AICD

AFRICA INFRASTRUCTURE COUNTRY DIAGNOSTIC

COUNTRY REPORT

Ethiopia's Infrastructure: A Continental Perspective

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Africa's Infrastructure | A Time for Transformation

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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.

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Synopsis

Infrastructure contributed 0.6 percentage points to Ethiopia's annual per capita GDP growth over the last decade. Raising the country's infrastructure endowment level to that of the region's middle-income countries could lift annual growth by an additional 3 percentage points. This would represent a significant boost over the growth performance of the mid-2000s, which averaged around 5 percent.

In recent years, Ethiopia has made significant progress in infrastructure, and its infrastructure indicators compare relatively well with low-income country peers. The country developed Ethiopia Airlines (now one of the three main African airlines) and associated regional air transport hubs. It has launched an ambitious investment program to upgrade its network of trunk roads and is establishing a modern funding mechanism for road maintenance. Access to water and sanitation is expanding rapidly (from a very low base) thanks to judicious concentration on intermediate options such as traditional latrines, wells, boreholes and standposts.

The country's greatest infrastructure challenge lies in the power sector, where a further 8,700 megawatts of generating plant will be needed over the next decade—a doubling of current capacity. In transport, the key challenge is to improve Ethiopia's exceptionally low levels of rural accessibility and ensure that recent investments in the road network receive adequate maintenance. In information and communications technology (ICT), Ethiopia lags in modernizing its institutional and regulatory framework. By awarding a second mobile license, the country could rapidly expand its mobile penetration rates and raise an estimated $0.5 billion in revenue.

Addressing Ethiopia's infrastructure deficit will require a sustained annual expenditure of $5.1 billion over the next decade. This level of investment is well beyond what the country can afford, however, as it represents more than 40 percent of GDP and is three times the already impressive infrastructure spending of around $1.3 billion that the country managed during the mid-2000s. The power sector alone would require $3.3 billion per year to develop, of which $1 billion would be designated for investments needed to permit regional trade in power and exploit the country's comparative advantage in the generation of electrical power.

Ethiopia faces one of the more challenging infrastructure situations of any country in Africa. The spending needed to upgrade the country's infrastructure platform and realize its power export potential is very large relative to the size of the economy. As of 2006, the gap between available and needed funds was $3.5 billion per year. While there are some inefficiencies in the system (estimated at around $0.5 billion per year), Ethiopia's infrastructure is relatively efficient, compared with that of other countries. Savings could be achieved by improving road maintenance and, to a lesser extent, by addressing the underpricing of power. But even if all inefficiencies were eliminated, a huge annual funding gap of $3 billion would remain. The only likely way to close that gap will be to allow the country more time to reach its infrastructure targets and to prioritize public investments in the interim. There is also some potential for reallocating public resources away from the ICT sector and allowing these assets to be developed by private investors.

Unless the funding gap is closed, the development of a sound infrastructure platform for the country could be unacceptably delayed by up to 30 years.

The continental perspective

The Africa Infrastructure Country Diagnostic (AICD) has collected and analyzed extensive infrastructure data for more than 40 Sub-Saharan countries, including Ethiopia. The results are presented in reports on various infrastructure sectors—ICT, irrigation, power, transport, water and sanitation—and policy areas, including investment needs, fiscal costs, and sector performance.

This country report presents the key AICD findings for Ethiopia. This will allow its infrastructure situation to be benchmarked against that of other African nations that, like Ethiopia, are low-income countries, with particular emphasis on immediate regional neighbors in East Africa.

Several methodological issues should be borne in mind. First, the cross country nature of the data collection creates an inevitable time lag. The period covered by the AICD runs from 2001 to 2006. Most technical data are presented for 2006 (or the most recent year available), while financial data typically are averaged over the available period to smooth out the effect of short term fluctuations. Second, cross country comparisons require standardization of the indicators and the analysis to ensure consistency. Therefore, some of the indicators may be slightly different from those that are routinely reported and discussed at the country level.

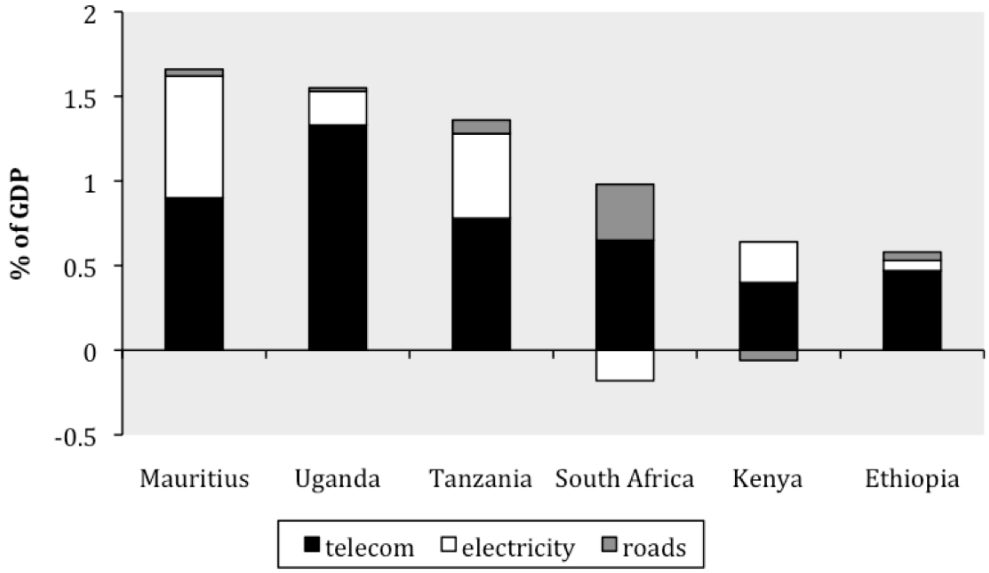
Why infrastructure matters

During the 2000s, Ethiopia's annual economic growth has averaged 4.8 percent, compared with only 0.5 percent in the previous decade. Notwithstanding this improvement, current annual growth levels still fall short of the sustained 7 percent needed to meet the Millennium Development Goals. Improved structural and stabilization policies generated an estimated 4.2 percent of Ethiopia's improved per capita growth performance during the 2000s, and improvements in the country's infrastructure platform over that period contributed up to 0.6 percentage points to growth. This was due almost entirely to the introduction of mobile telephony in Ethiopia. Simulations suggest that if Ethiopia's infrastructure platform could be improved to the level of the African leader, Mauritius, annual per capita growth rates could increase by 3.8 percent. This potential impact would come equally from improvements to transport, power, and ICT infrastructure (figure 1).

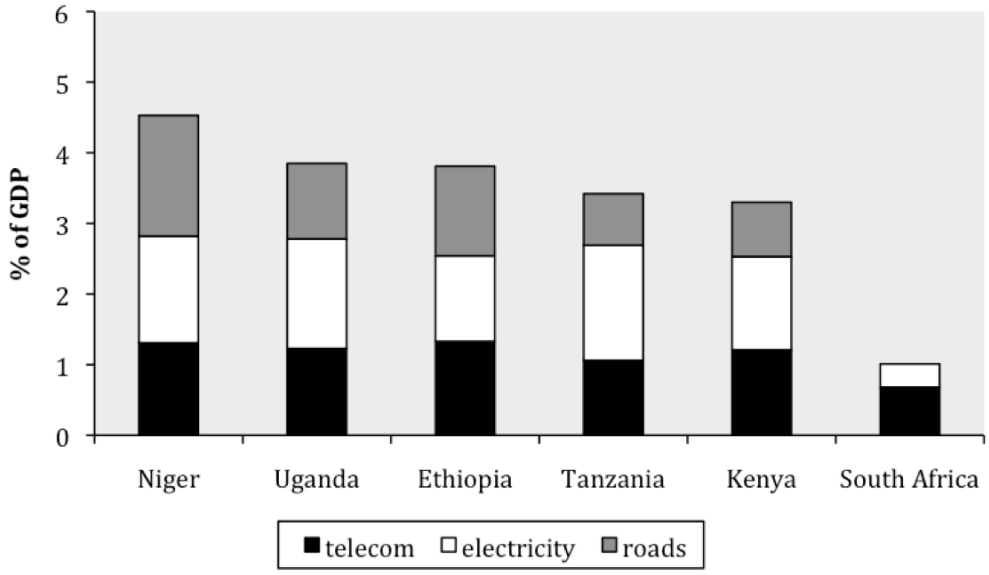
Evidence from enterprise surveys suggests that infrastructure constraints are responsible for an estimated 50 percent of the productivity handicap faced by Ethiopian firms. The remainder is caused by governance, red tape, and financing constraints. Power is by far the infrastructure constraint that weighs most heavily on Ethiopian firms (figure 2).

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

a. Historic changes in growth per capita



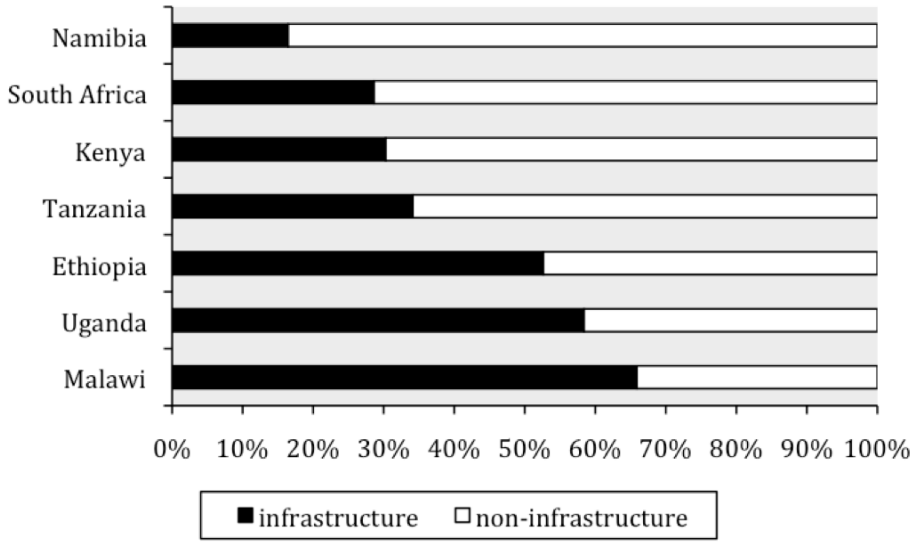
b. Potential improvements in growth per capita



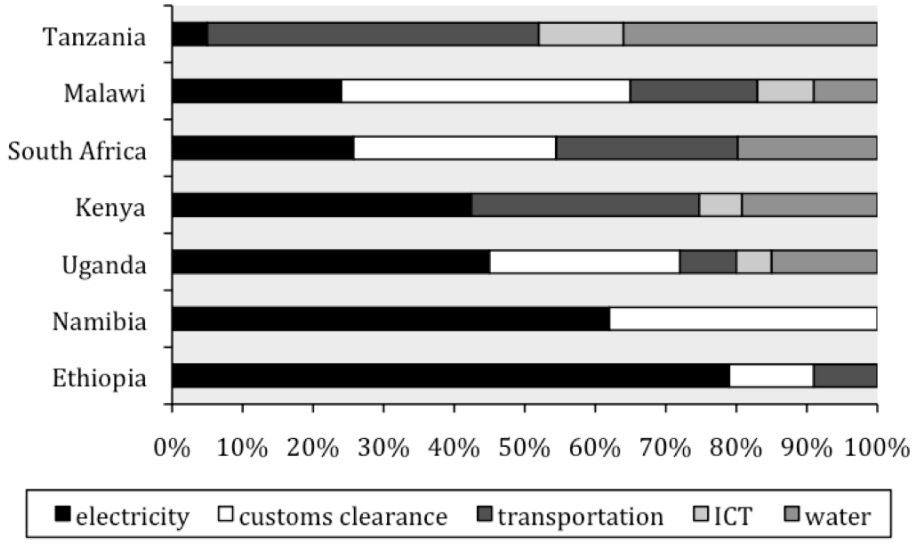
Source: Calderon 2008.

