. The renewable water resource per capita is estimated at about 8,700 m^3 per year, well above the Sub-Saharan African average of 7,000 m^3 per year. Zambia already has extensive water storage capacity amounting to 9,600 m^3 per hectare, compared with an average for Sub-Saharan Africa of only 800 m^3 per capita.

Challenges

Nevertheless, the country's water resources are largely underdeveloped. Available freshwater supplies are 60 times larger than the current levels of withdrawal for economic consumption. Only 27 percent of the country's 6,000 MW of hydropower potential have been tapped. Only 155,000 hectares (3 percent) of agricultural land are irrigated, and access to safe water remains low.

Zambia's current irrigated area could be increased substantially with good economic returns. Simulations suggest that with a threshold internal rate of return (IRR) of 6 percent it would already be economically viable to develop a further 110,000 hectares of land for irrigation. If the threshold IRR is raised to 12 percent the economically viable area for irrigation shrinks to 23,000 hectares. The area with irrigation potential is concentrated in the copper belt area and on the shores of Lake Kariba in the southwest of the country (figure 11).

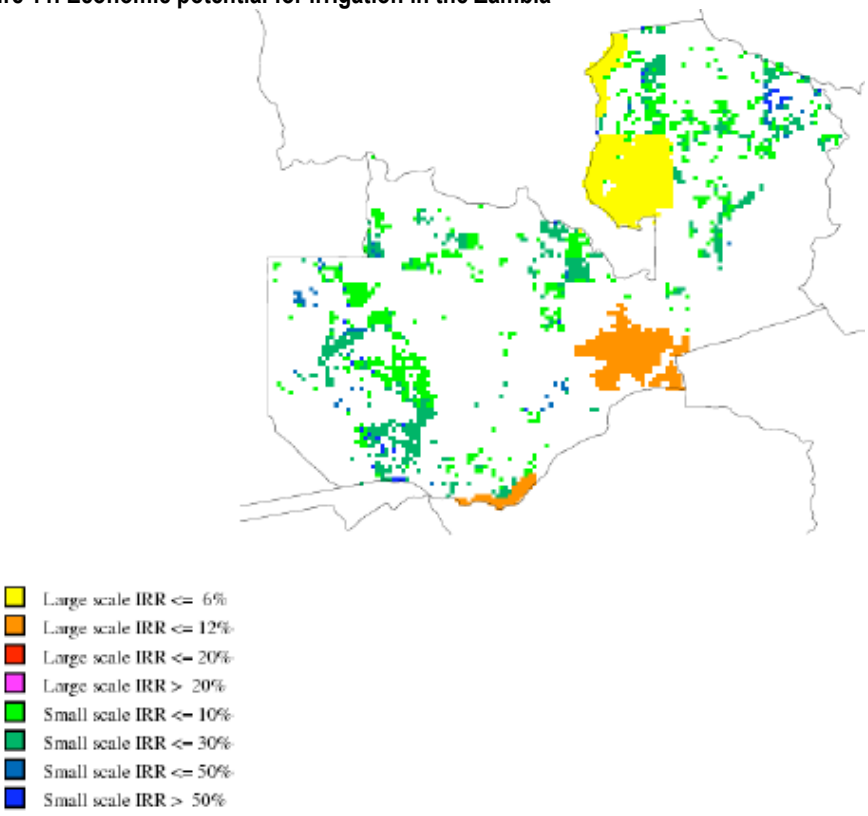
A high degree of spatial and intertemporal variability of water resources creates local scarcity. The uneven distribution of water resources across the country, high climatic variability leading to frequent floods and droughts, and degradation of water quality from mining discharges on the strategic Kafue catchment, result in localized issues of scarcity. From 1997 to 2007, floods and droughts are estimated to

[1] This section draws heavily on the recently completed World Bank report: *Managing Water for Sustainable Growth and Poverty Reduction—A Country Water Resources Assistance Strategy for Zambia*.

have cost Zambia a total of $13.8 billion in damages and lost outputs, a 0.4 percent loss of growth annually. Rainfall variability lowers agricultural growth by 1 percentage point, and regularly leads to crop failures and food shortages. Water scarcity also has serious consequences for Zambia's unique environmental resources, on which the country's significant tourist sector depend.

Given the wide range of conflicting uses (hydropower, water supply, irrigation, environment), it is essential to have a clearly defined basis for allocating water rights among sectors to maximize their development impact. To move ahead with important investments in water storage, Zambia needs to make further progress in integrated river-basin planning and investment. Beyond large-scale storage investments, the development of small-scale storage (as noted above) would do much to alleviate rural poverty and enhance the resilience of rural livelihoods.

Figure 11. Economic potential for irrigation in the Zambia



Source You and others 2009

Information and communication technology

Challenges

Zambia's GSM coverage is comparatively low by regional standards and well below what the market can deliver. Only 53 percent of Zambia's population lives within range of a GSM signal, compared with 67 percent among Africa's resource-rich states and 85 percent of the middle-income countries. Not only is the percentage low, but the architecture of the network (recall figure 2c) is very tightly clustered along the main economic arteries and almost nonexistent elsewhere. Simulations suggest more than 95 percent of

Zambia's population could be reached by a GSM signal on a commercially viable basis if measures were taken to dismantle regulatory barriers and promote competition to increase the market (figure 12).

The state-owned telecommunications incumbent, Zambia Telecommunications Company Ltd. (ZAMTEL), is characterized by inefficiency and an inability to compete with private mobile operators. The operator has become increasingly dependent on state financial support. The ZAMTEL monopoly is responsible for the exceptionally high prices of international voice communication that are observed in Zambia. In response, the government initiated a privatization process that aims to introduce private investment and management practices into the fixed-line sector.

