

Africa's Infrastructure:

A Time for Transformation

Summary of Main Findings



About AICD

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

AICD will produce a series of reports that provide an overview of the status of public expenditure, investment needs, and sector performance in each of the main infrastructure sectors, including energy, information and communication technologies, irrigation, transport, and water and sanitation. The underlying data will be made available to the public through an interactive Web site allowing users to download customized data reports and perform simple simulation exercises.

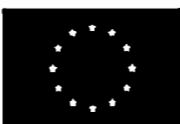
The first phase of AICD focuses on 24 countries that together account for 85 percent of the gross domestic product, population, and infrastructure aid flows of Sub-Saharan Africa. The countries are: Benin, Burkina Faso, Cape Verde, Cameroon, Chad, Congo (Democratic Republic of Congo), Côte d'Ivoire, Ethiopia, Ghana, Kenya, Madagascar, Malawi, Mali, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, South Africa, Sudan, Tanzania, Uganda, and

Zambia. Under a second phase of the project, coverage will be expanded to include additional countries.

AICD is being implemented by the World Bank on behalf 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, and major infrastructure donors. AICD grew from an idea presented at the inaugural meeting of the Infrastructure Consortium for Africa, held in London in October 2005.

Financing for AICD is provided by a multi-donor trust fund to which the main contributors are the Department for International Development (United Kingdom), the Public Private Infrastructure Advisory Facility, Agence Française de Développement, and the European Commission. A group of distinguished peer reviewers from policy making and academic circles in Africa and beyond reviews all of the major outputs of the study, with a view to assuring the technical quality of the work.

This and other papers analyzing key infrastructure topics, as well as the underlying data sources described above, will be available for download from www.infrastructureafrica.org.



Africa's growth performance has improved markedly during the last decade. Ten out of 48 countries experienced sustained economic growth in excess of 5 percent for the past three years or longer. But that performance still falls short of the 7 percent growth needed to achieve substantial poverty reduction and attain the Millennium Development Goals. Infrastructure has played a significant role in Africa's recent economic turnaround and will need to play an even greater role if the continent's development targets are to be reached.

Across Africa, infrastructure contributed 99 basis points to per capita economic growth over the period 1990 to 2005, compared with only 68 basis points for other structural policies (Calderon, 2008). That contribution is almost entirely attributable to advances in the penetration of telecommunication services. The deterioration in the quantity and quality of power infrastructure over the same period has had a significant retarding effect on economic growth. If these deficiencies could be cured, the effect would be remarkable. Simulations suggest that if all African countries were to catch up with Mauritius in infrastructure, per capita economic growth in the region could increase by 2.2 percentage points. Catching up with Korea's level would bring about economic growth per capita up to 2.6 percent per year. In a number of countries—including Cote d'Ivoire, Democratic Republic of Congo (DRC), and Senegal—the impact would be even larger.

Africa's extensive infrastructure deficit

In most African countries, particularly the lower-income countries, infrastructure emerges as a major constraint on doing business and is found to depress firm productivity by around 40 percent (Escribano and others, 2008). For most

countries, the negative impact of deficient infrastructure is at least as large as that associated with crime, red tape, corruption, and financial market constraints. For an important subset of countries, power emerges as by far the most limiting factor, being cited by more than half of firms in more than half of countries as a major business obstacle. However, inefficient functioning of ports and associated customs clearance is an equally significant constraint for a second group of countries. Deficiencies in broader transport infrastructure and infrastructure for information and communication technologies (ICT) are less prevalent but nonetheless substantial in some cases.

On just about every measure of infrastructure coverage African countries lag behind their peers in other parts of the developing world (Yepes and others, 2008). This lag is perceptible for low- and middle-income countries in Sub-Saharan Africa relative to other low- and middle-income countries (table 1). The differences are particularly large in the case of paved roads, telephone mainlines, and power generation capacity. Moreover, for these three key infrastructures, Africa has been expanding stocks much more slowly than other developing regions—meaning that unless something changes the gap will widen over time.

The comparison with South Asia—a region with similar per capita income—is particularly striking. In 1970, Sub-Saharan Africa had almost three times as much generating capacity per million people as South Asia. Three decades later, in 2000, South Asia had left Sub-Saharan Africa far behind—it now has almost twice the generation capacity per million people. Similarly, in 1970 Sub-Saharan Africa had twice the mainline telephone density of South Asia, but by 2000 the two regions had drawn even.

Table 1 Africa's infrastructure deficit

Normalized units	Sub-Saharan Africa LICs	Other low-income countries
Paved road density	31	134
Total road density	137	211
Mainline density	10	78
Mobile density	55	76
Internet density	2	3
Generation capacity	37	326
Electricity coverage	16	41
Improved water	60	72
Improved sanitation	34	51

Source: Yepes and others, 2008

Note: Road density is in kilometers per kilometer squared; telephone density is in lines per thousand population; generation capacity is in megawatts per million population; electricity, water and sanitation coverage are in percentage of population.