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

a. Overall contribution of infrastructure



b. Contribution of infrastructure by sector



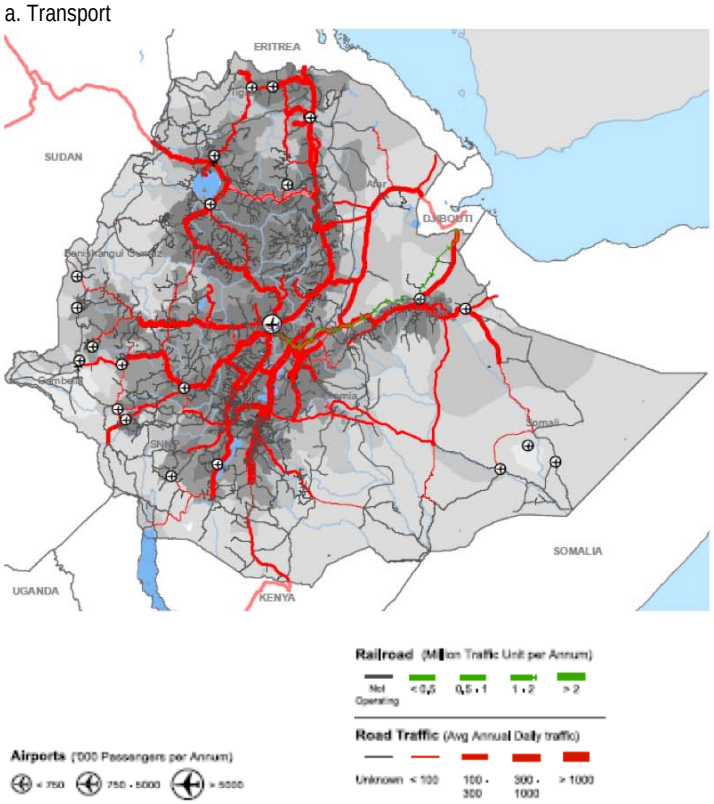
Source: Escribano and others 2008.

The state of Ethiopia's infrastructure

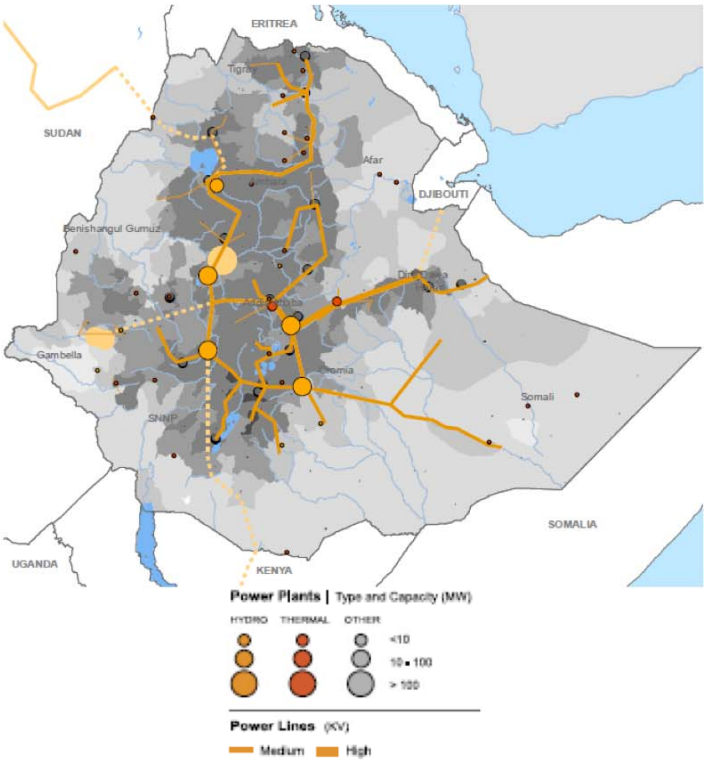
Ethiopia is a predominantly rural country. Addis Ababa, which is in the middle of the country, is by far the largest urban center. Population and agricultural activity are concentrated in the central and northern areas of the country, and the far south and east are only sparsely inhabited. Ethiopia's infrastructure backbone development therefore tends to be centered in Addis Ababa and to spread from there outward (figure 3).

Figure 3. Spatial view of Ethiopia's infrastructure networks against population density

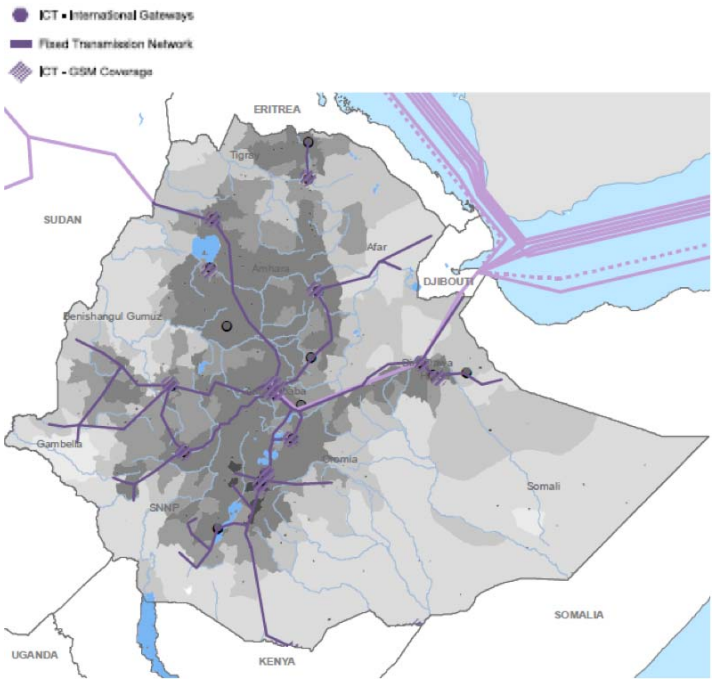
a. Transport



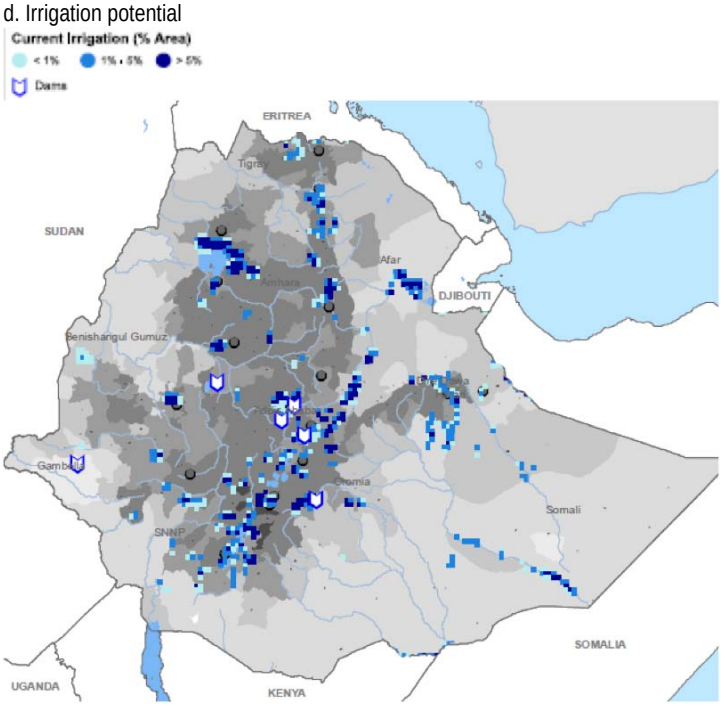
b. Power



c. ICT



d. Irrigation potential



The least developed infrastructure links are those to the southeast of the capital. Ethiopia's infrastructure networks are largely isolated from those of neighboring countries. On the transport side, a reasonable road corridor from Addis Ababa to neighboring Djibouti provides access to landlocked Ethiopia's major port. There is also a rail corridor, although it is currently idle. Otherwise, Ethiopia's infrastructure networks provide no meaningful connectivity with neighboring Kenya, Uganda, Sudan, and Eritrea.

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

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

	Achievements	Challenges
Air transport	One of top three African carriers Major regional air hub	Improving air traffic control at Addis Ababa Bole International Airport Developing domestic air transportation
ICT		Modernize regulatory framework Award a second mobile license Rebalance ICT tariffs in line with costs
Power		Undertake huge investment program Address underpricing of power
Surface transport	Major investment in trunk network Sound Road Fund in place	Improve rural accessibility Concession railway
Water resources		Develop additional water storage Develop viable areas for irrigation
Water and sanitation	Rapid expansion of coverage	Address utility inefficiencies

Surface transport

Achievements

The length of the trunk network is more than adequate. Ethiopia's road density indicators look relatively low by some standards, but the trunk network provides basic regional and national connectivity. It links the capital to the coast as well as the international border crossings and the internal provincial capitals.

In recent years, Ethiopia has dedicated three percent of GDP to road investments. This is one of the highest shares in Africa, although the absolute value of this spending (approximately $5 per capita annually) is comparable to what other East African countries are investing. The investment program focuses mainly on rehabilitation, upgrading, and widening of the trunk network. These efforts have brought the quality of Ethiopia's trunk network level with other low-income countries in Africa: 88 percent of the paved network and 60 percent of the unpaved network is in good or fair condition (table 2).

Ethiopia has established a sound system for funding road maintenance. The country has made great strides with institutional reforms. Its Road Fund meets most of the good practice design criteria. Yet the fuel levy of around $0.08 per liter (most of which takes the form of earmarked VAT transfers) is only about half the $0.16 per liter that would be needed to adequately finance the country's road maintenance needs (figure 4). Ethiopia's relatively high required fuel levy reflects the country's low traffic volume.