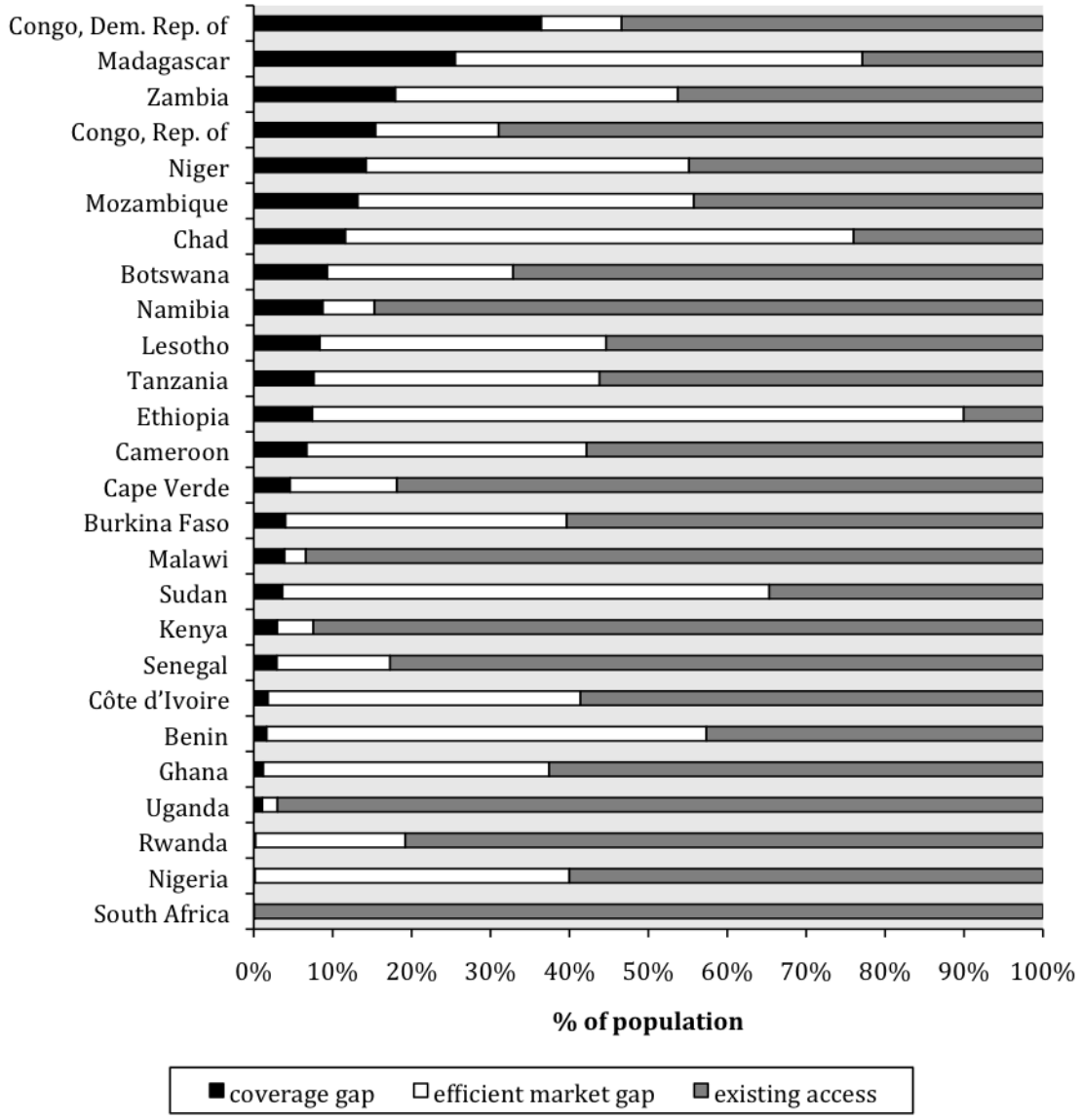
Table 7. Benchmarking ICT indicators

	Unit	Resource rich	**Zambia**	Middle-income countries
GSM coverage	% population	66.9	**53.0**	85.1
International bandwidth	Mbps/capita	4.0	**4.4**	104.0
Internet	Subscribers/100 people	0.1	**0.2**	3.0
Landline	Subscribers/100 people	19.3	**8.5**	34.8
Mobile phone	Subscribers/100 people	11.4	**20.9**	30.0
Labor productivity	Subscribers/employee	405.1	**505.8**	756.8
Quality of service	Faults/100 main lines	82.4	**90.8**	50.8
	Zambia	Without submarine cable		Other developing regions
Price of monthly mobile basket	**14.6**	11.12		9.9
Price of monthly fixed-line basket	**8.9**	13.58		—
Price of 20-hour Internet package	**81.5**	67.95		11.0
Price of a 3-minute call to the United States	**5.5**	2.59		2.0
Price of intra-Africa calls, mean	**1.2**	0.72		n.a.

Source: Minges and others, 2009

Note: — = data not available; n.a. = not applicable.

Figure 12. Potential for commercially viable expansion of GSM coverage



Source: Mayer and others 2009

Connecting to new East African submarine cables could slash international communication costs with competitive access. As with other African countries that lack access to submarine cables, Zambia faces even higher costs for Internet and international telecommunications than elsewhere. With the planned submarine cables along the east coast of Africa, and the extension of backbone connectivity inland for landlocked countries, there is the prospect of a 50 percent reduction in these charges based on experience elsewhere (table 8). These reductions will occur if there is competition on the international gateway to the submarine infrastructure, otherwise they will feed higher monopoly profits.