LIC = low-income country.

Africa's largest infrastructure deficit is to be found in the power sector. Whether measured in terms of generation capacity, electricity consumption, or security of supply. Africa's power infrastructure delivers only a fraction of the service found elsewhere in the developing world (Eberhard and others, 2008). The 48 countries of Sub-Saharan Africa (with a combined population of 800 million) generate roughly the same amount of power as Spain (with a population of 45 million). Power consumption, at 124 kilowatt hours per capita per year and falling, is only a tenth of that found elsewhere in the developing world, barely enough to power one 100-watt light bulb per person for three hours a day. Africa's firms report losing 5 percent of their sales as a result of frequent power outages; this rises to 20 percent for informal sector firms unable to afford backup generation facilities.

With regard to ICT, on the other hand, Africa is staying closer to developments elsewhere in the world. The percentage of Africa's population living within range of a GSM signal rose dramatically from 5 percent in 1999 to 57 percent in 2006 (Minges and others, 2008). Over the same period, more than 100 million Africans became mobile telephone subscribers. Indeed, in some countries, household access to mobile telephone services now exceeds that of piped water. Internet penetration, however, lags considerably behind, with little more than two million subscribers and a further 12 million estimated to be making use of public access facilities.

Africa's road density is sparse when viewed against the vastness of the continent. As a result, only one-third of Africans living in rural areas are within two kilometers of an all season road, compared with two-thirds of the population in other developing regions. However, due to low population densities, addressing the rural isolation problem would entail a doubling or tripling of the current classified network (Gwilliam and others, 2008). This is a challenging prospect. Relative to the continent's income (and hence its ability to pay for maintenance), even current levels of road density look rather high. Indeed, in a number of countries, the asset value of the road network exceeds 30 percent of GDP. The condition of roads lags somewhat behind other developing regions, although not significantly for the main trunk network. The limited historical evidence available suggests that most countries have achieved improvements in road quality in recent years. On average, about half of the main network is currently in good condition and a further third is in fair condition. In the case of the rural network, about a quarter is in good condition and a further quarter in fair condition.

Africa's water resources are abundant, but owing to an absence of water storage and irrigation infrastructure, they are grossly underutilized. The continent experiences a

particularly high level of hydrological variability, with huge swings in precipitation across areas, across seasons, and over time (Grey and Sadoff, 2008). This variability will only be exacerbated by climate change. As a result, the achievement of water security—defined as reliable water supplies and acceptable risks from floods and other unpredictable events, including those from climate change—will require a significant expansion of water storage capacity from current levels of 200 cubic meters per capita to levels. In other parts of the world, water storage capacity is in the order of thousands of cubic meters per capita. The cost of expanding water storage is extremely high in relation to the size of Africa's economies, suggesting that phasing of investments, with initial focus on achieving water security for key growth poles, may be warranted.

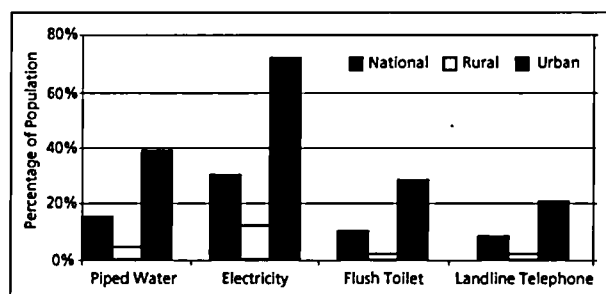
In addition to water storage, there is further need to distribute water for agricultural use. At present, only six million hectares, concentrated

dams, but most of it in the form of small-scale schemes (IFPRI, 2008). A couple of caveats are in order, however. Large-scale irrigation schemes are viable only to the extent that the bulk of the storage costs can be covered by other uses, such as power generation. A high share of today's large-scale irrigation schemes is in need of rehabilitation, suggesting that the institutional capacity to maintain them may not be in place.

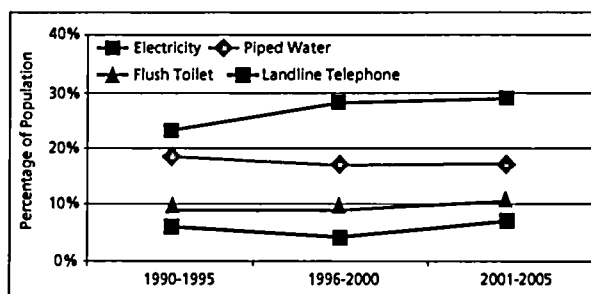
During the last 20 years, coverage of household services has barely improved (figure 1). Africa is unlikely to meet the Millennium Development Goals for water and sanitation. Moreover, if current trends continue, universal access to these services is more than 50 years away in most African countries (Banerjee and others, 2008). Even where infrastructure networks exist, a significant percentage of households remain unconnected, suggesting that demand-side barriers exist and that there is more to universal access than physical rollout of networks.