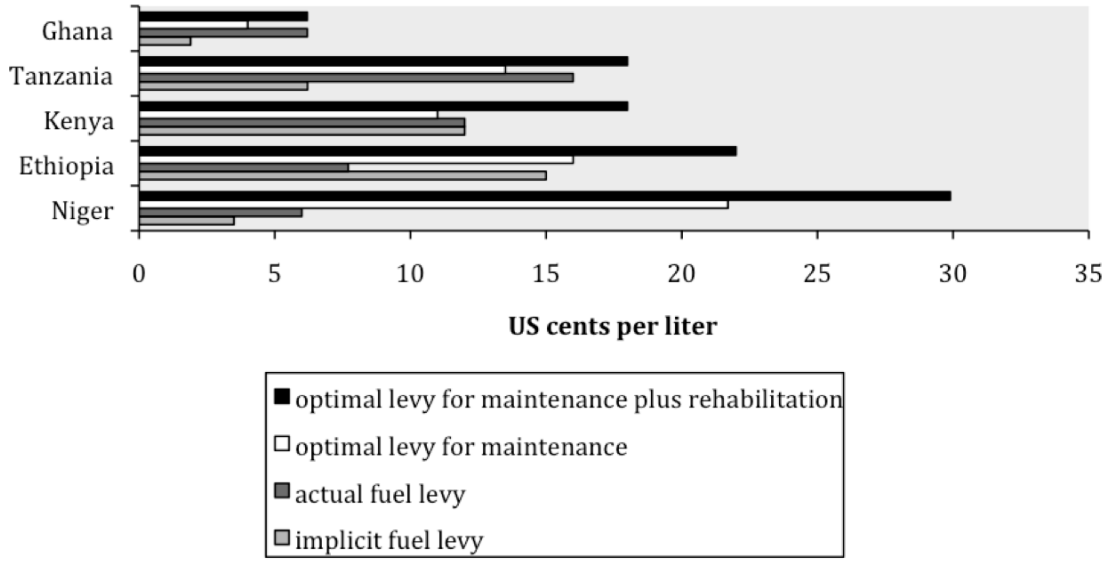
The government makes up part (but not all) of the financing shortfall for road maintenance from the public budget. While this is reasonable for the time being, it leaves the road sector exposed to any fiscal downturn. It also leaves a significant shortfall in road maintenance funding, which is likely to grow over time as the country's newly refurbished network begins to age.

Table 2. Benchmarking transport infrastructure

	Unit	Ethiopia	LIC
Paved road density	km/1000 km^2 of arable land	35.8	86.6
Unpaved road density	km/1000 km^2 of arable land	121.5	504.7
GIS Rural accessibility	% of rural pop within 2 km from all-season road	10.3	21.7
Paved road traffic	Average Annual Daily Traffic	499.4	1,049.6
Unpaved road traffic	Average Annual Daily Traffic	101.0	62.6
Paved network quality	% in good or fair condition	87.7	85.1
Unpaved network quality	% in good or fair condition	59.6	57.6
Perceived transport quality	% firms identifying as major business constraint	11.8	23.0

Source: Gwilliam and others 2008.

Figure 4. Actual and implicit fuel levy and optimal benchmarks



Source: Gwilliam and others 2008.

Challenges

Rural road accessibility is very low in Ethiopia. According to a GIS-based analysis, only 10 percent of Ethiopia's rural population lives within two kilometers of an all-weather road. This is only half of the benchmark level for low-income countries in Sub-Saharan Africa. Since as much as 76 percent of Ethiopia's population lives in rural areas, this is a high degree of isolation. The broad dispersion of the rural population makes it particularly challenging for the country to remedy this situation. It is estimated that placing the entire rural population within two kilometers of an all-weather road would entail tripling the length of the classified road network, a much higher level of effort than would be involved in most

other neighboring countries. The government of Ethiopia plans a major investment program to upgrade the rural road network once work on the trunk network has been completed. In rolling out this program, it will be important to prioritize areas with high agricultural potential to improve food security.

Ethiopia's rail corridor needs major rehabilitation. The rail corridor between Addis Ababa and the Port of Djibouti has deteriorated and fallen into disuse. Plans for a major rehabilitation program include a new railway concession. More than half of Sub-Saharan Africa's rail corridors have been awarded as concessions in recent years, and the clear lessons emerging from this experience may be relevant to Ethiopia. On the whole, rail concessions have been effective at improving operational performance and boosting traffic. Nevertheless, due to intense competition with the road sector and relatively low volumes of traffic overall, they have generally failed to raise adequate revenue to finance major rehabilitation programs without substantial public sector support. It is therefore important for governments to go into rail concessions with realistic expectations as to what they can achieve and to identify additional sources of public financing for major investments.

As a landlocked country, Ethiopia depends on the Port of Djibouti to handle its imports and exports and will benefit from improvements there. The port is both a major transit port for Ethiopian cargo and a potential major container transshipment hub in East Africa, and it has attracted a *whole port concession* that includes substantial greenfield development commitments. DP World, the Dubai-based international terminal operator, has a 20-year agreement to manage and invest in the port. This has made the port much more efficient, and the main components are in place to deliver new port capacity. A a new oil terminal is in operation, and a new container terminal opened for business in 2009. With the injection of foreign expertise and resources, Djibouti has, since the beginning of the millennium, markedly improved the port's operations and competitive position and has mapped out its future development.

Air transport

Achievements

Ethiopia is a regional leader in air transportation. Ethiopia Airlines, one of Africa's three top international carriers, has an extensive network across the continent and a safety record up to international standards. This public company has been successful because it has been allowed to operate at arm's length from the government and in line with sound commercial principles. Linked to the ascendancy of the national airline, Addis Ababa Bole International Airport has become one of the three main international gateways for Sub-Saharan Africa.

Challenges

There is scope for improving air traffic control at Addis Ababa Bole International Airport. The land and airside infrastructure at the airport is of good quality and generally adequate to handle current traffic levels and anticipated growth. Air traffic control is its greatest weakness, as there is no air traffic surveillance technology in place. Safety in air transport would greatly benefit if aircrafts were equipped with satellite-based technologies such as the ADS-B (Automatic Dependent Surveillance – Broadcast), which allow an aircraft's precise location to be determined.

The limited development of domestic air transport is striking. In contrast to Ethiopia Airlines' highly developed international network, domestic air transport plays a relatively minor role. As tourism becomes more important for the country, it may be necessary to devote greater attention to developing domestic services.

Water supply and sanitation

Achievements

From a very low base, access to improved water and sanitation is rising rapidly. The majority of Ethiopia's population relies on unimproved water and sanitation; 68 percent use surface water and 62 percent practice open defecation (table 3). These rates are almost twice as high as the benchmark level for low-income countries in Africa and represent a major public health risk. The deficit on the water side is largely explained by very low reliance on boreholes (10 percent in Ethiopia compared with 38 percent for the benchmark). The deficit on the sanitation side is largely explained by low coverage of traditional latrines (35 percent in Ethiopia compared with 48 percent for the benchmark).

Table 3. Benchmarking access to water and sanitation and water utility performance

	Unit	Ethiopia	Low-income countries
Access to piped water	% pop	6.0	10.1
Access to stand posts	% pop	15.8	16.1
Access to wells/boreholes	% pop	9.9	38.3
Access to surface water	% pop	67.9	33.8
Access to septic tanks	% pop	2.1	5.3
Access to improved latrines	% pop	0.9	9.3
Access to traditional latrines	% pop	34.7	47.9
No sanitation	% pop	62.2	37.1
Domestic water consumption	liter/capita/day	29.8	72.4
Revenue collection	% sales	97.0	96.0
Distribution losses	% production	22.0	22.1
Cost recovery	% total costs	47.0	56.0
Total hidden costs as % of revenue	%	132.7	121.2
Tariff (US cents per m3)	Ethiopia	Scarce water resources	Other developing regions
Residential tariff	23.41	60.26	3.0 – 60.0
Non-residential tariff	42.22	120.74	

Source: Banerjee and others 2008; and Morella and others 2008.

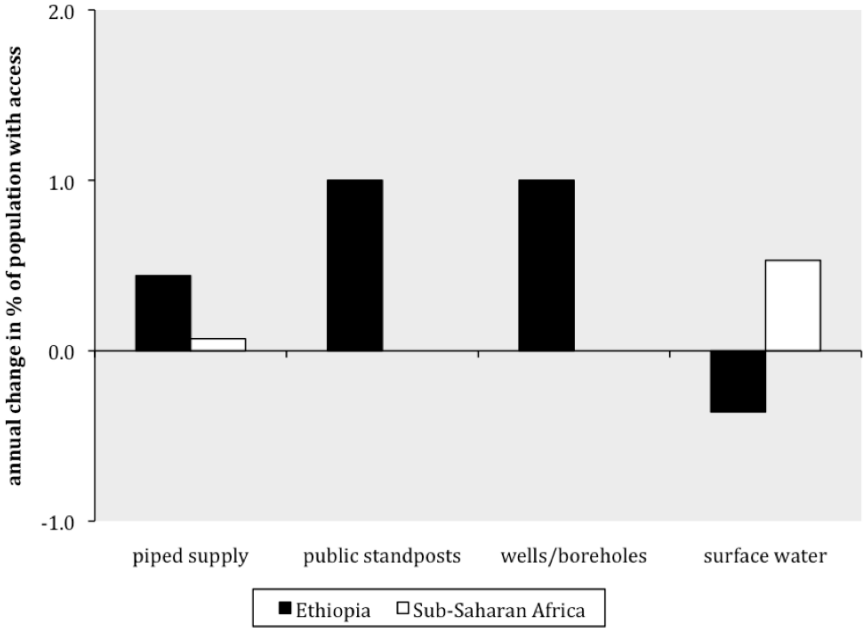
Rural water reforms have contributed to success in expanding improved water. Approximately 2.4 percent of Ethiopia's population is gaining access to some form of improved water every year, and reliance on surface water is in decline (figure 5). This stands in contrast to the rest of Sub-Saharan Africa, where access to improved water is largely stagnant, and reliance on surface water is growing. Some African countries have achieved success in this area by implementing a combination of reforms in rural water provision. Ethiopia has adopted some of these reforms including an explicit rural water policy, a dedicated central budget funding, and a cost recovery policy for rural water. But the country lacks some

important features such as a rural water agency to spearhead the implementation of rural water projects, and a map of rural water points to monitor progress.

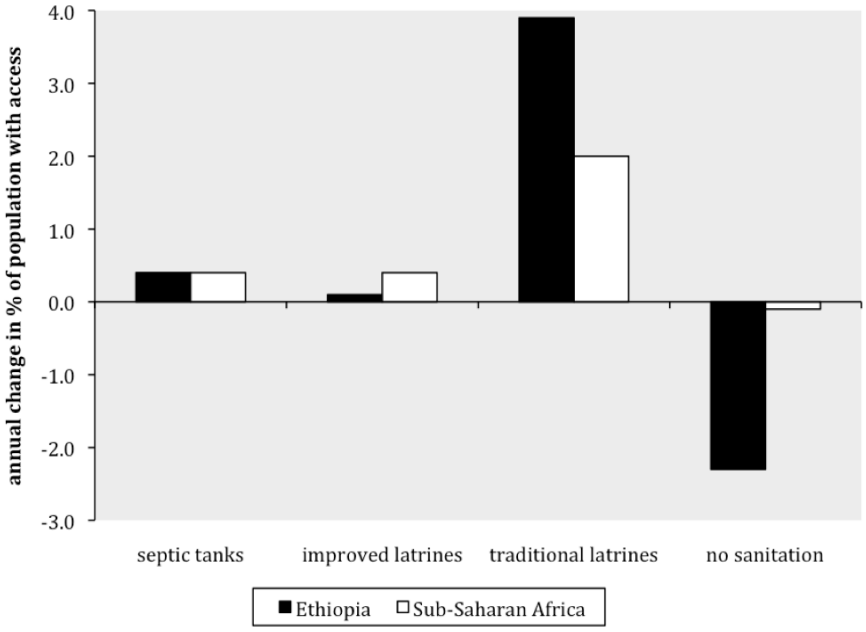
Hygiene promotion efforts have held the key to success in sanitation. Exceptionally rapid expansion of traditional latrines benefits 4.4 percent of Ethiopia's population each year. The practice of open defecation is declining steeply, in contrast to the rest of Sub-Saharan Africa. A key factor behind this success has been the adoption of a major hygiene education program that has motivated the public to invest household resources in the development of traditional latrines.