Table 8. 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: Minges and others, 2009

Financing Zambia's infrastructure

Zambia needs to implement an ambitious infrastructure investment agenda over the next decade. In order to meet its most pressing infrastructure needs and catch up with developing countries in other parts of the world, Zambia needs to expand its infrastructure assets in a number of key areas. The targets outlined in table 9 are purely illustrative in nature, but they represent reasonable aspirations. Developed in a way that is standardized across African countries, they allow for cross-country comparisons of the affordability of meeting the targets, which can be modified or delayed as needed to achieve financial balance.

Table 9. Illustrative investment targets for infrastructure in Zambia

	Economic target	**Social target**
ICT	Fiber-optic links to neighboring capitals and submarine cable	Universal access to GSM signal and public broadband facilities
Irrigation	Develop 23,000 hectares that are economically viable for irrigation	n.a.
Power	Refurbish 1,700 MW of generation and develop 1,700 MW of new generation	Raise electrification to 24% (50% urban and 15% 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 meters
WSS		Achieve MDGs

Source: Derived from Foster and Briceño-Garmendia 2009

n.a. = not applicable.

Meeting these illustrative infrastructure targets for Zambia would cost $1.6 billion per year over the next decade. Capital expenditure would account for 70 percent of this requirement. The country's power needs represent the single largest item and are estimated to be $0.6 billion per year to refurbish 1,700 MW of generation capacity and develop a further 1,700 MW of new capacity. The second-largest item is the expenditure of $0.5 billion a year for the WSS sector, needed to meet the MDGs. Both transport and ICT spending needs are somewhat lower (table 10).

Table 10. Indicative infrastructure spending needs in Zambia, 2006–15

	$ million per year		
Sector	CAPEX	O&M	Total needs
ICT	132	86	218
Power (trade stagnation)	532	99	631
Transport (basic)	145	144	289
WSS	317	154	471
Irrigation	5	0	5
Total	1,131	483	1,614

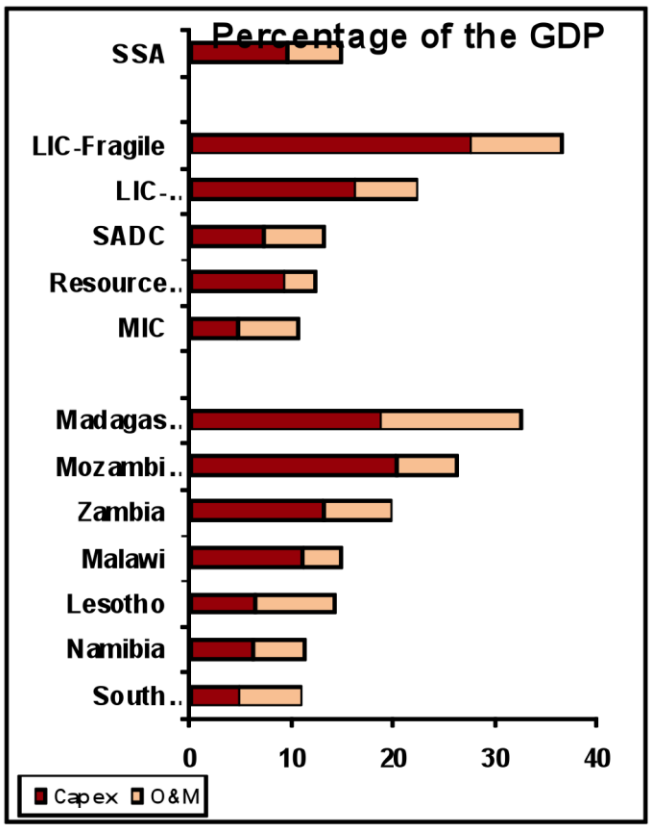
Source: Briceño-Garmendia, Smits, and Foster 2008.

Note: Figures refer to investment except public sector that also includes recurrent spending. Public sector covers general government and nonfinancial enterprises.

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

This total spending requirement would absorb 19.2 percent of Zambia's GDP for a decade, with about 13.2 percent going to investment and 6.6 percent to operations and maintenance (O&M, figure 13). This would be a substantial burden for the economy, but is within the scope of what other countries around the world have spent on infrastructure during periods of intensive development. As a point of reference, China dedicated 15 percent of its GDP just to infrastructure *investment* during the mid-2000s. So while spending at these levels would certainly be very challenging, it is not entirely inconceivable.

Figure 13. The burden of infrastructure needs



Source: Briceño-Garmendia, Smits, and Foster 2008.

Zambia already spends a sizeable $0.7 billion per year to meet infrastructure needs (table 11). (Due to the nonavailability of financial statements from the ZAMTEL, the state-owned telecommunications incumbent, these figures represent a lower limit for the level of infrastructure spending in the country.) About 65 percent of the recorded total is allocated toward capital expenditure and 35 percent toward operating expenditures. Two-thirds of total spending is domestically financed, coming from the pockets of Zambian taxpayers and users of utility services. Focusing on infrastructure investment alone, about half is funded by the public budget and the remaining half by a range of external financiers—primarily private investors and official development assistance (ODA) partners. Zambia receives relatively little infrastructure investment from countries outside the Organisation for Economic Co-operation and Development (OECD). Private finance goes almost entirely to the ICT sector, while ODA is evenly split between the transport and WSS sectors.