Figure 5. Annual growth in use of water and sanitation types

a. Water



b. Sanitation

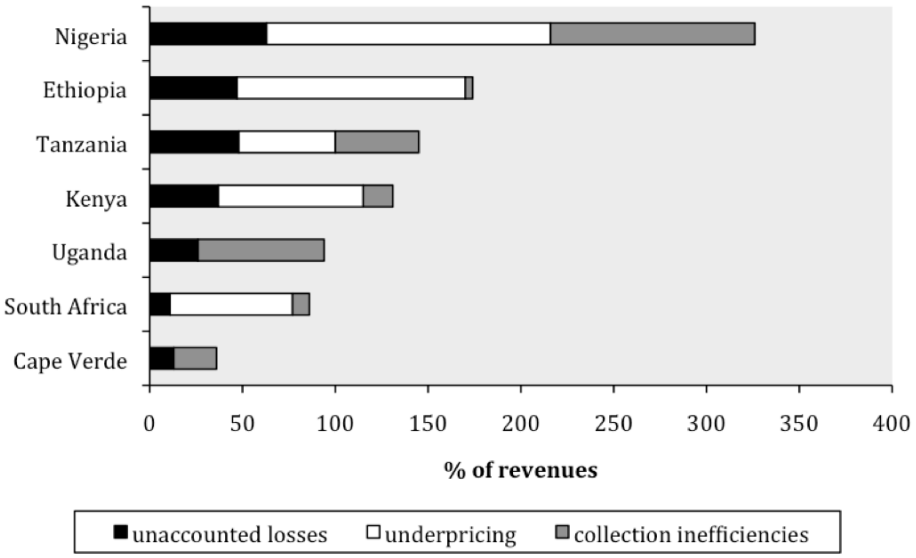


Source: Banerjee and others 2008; Morella and others 2008.

Challenges

Ethiopia's water utilities continue to generate large hidden costs. Notwithstanding important progress in improving access, the urban utility sector has made little progress on the institutional reform agenda and remains highly inefficient. Ethiopia's utilities are barely capturing the 60 percent of the revenue stream that they need to operate effectively, a comparatively poor performance by regional standards. The main sources of hidden costs are underpricing and unaccounted for water. At $0.20-0.40 per cubic meter, Ethiopia's water tariffs are substantially lower than those found in other African countries with scarce water resources, and they recover only 47 percent of utility costs. Distribution losses are typically around 40 percent compared with 33 percent in other low-income African countries. By contrast, revenue collection is very good at 97 percent. Overall, hidden costs in Ethiopia's water utilities total 145 percent of revenues (figure 6). Addressing these inefficiencies will help to place the utilities on a firmer financial footing, and thus put them in a better position to invest further in network expansion.

Figure 6. Hidden costs of water utilities



Source: Briceño-Garmendia and others 2009.

Power

Achievements

Ethiopia has the potential to become one of the largest power exporters in Africa. Ethiopia is endowed with vast hydropower potential. The long term marginal cost of developing this generating capacity is around $0.04 per kilowatt-hour, significantly below that of neighboring countries. If there were no barriers to developing and trading Ethiopia's hydropower, the country would have the potential to export more than 26 terawatt-hours of electricity per year (table 4). This would be second only to the Democratic Republic of Congo, which has the potential to export 52 terawatt-hours per year. If a profit margin of $0.01 per kilowatt-hour could be obtained from exports, Ethiopia could generate annual net revenue of $263 million for Ethiopia, or around two percent of GDP.

Table 4. Ethiopia has the potential to export significant amounts of power

		Net Revenue		Required Investments	
	Exports (TWh pa)	($m pa)	(% GDP)	($m pa)	(% GDP)
DRC	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.

Note: net revenue based on illustrative profit margin of $0.01 per kWh.

Challenges

It will take time for Ethiopia to develop its substantial hydropower capacity. Ethiopia has one of the most underdeveloped power systems in Sub-Saharan Africa. Its installed generation capacity is less than 10 megawatts per million of population, which is less than half of the (already low) low-income country benchmark (table 5). Power consumption, at 33 kilowatt-hours per person per year, is about one-third of the (also already low) low-income country benchmark. Access to electricity at 12 percent is below the already low benchmark for low-income countries in Africa; although urban access to electricity is actually exceptionally high at 86 percent, the rural majority of the population has almost no access to power. Ambitious plans exist to expand electrification over the coming years.

Table 5. Benchmarking power infrastructure and capacity, access, and utility performance

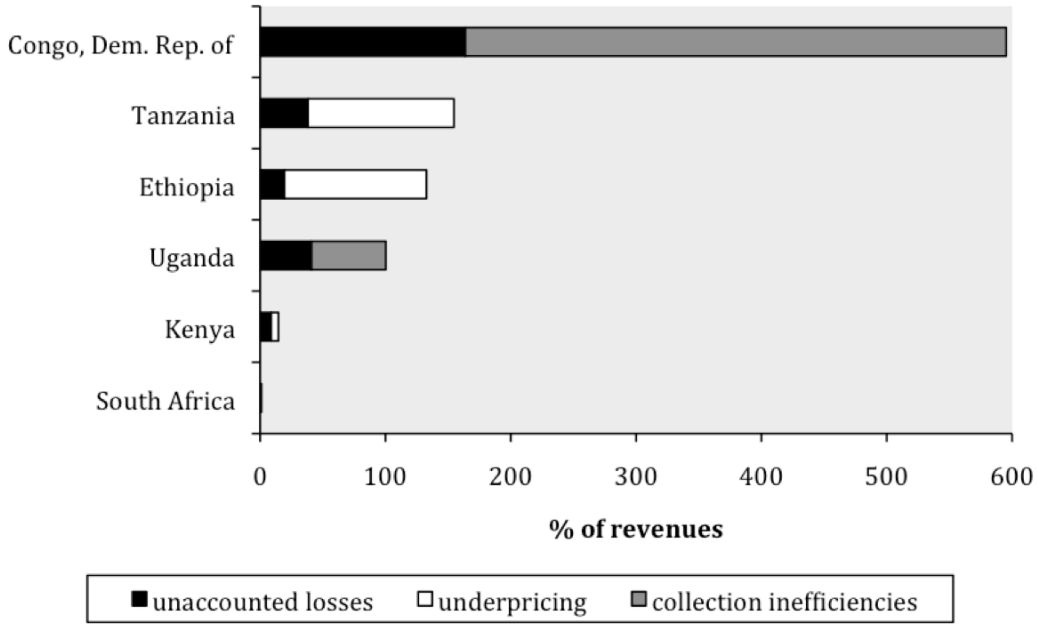
	Unit	Ethiopia	Low-income countries
Installed power generation capacity	MW/mil. people	9.8	24.4
Power consumption	kWh/capita	33.6	99.5
Power outages	day/year	44.2	40.6
Firms' reliance on own generator	% consumption	6.9	17.7
Firms' value lost due to power outages	% sales	0.9	6.1
Access to electricity	% population	12.0	15.4
Urban access to electricity	% population	86.0	71.0
Rural access to electricity	% population	2.0	12.0
Growth access to electricity	% population/year	0.4	1.4
Revenue collection	% billings	96.5	88.2
Distribution losses	% production	22.0	22.1
Cost recovery	% total cost	46.0	90.0
Total hidden costs as % of revenue	%	132.7	121.2

Tariff (US cents per kWh)	Ethiopia	Predominantly hydro generation	Other developing regions
Power tariff (residential at 75 kWh)	4.07	10.27	5.0 – 10.0
Power tariff (commercial at 900 kWh)	8.26	11.73	
Power tariff (industrial at 50,000 kWh)	4.76	11.39	

Source: Eberhard and others 2008.

To meet domestic demand and realize its export potential, Ethiopia would need to develop 8,700 megawatts of generation capacity during the next decade—a huge rise from the barely 1,200 megawatts installed today. In addition, 3,000 megawatts of cross border transmission capacity would need to be developed to support power trade. Overall, this would require spending more than $3 billion per year. About one third of this total – or $1 billion annually – would be needed just to serve export markets, which, at least in theory, could be partially financed through capital contributions from beneficiary (or importing) countries make in exchange for a lower export price.

Figure 7. Hidden costs of power utilities



Source: Briceño-Garmendia and others 2008.

The central actor in the much needed development of Ethiopia's power network is the national power utility, Ethiopian Electric Power Corporation (EEPCO). EEPCO performs well in terms of revenue collection (97 percent versus a benchmark of 88 percent) and distribution losses (22 percent, on par with benchmark). However, underpricing is a significant issue. Ethiopia's power tariffs of $0.04-0.08 per kilowatt-hour are low by regional standards and recover only 46 percent of the costs of the utility. Although the long-term marginal cost of generation is low at $0.04 per kilowatt-hour, major investment needs in the country's transmission and distribution networks push up the overall long-term marginal cost of power to around $0.16 per kilowatt-hour. Underpricing in the power sector is equivalent to 1.3 percent of GDP, which is even higher than the (already high) low-income country benchmark of 0.8 percent of GDP. Power tariffs will inevitably need to be adjusted upward in the medium term; such a realignment would strengthen the financial position of the company. The overall hidden costs of power sector inefficiency absorb around 100 percent of EEPCO revenues; meaning that the company only captures about half the revenue that it would need to function effectively. This performance, though comparable with other power utilities in East Africa, leaves significant room for improvement (figure 7).