Table 11. Existing financing flows for infrastructure, average, 2001–06

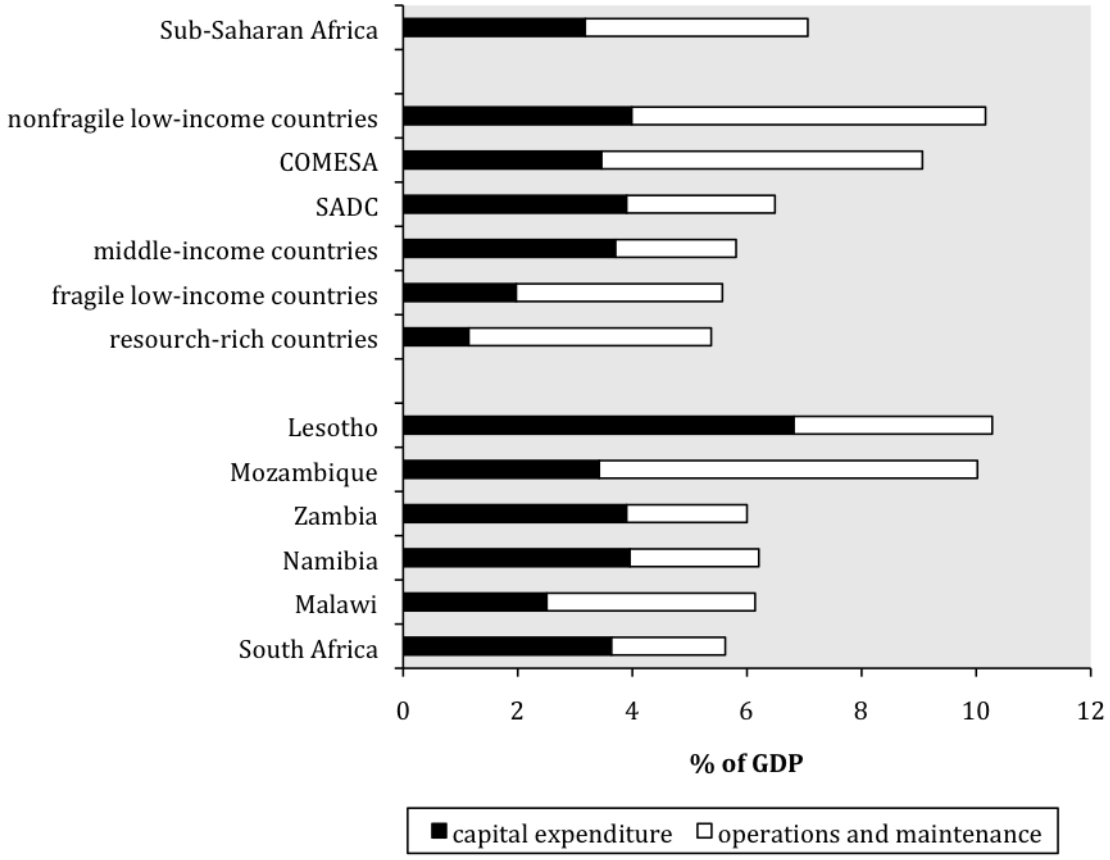
Sector	$m per year						
	O&M	Capital expenditure					Total spending
	Public sector	Public sector	ODA	Non-OECD financiers	PPI	Total CAPEX	
ICT	n.a.	n.a.	1	0	89	90	>90
Power	99	70	2	8	0	81	180
Transport	99	85	52	6	3	145	245
WSS	35	67	47	1	9	123	158
Total	233	224	99	15	101	439	>673

Source: Briceño-Garmendia, Smits, and Foster 2008.

Note: Due to nonavailability of ZAMTEL financial statements the data represent a lower bound on total spending.

PPI = private participation in infrastructure; OECD = Organisation for Economic Co-operation and Development; n.a. = not applicable.

Figure 14. Burden of infrastructure spending



Source: Briceño-Garmendia, Smits, and Foster 2008.

In terms of GDP, Zambia's existing infrastructure spending is typical of other resource-rich countries in Africa. During the early 2000s, Zambia was spending an average of around 6 percent of GDP on infrastructure (figure 14). This is close to the average for resource-rich countries, but well below the average of 10 percent for low-income countries in Africa. Thus, relative to African peers, Zambia's existing spending on infrastructure does not look that high.

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

There is evidence that some $315 million of additional resources each year could be recovered by improving efficiency (table 12). The three largest potential sources of efficiency gains are improving cost-recovery (particularly in the power sector), improving capital budget execution (particularly in the transport sector), and improving various aspects of operational efficiency (particularly in the water sector).

Table 12. The efficiency gap

	ICT	Power	Transport	WSS	Total
Overstaffing	—	—	—	2	2
Distribution losses	—	6	—	22	27
Undercollection	—	0	0	30	30
Undermaintenance	—	—	0	—	0
Low budget execution	0	2	39	17	57
Underrecovery of costs	—	152	20	25	198
Total	0	160	59	96	315

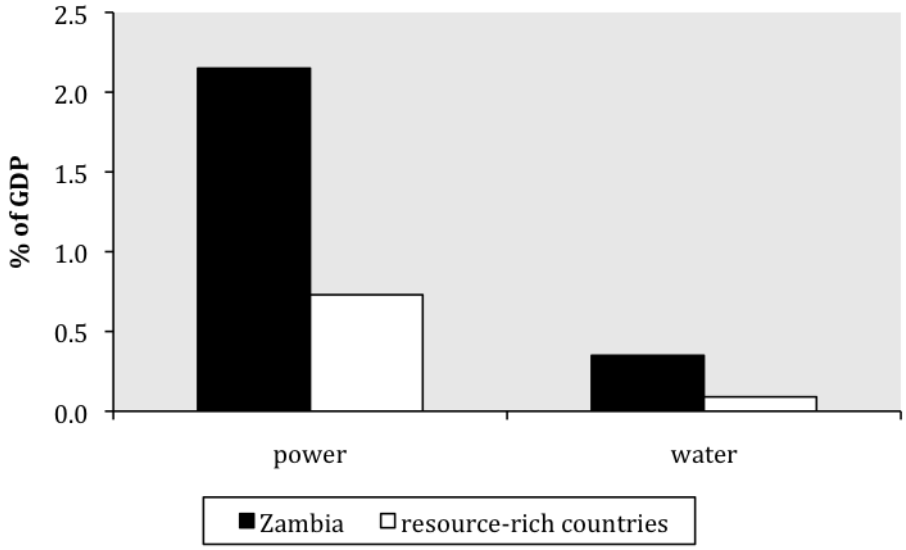
Source: Briceño-Garmendia, Smits, and Foster 2008.

— = data not available.

Undercharging for power services costs Zambia about $152 million per year (more than 2 percent of GDP). As noted above, Zambia's power tariffs of $0.03–$0.04 per kWh barely cover half of the full economic costs of power production. Overall, the national power utility, ZESCO, covers barely 40 percent of its costs. The associated financial burden is substantial at the macroeconomic level, amounting to more than 2 percent of GDP, and is also several times larger than that found in other resource-rich countries in Africa (figure 15). Underpricing of water services, though significant in absolute terms and substantially higher in Zambia than in other resource-rich countries in Africa, remains less of a macroeconomic issue due to the relatively low turnover of the sector, amounting to 0.4 percent of GDP.

Zambia's inequitable access to power and water makes subsidized tariffs a highly regressive policy. Zambian power consumers are having the full capital costs of their service (implicitly or explicitly) subsidized by the state. Given that 84 percent of households with access to power belong to the top quintile of the budget distribution—and indeed 99 percent of those with access belong to the top two quintiles of the distribution—this amounts to a highly regressive subsidy (figure 16). Though less significant in absolute magnitude, subsidies to the water sector are equally regressive in nature since the pattern of access to piped water mimics that of access to power.

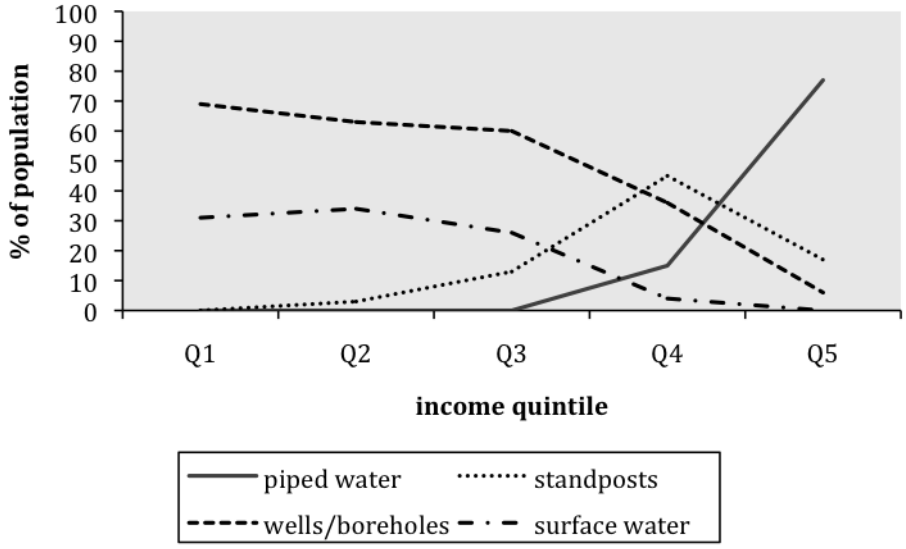
Figure 15. Underpricing in the power and water sectors



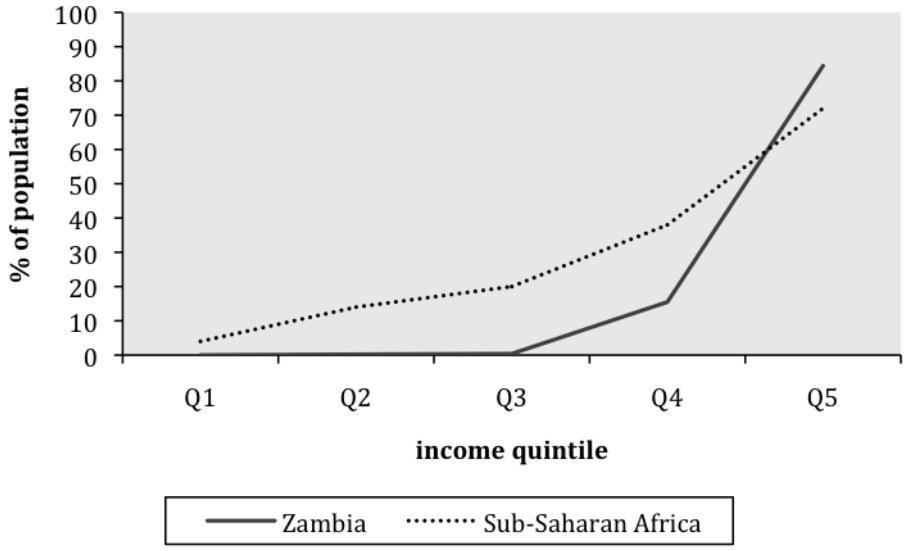
Source: Briceño-Garmendia, Smits, and Foster 2008.