Water resources

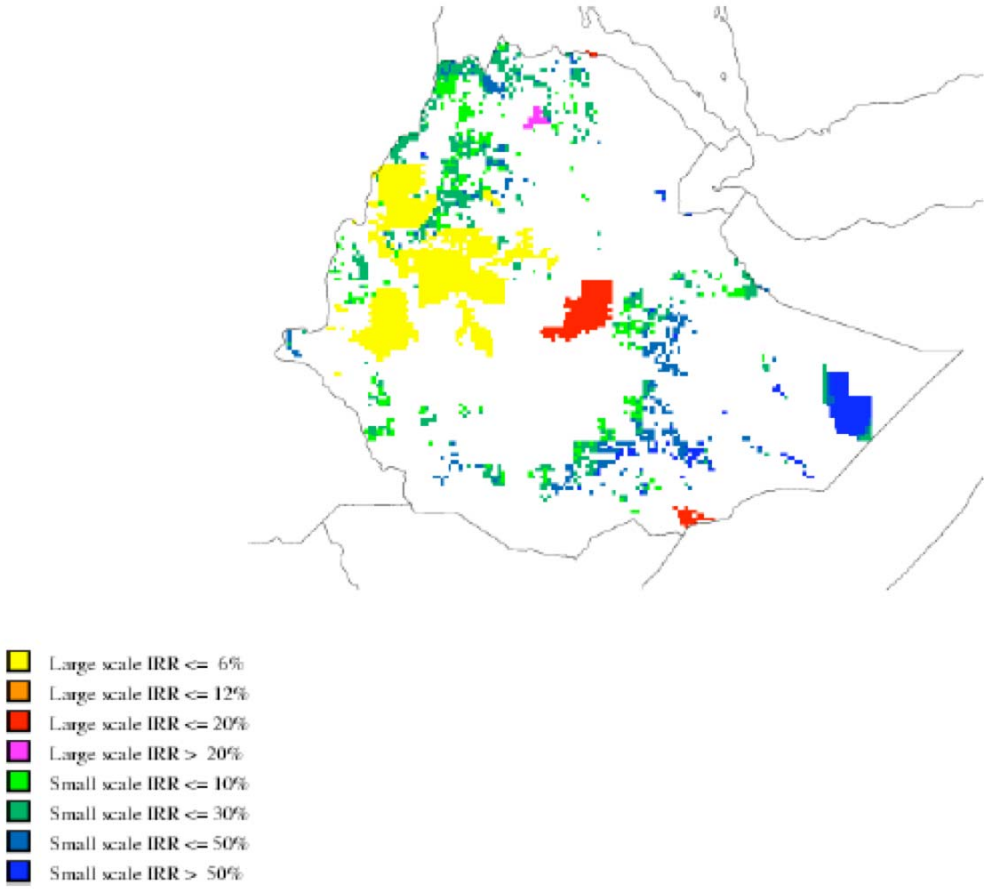
Challenges

Closely related to the development of hydro-power is the management of water resources. Ethiopia suffers from exceptionally high hydrological variability, which is a major drag on the economy. Frequent droughts and floods seriously affect the agriculture sector's productivity and on average cost the economy about one percentage point of GDP growth per year.

Ethiopia will need to invest substantially in storage capacity to achieve water security. The country's current storage levels are only 47 cubic meters per capita, compared with 750 cubic meters per capita in South Africa. The exact amount of storage needed to achieve water security is not yet known, but the costs are likely to be high. For example, doubling current storage capacity to 94 cubic meters per capita would require an estimated $2.4 billion in investment. The best way to develop water storage is through multipurpose schemes, usually financially anchored in hydropower generation. Since Ethiopia's power sector investment plans call for a major development of new hydro capacity, there is an opportunity to develop multipurpose storage that serves the needs of the power sector, provides for other uses such as irrigation, and is managed in such a way as to attenuate extreme hydrological events, such as droughts and floods.

Doubling the country's current irrigated area is economically viable. At present, Ethiopia only irrigates around 290,000 hectares of agricultural land, barely three percent of the country's cultivated area (recall figure 3d). Simulations suggest that it is already economically viable to develop a further 347,000 hectares of land for irrigation, which would yield an internal rate of return in excess of 12 percent (see figure 8). Of this total area, 191,000 hectares lie downstream of existing and future dams that are not yet being exploited for irrigation. The irrigation scheme could be achieved with an investment of $373 million in the extension of the water distribution infrastructure to serve land lying downstream from these dams. A further 156,000 hectares appear viable for the development of small scale irrigation schemes, at a total cost of $560 million. These areas show agronomical potential and are sufficiently close to road networks and other basic infrastructure to ensure that the resulting production increases could reach the market. Figure 3d is a graphic representation of the areas viable for irrigation.

Figure 8. Map showing areas of highest return for irrigation development



Source: You and others 2009.

Information and communication technologies

Challenges

Coverage of ICT services in Ethiopia is the lowest in Africa. GSM signals cover barely 10 percent of the population, compared with 48 percent for the low-income country benchmark; and the GSM subscription rate is only 1.6 percent of the population in Ethiopia, compared with 15.1 for the low-income country benchmark (table 6). Furthermore, whereas the typical African country adds 1.7 percent of the population to the GSM subscriber base per year, the figure for Ethiopia is only 0.1 percent. Internet bandwidth in Ethiopia is only 0.3 megabits per second per capita, compared with 5.8 megabits per second per capita for the low-income country benchmark. Only on fixed-line density does Ethiopia perform on par with its peers. However, Ethiopia's weak penetration of telecommunications cannot be attributed to lack of demand for these services. Simulations suggest that more than 90 percent of the country's population could be profitably provided with a GSM signal (figure 9). This performance shortfall can be attributed to the absence of a liberalized regulatory framework and competitive market structure. As of today, all ICT services in Ethiopia are provided monopolistically by the state-owned telecom incumbent.

Prices of ICT services in Ethiopia are also very low—except for international calls—and much lower than in the rest of Africa. For example, a standardized monthly basket of mobile telephone services costs $3.37 in Ethiopia compared with the African benchmark of $11.12. Such low tariffs for domestic mobile (and fixed) services seem to be supported by cross subsidies from international call charges, which are substantially higher than the African benchmark. This is because ICT tariffs in Ethiopia have not yet been rebalanced to bring them closer into line with cost structures, a move that most African countries have undertaken to prepare the market for competition. Surprisingly, the low cost of services does not seem to have promoted wider access to these services in Ethiopia.

Ethiopia's central challenge is to introduce competition to the ICT sector. The Ethiopian market could potentially experience the same explosive growth of GSM coverage as has taken place across Africa. To make the transition, the country needs to modernize the sector's institutional and regulatory framework, which is among the least developed in Africa. Ethiopia scores only 28 percent on an AICD index of institutional reform that captures the extent to which countries have modernized in terms of sector reform, regulatory framework and governance of state-owned ICT incumbents, compared with around 50 percent for the median African country (figure 10). The key step would be to license a second mobile operator in the market, and eventually additional ones. In addition to accelerating the expansion of GSM coverage, such a move has the potential to raise significant fiscal resources for the government—based on the experience if the 2000s in Africa, the license could potentially raise at least $0.5 billion.

Table 6. Benchmarking ICT infrastructure

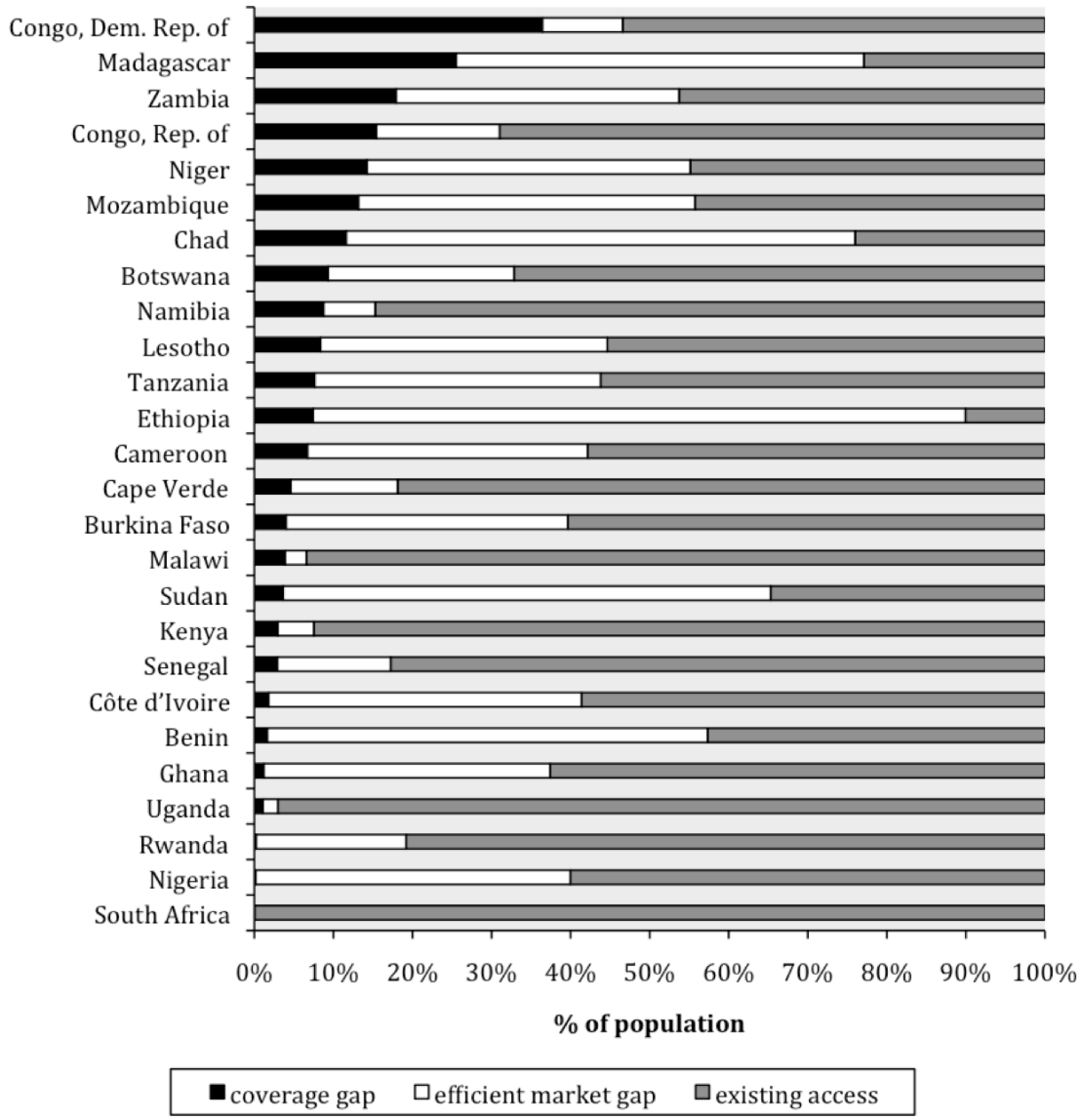
	Unit	Ethiopia	Low-income countries
GSM coverage	% population	9.9	48.2
International bandwidth	Mbps/capita	0.3	5.8
Internet	subscribers/100 people	0.0	0.1
Landline	subscribers/100 people	1.0	0.8
Mobile phone	subscribers/100 people	1.6	15.1
Prices ($)	Ethiopia	Without submarine cable	Other developing regions
Price of monthly mobile basket	3.37	11.12	9.9
Price of monthly fixed line basket	2.00	13.58	—
Price of 20-hour Internet package	14.85	67.95	11.0
Price of a 3-minute call to United States	3.33	2.59	2.0
Price of inter-Africa telephone calls, mean	1.27	0.72	n.a.

Source: Minges and others 2008.

— = Data not available.