Figure 16. Infrastructure and income

a. Water supply



b. Power

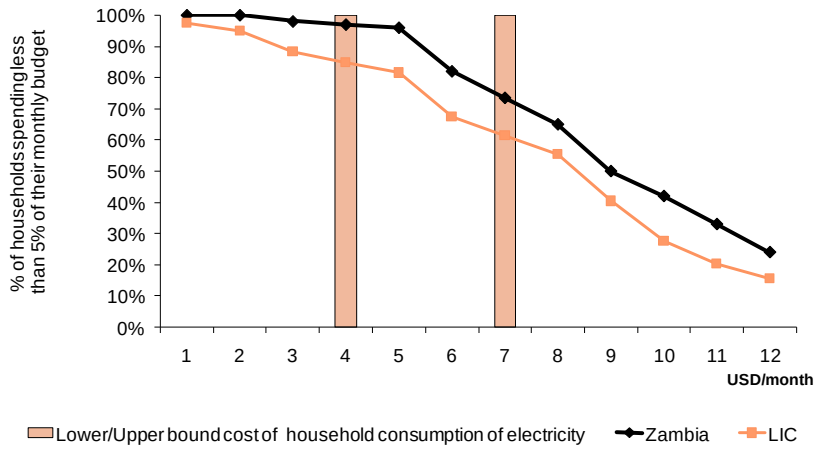


Source: Banerjee and others, 2008.

Interestingly enough, in Zambia those with access to electricity and power (and many of those without access) do not face major affordability problems. To evaluate the social feasibility of raising power tariffs to 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 17 illustrates the percentage of Zambian households able to afford monthly utility bills at various levels. Thus, a monthly utility bill of $2 would be affordable for essentially all Zambians, whereas a monthly utility bill of $12 would be affordable for only the richest 20 percent of Zambia's households.

Purchasing a subsistence consumption bundle at cost-recovery prices would be affordable for the vast majority of Zambian households. Taking a cost-recovery tariff of $0.08 per kWh for power and a subsistence consumption of 50 kWh per month—which is enough to power four 100-watt light bulbs for four hours per day—the monthly power bill would amount to $4.00, which would be affordable for almost 100 percent of the Zambian population (figure 17). Even taking a more generous consumption allowance of 75–100 kWh per month, a monthly bill based on a cost-recovery tariff would still amount to around $7.00, which would be affordable for 70 percent of the population. Given that, as of today, only the more affluent 20 percent of the Zambian population have access to electricity, it is clear from the analysis that cost-recovery tariffs would be perfectly affordable for this segment of the population. Moreover, even if electrification rates were rapidly expanded to reach the middle tranches of income distribution, power would remain affordable. Thanks to Zambia's relatively low-cost energy resources, and a population that is relatively well-off by the standards of low-income countries in Africa, power tariffs are likely to remain affordable.

Figure 17. Those with access (and many of those without access) do not face major affordability problems

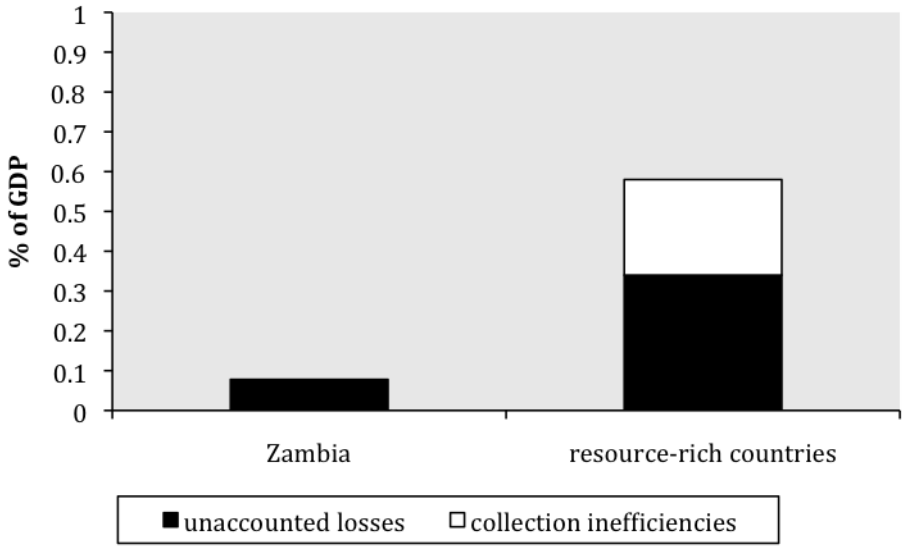


Source: Banerjee and others, 2008.

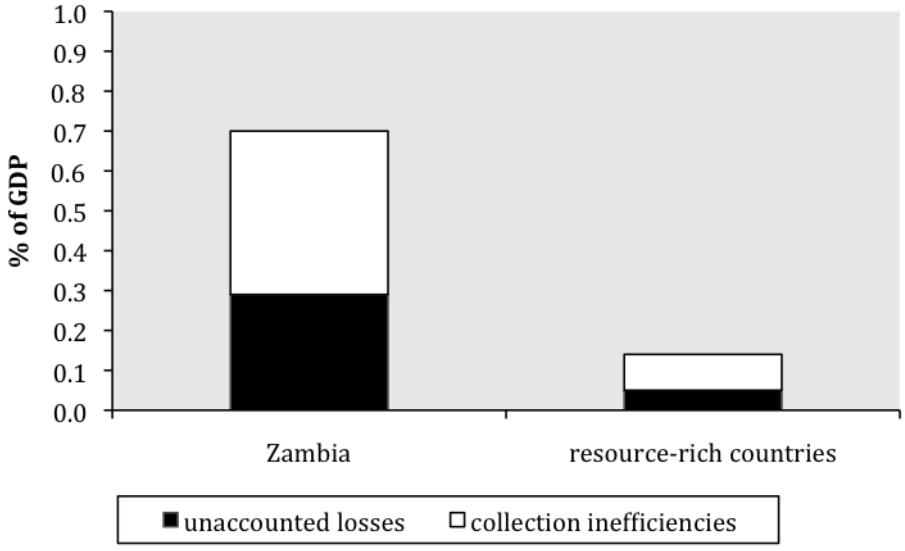
Distribution losses and low collection rates of water utilities are costing the country $52 million a year. While Zambia's power utilities are relatively efficient by the standards of its peers, Zambia's water utilities are relatively inefficient when judged by the same standard (figure 18). Whereas water utilities in other resource-rich African countries typically face operational inefficiencies that amount to 0.14 percent of GDP, the operational inefficiencies of Zambian water utilities are wasting 0.7 percent of GDP. Just under half of this waste derives from unaccounted water, and just over half from undercollection of revenues.