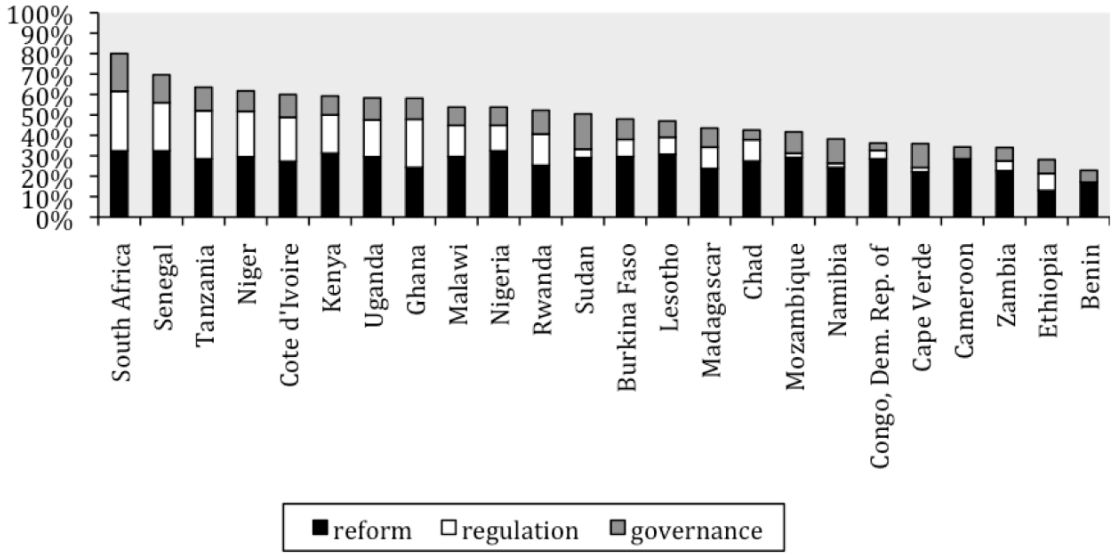
n.a. = Not applicable.

Figure 9. Coverage and efficient market gap



Source: Mayer and others 2008.

Figure 10. Institutional framework



Source: Vagliasindi and others 2008.

Financing Ethiopia's infrastructure

Ethiopia needs to implement an ambitious infrastructure investment agenda. To meet its most pressing infrastructure needs and catch up with developing countries in other parts of the world, Ethiopia needs to expand its infrastructure assets in several key areas (table 7). The targets outlined below are purely illustrative in nature, but they represent a reasonable level of aspiration. They have been developed in a way that is standardized across African countries and thus allows for cross country comparisons of the affordability of meeting the targets. Ultimately, the targets can be modified or delayed as possible means of achieving financial balance.

Table 7. Illustrative investment targets for infrastructure in Ethiopia

	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 additional 350,000 hectares of economically viable irrigation schemes	
Power	Develop 8,700 MW of new generation capacity and 3,000 MW of interconnectors	Raise electrification to 60 percent (100 percent urban and 50 percent rural)
Transport	Achieve regional connectivity with good quality two lane paved road and national connectivity with one lane paved road	Provide rural road access to 80 percent of highest value agricultural land, and urban road access within 500m
WSS		Achieve Millennium Development Goals

Meeting Ethiopia's infrastructure needs would cost $5.2 billion per year for the next decade. Capital expenditure accounts for 82 percent of this requirement. The country's power needs are massive and would require approximately $3.4 billion per year to install 8700 megawatts of new hydropower capacity and 3,000 megawatts of interconnectors each year. This would allow Ethiopia to keep pace with demand

while developing its power export potential, which alone accounts for $1 billion of these annual needs. While small relative to power needs, transport and WSS needs are high in absolute terms: each amounts to almost $1 billion annually. In the power sector, the need for investment is particularly high, at $3.1 billion. In the WSS sector, the need for operations and maintenance spending is particularly high, at $355 million. ICT sector spending needs are comparatively modest (table 8).

Table 8. Indicative infrastructure spending needs in Ethiopia

US$ millions per year

Sector	Capital expenditure	Operation and maintenance	Total spending
ICT	72	139	211
Power	3,105	276	3,380
Transport	248	149	398
WSS	846	355	1,201
Irrigation	6	—	6
Total	4,277	919	5,196

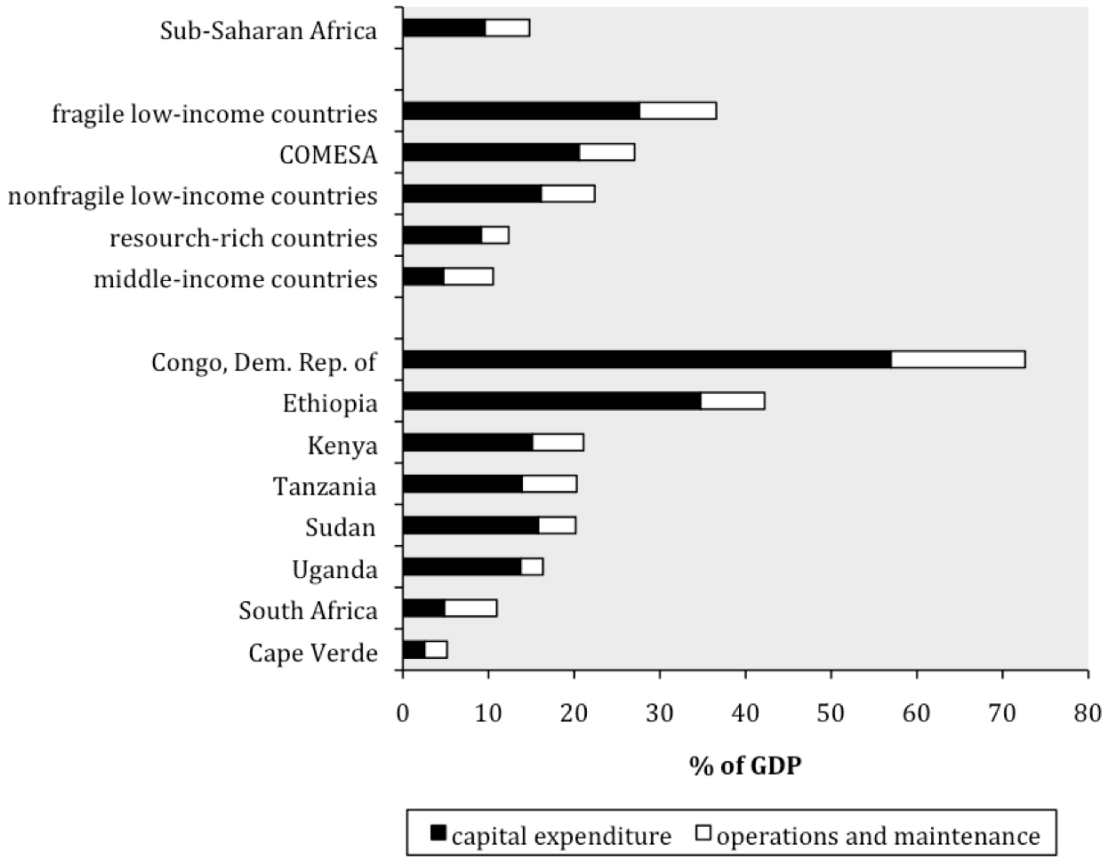
Source: Briceño-Garmendia and others 2008.

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

Ethiopia's total spending requirement is among the highest in Sub-Saharan Africa and is huge relative to the size of Ethiopia's economy: an untenable 42 percent of the country's GDP. This is one of the largest infrastructure spending burdens found for any African country in the study (figure 11).

Ethiopia currently allocates $1.3 billion per year to meeting its infrastructure needs. Capital expenditure absorbs 60 percent of total spending (table 9). Operating expenditure is entirely covered from budgetary resources and charges contributed by infrastructure users. Overseas Development Assistance accounts for 40 percent of total capital expenditure and is the largest source of external finance for infrastructure investment in Ethiopia. From the non-OECD financiers, China is an increasingly important source of external finance and currently contributes 20 percent of total capital expenditure. Private participation is conspicuously absent, particularly in ICT, where the absence of a liberalized regulatory framework and competitive market structure hampers provider diversification. Households play a significant role in funding on-site sanitation.

Figure 11. Ethiopia's spending requirements are very high relative to GDP



Source: Briceño-Garmendia and others 2008.

Table 9. Annualized spending on infrastructure in Ethiopia from all sources (average, 2003/05)

US$ millions per year

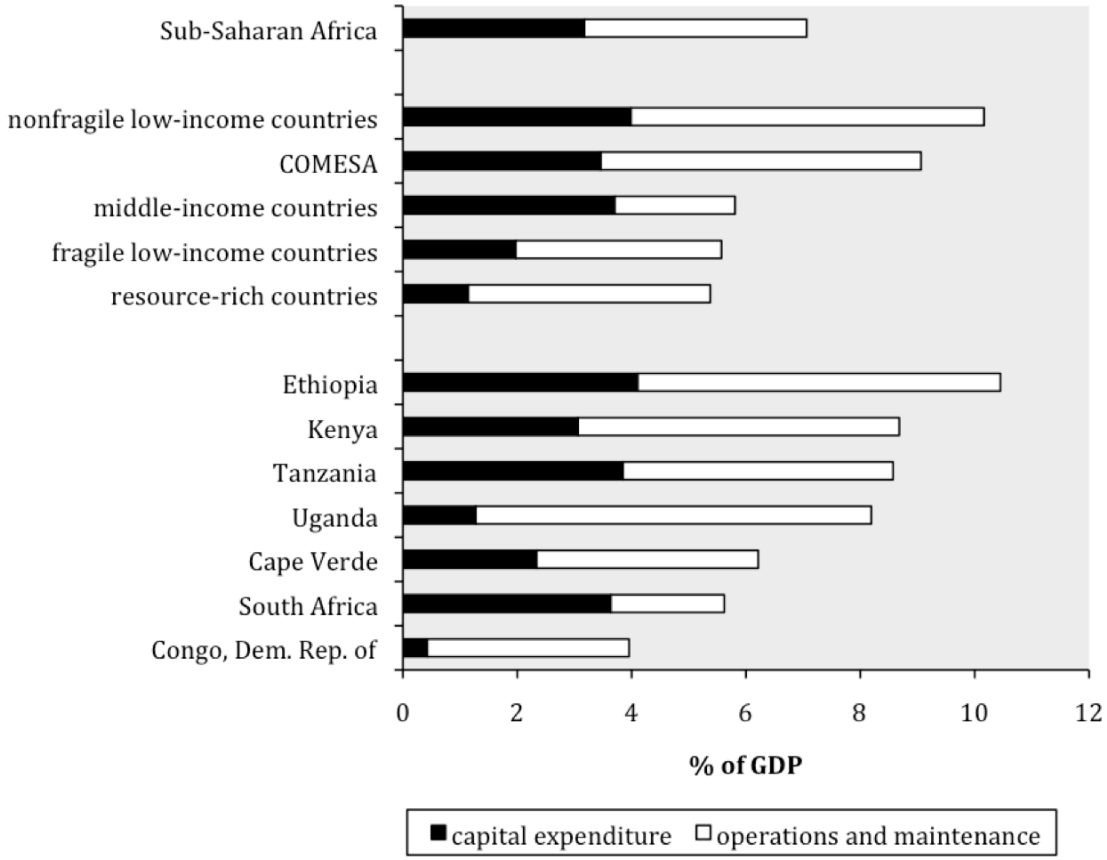
	O&M	Capital expenditure						
Sector	Public sector	Public sector	ODA (OECD)	Non-OECD financiers	PPI	Household self-finance	Capex total	Total
ICT	54	52	1	18	0	0	72	126
Power	276	21	159	20	0	0	200	476
Transport	53	117	120	12	0	0	248	301
WSS	123	74	92	0	0	94	260	383
Irrigation	—	—	—	—	—	—	—	—
Total	506	246	324	117	0	94	780	1,286

Source: Briceño-Garmendia and others 2008.

— = Data not available.

Ethiopia's infrastructure spending as a share of GDP is among the highest in Africa. Ethiopia currently devotes 10 percent of GDP to infrastructure spending, which is higher than the average for low-income countries and for its East African neighbors (figure 12).

Figure 12. Ethiopia's infrastructure spending is high compared to other countries in Africa

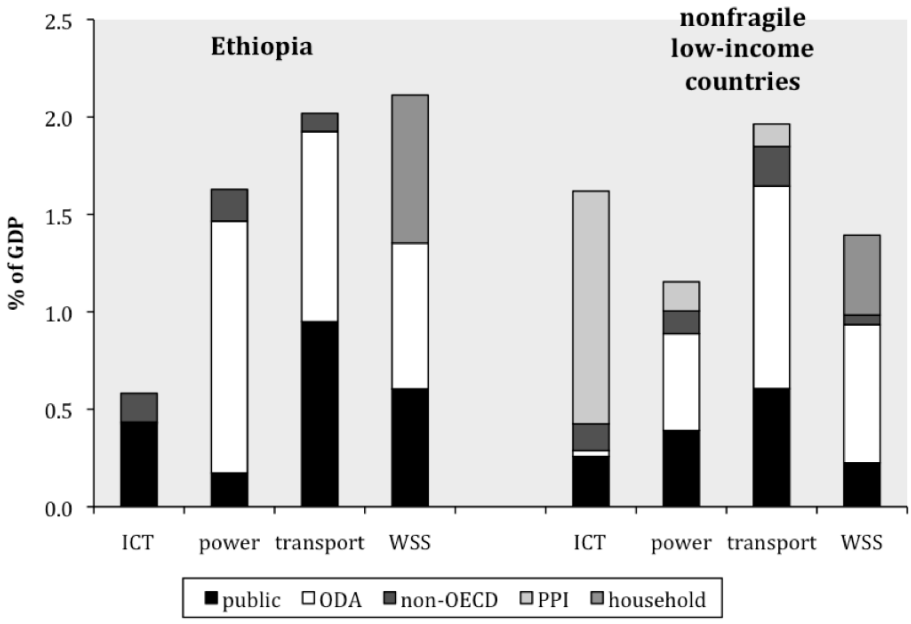


Source: Briceño-Garmendia and others 2008.

Although Ethiopia invests more in infrastructure than other low-income countries in Africa, the pattern of financing is similar, with the notable exception of ICT. Ethiopia invests more in power and WSS infrastructure than its African peers, about the same in transport, and substantially less in ICT. For power, transport, and WSS the pattern of finance is similar to the peer group, with a mix of public and donor finance. In the case of ICT, however, there are notable differences. Ethiopia relies heavily on public finance and some non-OECD finance for ICT, whereas in the peer group ICT investments are financed predominantly by the private sector (figure 13).

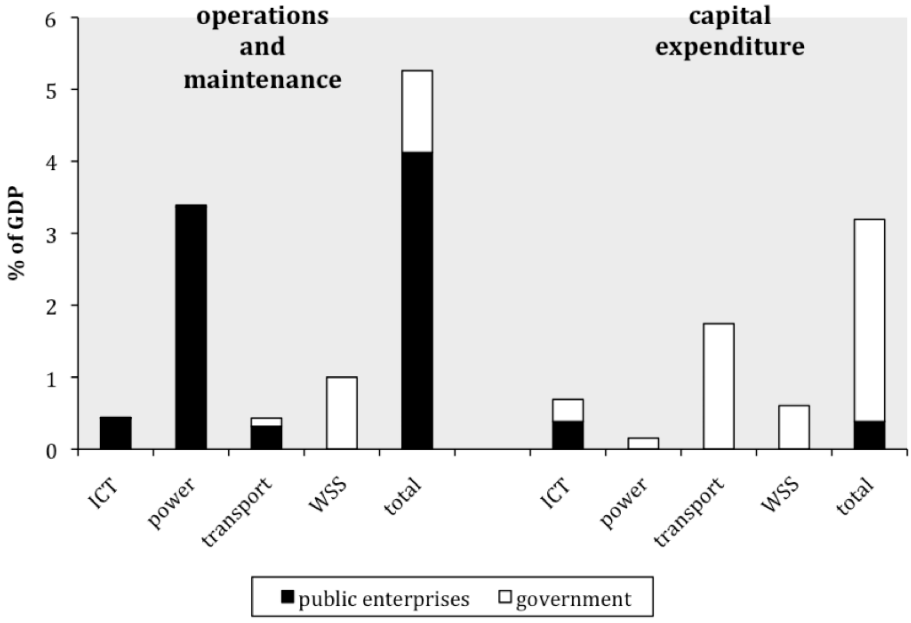
Public investment is channeled almost entirely through the central government. Neither power nor water utilities report any significant investment of their own. Operating expenditure, on the other hand, is channeled almost entirely through state-owned enterprises (figure 14).

Figure 13. Sources of financing for infrastructure capital investment



Source: Briceño-Garmendia and others 2008.

Figure 14. Split investment responsibilities between government and public enterprises, Ethiopia



Source: Briceño-Garmendia and others 2008.

How much more can be done with existing resources?

There is substantial evidence that much more could be achieved by using Ethiopia's existing resources more efficiently.

Ethiopia is losing an estimated $450 million per year to various inefficiencies in infrastructure operations or spending. Overall, inefficiencies in the power sector total 0.66 percent of GDP, and inefficiencies in the water sector total 0.26 percent of GDP (figure 15). There are four distinct opportunities for efficiency gains: improving budget execution rates; reallocating existing spending toward subsectors in greatest need; raising user charges closer to cost recovery levels; and increasing the operating efficiency of utilities and other service providers.

Low capital budget execution in the infrastructure sector results in losses of around $63 million per year. From its central government alone, Ethiopia's government allocates on average $485 million (4 percent of GDP) to support infrastructure provision. However, on average, only 82 percent of public investment allocated to infrastructure can be allocated within the budget cycle; the ratio is even lower for the ICT sector (table 10). Improving the efficiency of budget execution could make a further $63 million available for infrastructure spending each year.

Table 10. Annual budgetary flows and budget variation ratio for capital spending

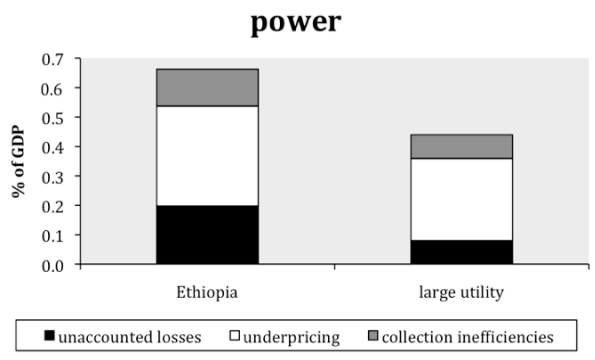
Sector	Budget variation ratio for capital spending, %
ICT	57
Power	100
Transport (roads)	78
Water	100
Irrigation	—
ICT	82

Source: Briceño-Garmendia and others 2008.
— = Data not available.

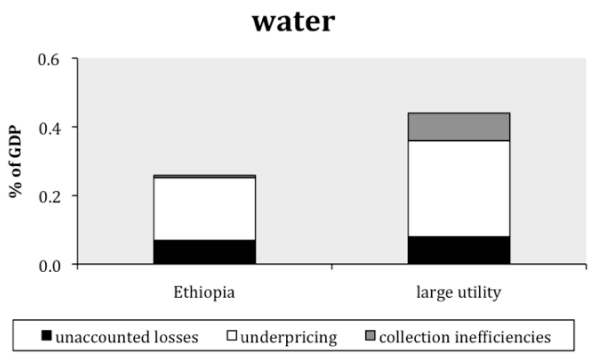
A further $102 million could be captured for Ethiopia's infrastructure if services were priced closer to cost recovery levels (table 12). Utility tariffs are below full cost recovery levels in both the power sector and the water sector. In the transport sector, the fuel levy is somewhat below the level needed to allow for full recovery of road maintenance costs.

Figure 15. Hidden costs of power and water sector inefficiency

Power



Water

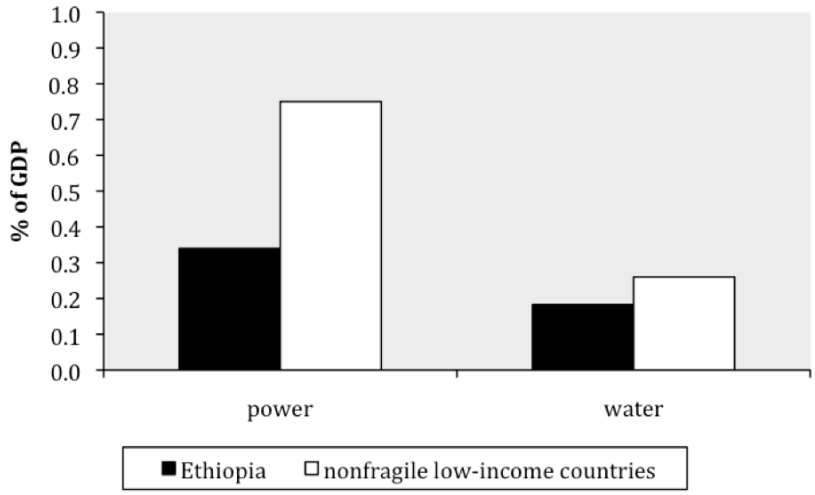


Note: The Ethiopian utility EEPCO is here benchmarked against other utilities with comparable market size in Sub-Saharan Africa.
Source: Briceño-Garmendia and others 2008.

The average historical cost of producing electricity in Ethiopia has been $0.09 per kilowatt-hour when all operating and capital costs are taken into account. The average effective power tariff in the country has been no more than $0.07 per kilowatt-hour. As a result, only 77 percent of the full system costs are now being covered, and the resulting losses amount to 0.34 percent of GDP (figure 16). This is a sizeable amount in absolute terms, yet substantially lower than what is found in other nonfragile low-income countries.

In the water sector, it is estimated that the average total cost of producing utility water is $0.67 per cubic meter. By comparison, the average effective tariff is only $0.32, which is sufficient to cover only operating and maintenance costs. Overall, the main utilities in the sector cover only 47 percent of their costs. However, due to the relatively small financial turnover of these utilities, the associated financial burden is less than 0.2 percent of GDP, somewhat below the average for the peer group.

Figure 16. Cost recovery in Ethiopia's power and water sectors



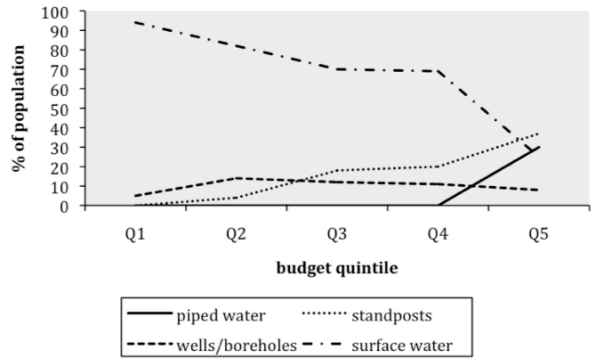
Source: Briceño-Garmendia and others 2008.