Figure 18. Hidden costs of the power and water sectors due to inefficiencies

a. Power



b. Water



Source: Briceño-Garmendia, Smits, and Foster 2008.

Annual funding gap

Zambia's infrastructure funding gap amounts to $0.5 billion per year (or about 6.5 percent of GDP) and is mainly associated with spending needs in the power and water sectors (table 13). Almost 60 percent of the infrastructure funding gap is for power, representing a shortfall of almost $0.3 billion. The rest of the gap is largely related to the WSS sector, where an additional $0.2 billion is needed to meet the MDGs. No significant funding gap is found for transport, once efficiency gains are taken into account. In the case of ICT, the magnitude of the funding gap cannot be assessed due to the absence of

comprehensive information on existing spending; however, based on the experience of other African countries, it is safe to assume that a funding gap for this sector is small or nonexistent.

Table 13. Funding gaps by sector

	ICT	Power	Transport	WSS	Total
Spending needs	(218)	(631)	(289)	(471)	(1,609)
Existing spending	90+	180	245	158	673
Efficiency gains	n.a.	160	59	96	315
Funding gap	n.a.	(291)	15	(217)	(493)
Potential for reallocation	0	30	65	0	95

Source: Briceño-Garmendia, Smits, and Foster 2008.
n.a. = not applicable.

Every year about $95 million more is spent than needed to meet Zambia's estimated infrastructure requirements (recall table 9). Most of this overspending is on the transport sector ($65 million), which in recent years is being funded at rates apparently over and above long-term requirements. There is also evidence of overspending on O&M in the power sector, due to utility inefficiencies and an overextended distribution network. Since there is a large funding gap in this sector, these resources would be better diverted to finance power investments.

What else can be done?

There are a number of ways of addressing the infrastructure funding gap; filling it with money is not the only relevant approach. A number of policy choices relating to technology selection and regional approaches to infrastructure development could reduce the gap by lowering the costs of meeting infrastructure targets. Alternatively, there is the possibility of taking a longer period of time to meet defined goals.

Adopting lower-cost technologies for meeting the MDG targets for WSS could reduce Zambia's infrastructure funding gap by $0.2 billion. The estimated cost of reaching the MDG targets is based on Zambia maintaining its current mix of WSS technologies, which as noted tends to be skewed toward higher-end solutions such as private taps. If, instead, the service expansion needed to meet the MDG targets was undertaken entirely through lower-end solutions, such as standposts and boreholes, the associated cost could fall substantially, by $218 million or almost one-half.

Eventually, importing power from the DRC through an enhanced SAPP could reduce the funding gap by $0.2 billion. Although not feasible at present, in the medium to long term (as the DRC develops the hydropower at Inga), a larger volume of low-cost power would become available through the SAPP. Since the DRC's hydropower resources are more cost-effective than those of Zambia, the latter could reduce its power-sector development costs substantially in the longer term by moving toward increased reliance on power trade, with potential cost savings of $160 million per year.

Adopting more appropriate standards for paved roads could shave a further $0.1 billion from the funding gap. The spending needs for the transport sector assume that regional and national connectivity standards will be met by standard asphalt paved roads. But, in practice, it may be possible to reduce costs

by adopting more appropriate paving technologies. For example, use of single-surface treatment instead of asphalt surfacing would reduce road sector development costs by $60 million per year.

If it were possible to adopt all of the above policy measures at once, Zambia's infrastructure funding gap would all but disappear. The combined value of these cost-saving policy measures is $453 million, which is very close to the funding gap of $493 million. While it may not necessarily be possible to reap all of these cost savings in the medium term, this calculation serves to illustrate the power of strategic policy choices in ensuring the feasibility of meeting the country's infrastructure needs.

Holding spending at current levels but going after efficiency gains would allow Zambia to meet identified infrastructure targets in 15 years instead of the notional 10 years from 2006-2015 assumed for this exercise. Assuming that Zambia had no means of raising additional infrastructure finance and was not able to implement the cost-saving policies described above, the only way to meet the infrastructure targets would be to take a longer period of time than the decade that was contemplated at the outset of this exercise. If Zambia were able to redress the various inefficiencies identified above, and preserve overall spending at current levels, the targets would take 15 years to reach, which is to say they would be achievable by the year 2020. Without tackling inefficiencies, the country would take another 15 years, or until 2035.

Zambia's infrastructure situation is more hopeful than that of many other African countries. For a start, infrastructure spending needs—though large—are not beyond the realms of possibility. Second, Zambia's resource wealth and relatively well-off population provide a more solid financing basis than is available to many other countries. Third, Zambia's funding gap—though substantial—can be dramatically reduced through a range of policy measures aimed at stemming inefficiencies and lowering costs. In sum, notwithstanding the numerous infrastructure challenges that Zambia faces, their resolution looks much more tractable than in the case of many African peers.

Bibliography

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.

General

Africa's Infrastructure: A Time for Transformation (AICD Web site), http://www.infrastructureafrica.org

Foster, Vivien, and Cecilia Briceño-Garmendia, eds. 2009. *Africa's Infrastructure: A Time for Transformation.* Paris and Washington, DC: Agence Française de Développement and World Bank.

Growth

Calderón, César. 2009. "Infrastructure and Growth in Africa," Policy Research Working Paper 4914, World Bank, Washington, DC.