In effect, water and power services are subsidized (implicitly or explicitly) by the state in Ethiopia. Given that 90 percent of households with access to piped water or electricity belong to the top quintile of the income distribution, this is a very regressive subsidy (figure 17).

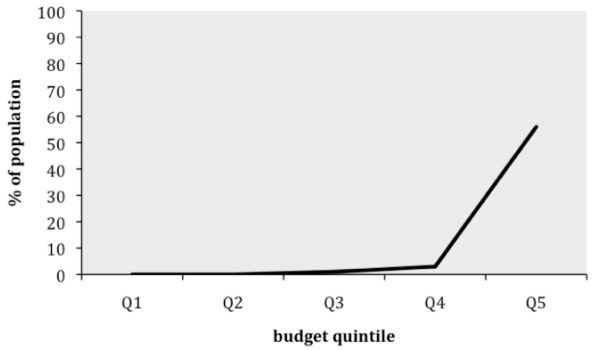
To evaluate the social feasibility of raising power and water tariffs toward cost recovery levels, an affordability threshold of 5 percent of the household budget is used. Assuming a cost recovery tariff of $0.09 per kilowatt-hour for power and a subsistence consumption of 25 kilowatt-hours per month (enough to power two 100 watt light bulbs for four hours per day), subsistence consumption would cost a household $2.25 per month. For water, assuming a cost recovery tariff of $0.70 and a subsistence consumption of 4 cubic meters per month (equivalent to 25 liters per person per day for a family of five), subsistence consumption would cost a household $2.80 per month. Based on these figures, subsistence consumption of power and water at cost recovery prices would be affordable only by roughly 30 percent and 20 percent of households, respectively (figure 18). This analysis suggests that, given the level of household budgets in Ethiopia and the costs associated with utility services, affordability issues appear to be a major concern except for a very small segment of the richest.

Figure 17. Access to infrastructure service by budget quintile

Water supply

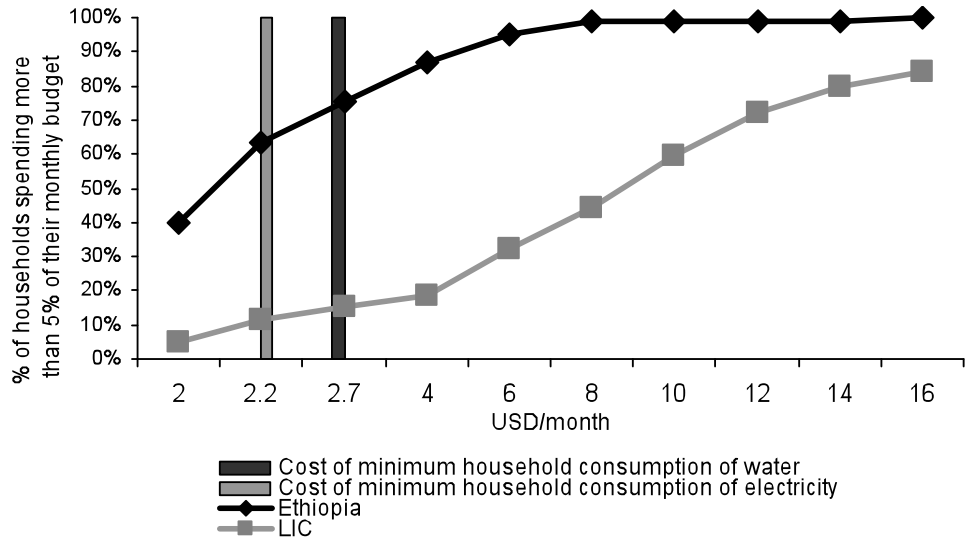


Electricity



Source: Banerjee and others 2008.

Figure 18. Percentage of households unable to afford various monthly utility bills



Source: Africa Infrastructure Country Diagnostic.

Reducing operating inefficiencies

Overall, operating inefficiencies cost Ethiopia's infrastructure sectors $451 million a year (or 3.4 percent of GDP) (table 11). The single largest component relates to under-maintenance of infrastructure assets. Timely maintenance can prevent rapid deterioration of asset and massive rehabilitation backlogs. Currently, about 26 percent of Ethiopia's infrastructure assets are in need of rehabilitation. For roads, under-maintenance leads to additional capital spending of $263 million (2.1 percent of GDP). Under-collection of sector revenue (particularly with regard to power tariffs and fuel levies) accounts for $44 million per year, while distribution losses (mainly in the power sector) contribute a further $33 million per year. Finally, there is evidence of overstaffing in the state-owned telecom incumbent, leading to additional costs of $9 million a year.

Table 11. Potential gains from greater efficiency

US$ million per year

	ICT	Power	Transport	Water	Irrigation	Total
Underrecovery of costs	--	42	37	23	--	102
Overstaffing	9	--	--	--	--	9
Distribution losses	--	24	--	9	--	33
Under collection	--	15	28	1	--	44
Under maintenance	0	0	263	0	0	263
Total	9	40	290	9	0	451

Source: Briceño-Garmendia and others 2008.

Annual funding gap

Ethiopia's infrastructure funding gap amounts to $3.5 billion per year (or about 26 percent of GDP) across various sectors (table 12). Over 77 percent ($2.9 billion) of the infrastructure funding gap is in the power sector, much of which is associated with the development of the generation capacity that Ethiopia would need to become a power exporter (figure 19). The rest of the gap is related to water and sanitation, where an additional $809 million per year is needed to meet the Millennium Development Goals. No financing gap was found for transport.

Table 12. Funding gaps by sector

US$ millions per year

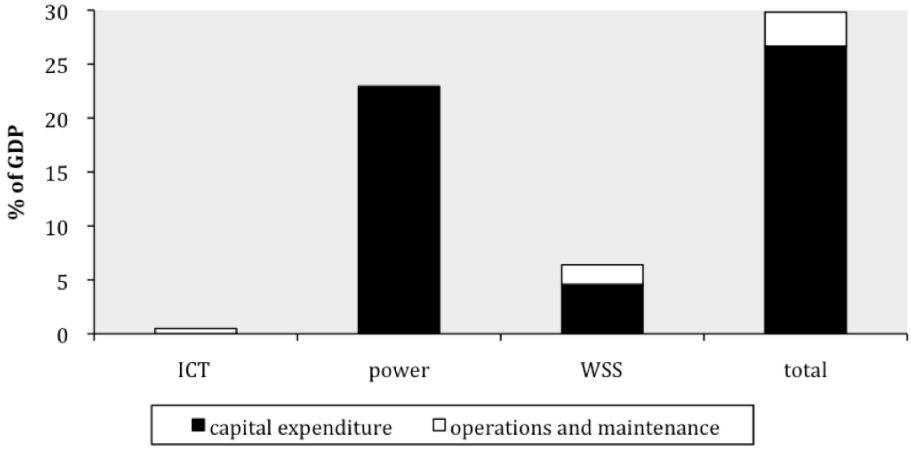
	ICT	Power	Transport	WSS	Irrigation	Total
Needs	(211)	(3,380)	(398)	(1,201)	(6)	(5,196)
Spending	126	476	301	383	—	1,286
Potential efficiency gains	9	40	290	9	0	451
(GAP) or surplus	(76)	(2,864)	193	(809)	(6)	(3,459)
Reallocation potential	149	142	196	0	—	486

— = Data not available.

Despite the overall shortfall, about $486 million a year is spent above the estimated requirements to meet the identified infrastructure needs in some sectors. First, Ethiopia's large road investment program, which is an effort to catch up with the investment backlog in roads, goes beyond what the country might need to do in the steady state, once it has caught-up with its historic road rehabilitation and construction backlog. Second, Ethiopia is allocating a much higher level of public spending for ICT than would be strictly necessary to meet the associated development goals if private sector initiative were used. Finally, operations and maintenance spending looks quite high relative to the country's long-term needs once its hydropower portfolio is further developed.

For purposes of calculating the funding gap, only the potential efficiency gains are netted out from the investment needs. The reason is that, although there is evidence of overspending in some areas of infrastructure, it cannot be assumed that if these resources were reallocated they would necessarily be allocated to the other infrastructure sectors, as in principle they could contribute to any part of the budget.

Figure 19. Magnitude and composition of Ethiopia's funding gap



Source: Briceño-Garmendia and others 2008.

What else can be done?

The funding gap can be addressed only by raising additional financing or adopting lower cost technologies or less ambitious targets for infrastructure development. The sizeable gap forces Ethiopia to be realistic about targets and to prioritize spending of its relatively limited resources.

Adopting lower cost technologies for meeting the MDG targets for water and sanitation could reduce Ethiopia's infrastructure funding gap by $0.5 billion. The estimated cost of reaching the MDG targets is based on Ethiopia's maintaining its current mix of water and sanitation technologies, which tends to be skewed towards higher end solutions such as private taps. If the service expansion needed to meet the MDG targets were instead undertaken using lower end solutions such as stand posts and boreholes, the associated cost could fall substantially.

Obtaining cross border finance for export oriented power projects could also narrow the funding gap. Given the weight of export related power projects in Ethiopia's overall spending requirement—about $1 billion in all, or 20 percent of the total—it is important to consider the possibility of cross border financing arrangements through which countries that would benefit from importing Ethiopian power make capital contributions up front to finance the associated investments.

Assuming that Ethiopia had no means of raising additional infrastructure finance, the only way to meet the infrastructure targets identified here would be to take longer than ten years. If Ethiopia were able to redress the various inefficiencies identified above and preserve overall spending at current levels, the targets would take 30 years to reach. Without eliminating inefficiencies, meeting the targets would take significantly longer 40 years in all.

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

Ampah, Mavis, Daniel Camos, Cecilia Briceño-Garmendia, Michael Minges, 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 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.

Other

Africon. 2008. "Unit Costs of Infrastructure Projects in Sub-Saharan Africa." AICD Background Paper 11, World Bank, Washington, D.C.

Irving, J., and A. Manroth. 2008. "Potential for Local Private Finance of Infrastructure in Africa." AICD Working Paper, World Bank, Washington, D.C.

Nogales, A. 2008. "Lifecycle Costs of Roads under Alternative Maintenance Scenarios." AICD Working Paper, World Bank, Washington, D.C.

Perrault, J., and L. Savard. 2008. "The Impact of Infrastructure Spending in Sub-Saharan Africa: A CGE Modeling Approach." AICD Working Paper, World Bank, Washington, D.C.

Teravaninthorn, S., and G. Raballand. 2008. "Transport Prices and Costs in Africa: A Review of the Main International Corridors." AICD Working Paper, World Bank, Washington, D.C.

Wodon, Q., and others 2008. "Electricity Tariffs and the Poor: Case Studies from Sub-Saharan Africa." AICD, Working Paper, World Bank, Washington, D.C.

Wodon, Q., and others 2008. "Water Tariffs and the Poor: Case Studies from Sub-Saharan Africa." AICD, Working Paper, World Bank, Washington, D.C.

You, L., S. Wood, and U. Wood-Sichra. 2007. "Generating Plausible Crop Distribution and Performance Maps for Sub-Saharan Africa Using a Spatially Disaggregated Data Fusion and Optimization Approach." IFPRI Discussion Paper 720, International Food Policy Research Institute, Washington, DC.