Escribano, Alvaro, J. Luis Guasch, and Jorge Pena. 2010. "Assessing the Impact of Infrastructure Quality on Firm Productivity in Africa." Policy Research Working Paper 5191, World Bank, Washington, DC.

Yepes, Tito, Justin Pierce, and Vivien Foster. 2009. "Making Sense of Africa's Infrastructure Endowment: A Benchmarking Approach." Policy Research Working Paper 4912, World Bank, Washington, DC.

Financing

Briceño-Garmendia, Cecilia, Karlis Smits, and Vivien Foster. 2009. "Financing Public Infrastructure in Sub-Saharan Africa: Patterns and Emerging Issues." AICD Background Paper 15, Africa Region, World Bank, Washington, DC.

Information and communication technologies

Michael Minges, Mavis Ampah, Daniel Camos, Cecilia Briceño-Garmendia, Maria Shkratan, and Mark Williams. 2009. "Information and Communications Technology in Sub-Saharan Africa: A Sector Review." AICD Background Paper 10, Africa Region, World Bank, Washington, DC.

Mayer, Rebecca, Ken Figueredo, Mike Jensen, Tim Kelly, Richard Green, and Alvaro Federico Barra. 2009. "Connecting the Continent: Costing the Needs for Spending on ICT Infrastructure in Africa." AICD Background Paper 3, Africa Region, World Bank, Washington, DC.

Irrigation

Svendsen, Mark, Mandy Ewing, and Siwa Msangi. 2008. "Watermarks: Indicators of Irrigation Sector Performance in Africa." AICD Background Paper 4, Africa Region, World Bank, Washington, DC.

You, L., C. Ringler, G. Nelson, U. Wood-Sichra, R. Robertson, S. Wood, G. Zhe, T. Zhu, and Y. Sun. 2009. "Torrents and Trickles: Irrigation Spending Needs in Africa." AICD Background Paper 9, Africa Region, World Bank, Washington, DC.

Power

Eberhard, Anton, Vivien Foster, Cecilia Briceño-Garmendia, Fatimata Ouedraogo, Daniel Camos, and Maria Shkaratan. 2008. "Underpowered: The State of the Power Sector in Sub-Saharan Africa." AICD Background Paper 6, Africa Region, World Bank, Washington, DC.

Foster, Vivien, and Jevgenijs Steinbuks. 2009. "Paying the Price for Unreliable Power Supplies: In-House Generation of Electricity by Firms in Africa." Policy Research Working Paper 4913, World Bank, Washington, DC.

Rosnes, Orvika, and Haakon Vennemo. 2009. "Powering Up: Costing Power Infrastructure Spending Needs in Sub-Saharan Africa." AICD Background Paper 5, Africa Region, World Bank, Washington, DC.

Transport

Bullock, Richard. 2009. "Off Track: Sub-Saharan African Railways." AICD Background Paper 17, Africa Region, World Bank, Washington, DC.

Carruthers, Robin, Ranga Rajan Krishnamani, and Siobhan Murray. 2009. "Improving Connectivity: Investing in Transport Infrastructure in Sub-Saharan Africa." AICD Background Paper 7, Africa Region, World Bank, Washington, DC.

Gwilliam, Ken, Vivien Foster, Rodrigo Archondo-Callao, Cecilia Briceño-Garmendia, Alberto Nogales, and Kavita Sethi. 2008. "The Burden of Maintenance: Roads in Sub-Saharan Africa." AICD Background Paper 14, Africa Region, World Bank, Washington, DC.

Heinrich C. Bofinger. 2009. "An Unsteady Course: Growth and Challenges in Africa's Air Transport Industry." AICD Background Paper 16, Africa Region, World Bank, Washington, DC.

Kumar, Ajay, and Fanny Barrett. 2008. "Stuck in Traffic: Urban Transport in Africa." AICD Background Paper 1, Africa Region, World Bank, Washington, DC.

Ocean Shipping Consultants, Inc. 2009. "Beyond the Bottlenecks: Ports in Africa." AICD Background Paper 8, Africa Region, World Bank, Washington, DC.

Water resources

World Bank. 2009. *Zambia Managing Water for Sustainable Growth and Poverty Reduction: A Country Water Resources Assistance Strategy for Zambia*. Water Resources Management, Africa Region. August 2009.

Water supply and sanitation

Banerjee, Sudeshna, Vivien Foster, Yvonne Ying, Heather Skilling, and Quentin Wodon. "Cost Recovery, Equity, and Efficiency in Water Tariffs: Evidence from African Utilities." AICD Working Paper 7, World Bank, Washington, DC.

Banerjee, Sudeshna, Heather Skilling, Vivien Foster, Cecilia Briceño-Garmendia, Elvira Morella, and Tarik Chfadi. 2008. "Ebbing Water, Surging Deficits: Urban Water Supply in Sub-Saharan Africa." AICD Background Paper 12, Africa Region, World Bank, Washington, DC.

Gulyani, Sumila, Debabrata Talukdar, and Darby Jack. 2009. "Poverty, Living Conditions, and Infrastructure Access: A Comparison of Slums in Dakar, Johannesburg, and Nairobi." AICD Working Paper 10, World Bank, Washington, DC.

Keener, Sarah, Manuel Luengo, and Sudeshna Banerjee. 2009. "Provision of Water to the Poor in Africa: Experience with Water Standposts and the Informal Water Sector." AICD Working Paper 13, World Bank, Washington, DC.

Morella, Elvira, Vivien Foster, and Sudeshna Ghosh Banerjee. 2008. "Climbing the Ladder: The State of Sanitation in Sub-Saharan Africa." AICD Background Paper 13, Africa Region, World Bank, Washington, DC.

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 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.