Figure 1 Access to household services

(a) Rural-urban divide



(b) Stagnant trends



Source: Banerjee and others, 2008.

in a handful of countries, are equipped for irrigation. Although less than 5 percent of Africa's cultivated area; the irrigation-equipped area represents 20 percent of the value of agricultural production. Analysis suggests that a further 22 million hectares could be economically viable for irrigation expansion, some of it associated with current or proposed large multi-purpose

As might be expected, access to infrastructure in rural areas is only a fraction of that in urban areas, even when urban coverage is already low by international standards (Banerjee and others, 2008). Both the current spatial distribution and rapid urban-rural migration of Africa's population creates major challenges for reaching universal access.

In rural areas, over 20 percent of the population lives in dispersed settlements where typical population densities are less than 15 people per square kilometer. The unit cost of providing a basic infrastructure package in these conditions is US\$5,000 per capita, compared with US\$500 per capita in densely populated cities, although the difference can be substantially reduced (or even eliminated) if the possibility of applying cheaper decentralized technologies in rural areas is taken into account.

In urban areas, population growth rates averaging 3.6 percent per annum are leaving infrastructure service providers severely stretched. As a result, urban service coverage has actually declined over the last decade, and the resulting gap is being filled by lower-cost alternatives, such as boreholes and pit latrines, both of which are currently expanding at a much faster rate than improved alternatives, such as piped water, standposts, improved latrines or flush toilets (Banerjee and others, 2008; Morella and others, 2008).

In addition, population densities in African cities are relatively low by global standards and do not benefit from such large economies of agglomeration in the provision of infrastructure services. As a result, the costs of providing a basic infrastructure package can easily be twice as much as in other developing cities (Dorosh and others, 2008).

While overall access trends are not encouraging, some African countries are doing relatively well at expanding access to improved water sources. With the exceptions of Ethiopia and Uganda, these stronger performers tend to be francophone countries. The utilities with the best track record at expanding connections rapidly to the unserved population, also tend to be those that are most financially viable.

The sanitation agenda differs markedly across African countries. In a number of countries where the vast majority of the population is still

practicing open defecation, the central challenge is one of behavioral change. However, in most countries the bulk of the population has access to traditional latrines, the precise sanitary characteristics of which are difficult to determine. Traditional latrines are also by far the fastest-growing form of sanitation in Africa. Given the limited budgets of African households, the issue is how to encourage the local construction sector to provide improved latrines that are more sanitary but still affordable.

The missing links

Africa's infrastructure networks are highly fragmentary, reflecting the continent's atomized nation states. As a result, the level of intraregional connectivity is very low, whether measured in terms of transcontinental highway links, power inter-connectors, or intraregional fiber optic backbone (figure 2). In infrastructure, as in many other areas, a regional approach is needed, because Africa's small and isolated economies are simply too small to go it alone.

Regional integration lowers the cost of infrastructure by giving smaller countries access to more efficient technologies and a larger scale of production. For example, many African countries have power systems that are too small to be able to generate power efficiently. Nor would they have the means to provide for their own satellite or submarine cable.

Regional cooperation on infrastructure also helps to harness and share the benefits of transboundary commons. A key example is provided by Africa's 63 international river basins, which are shared by two or more countries and require careful coordination of water resource management and associated infrastructure investments. Similarly, the ports and connecting sea corridors of the coastal nations are regional public goods that typically service multiple landlocked countries in the hinterland.

Although well endowed with both hydro and thermal energy resources, Sub-Saharan Africa has developed only a small fraction of its power-generation potential (Eberhard and others, 2008). An important reason is that some of the continent's most cost-effective energy resources are concentrated in countries that are remote from major centers of demand and too poor to raise the multi-billion dollar finance needed to develop them. For example, 60 percent of the region's hydroelectric potential is to be found in DRC and Ethiopia. At the same time, 21 of 48 Sub-Saharan countries have national power systems that fall below the minimum efficient scale of 200 MW for electricity generation. As a result, they pay a heavy penalty, with operating costs reaching US\$0.25 per kilowatt hour compared with the US\$0.13 per kilowatt hour found in the continent's larger power systems. At present, only 16 percent of power production is traded (almost all of it between South Africa and its immediate neighbors), a level that can be substantially increased.

It is estimated that some US\$500 million per year through 2015 would have to be invested

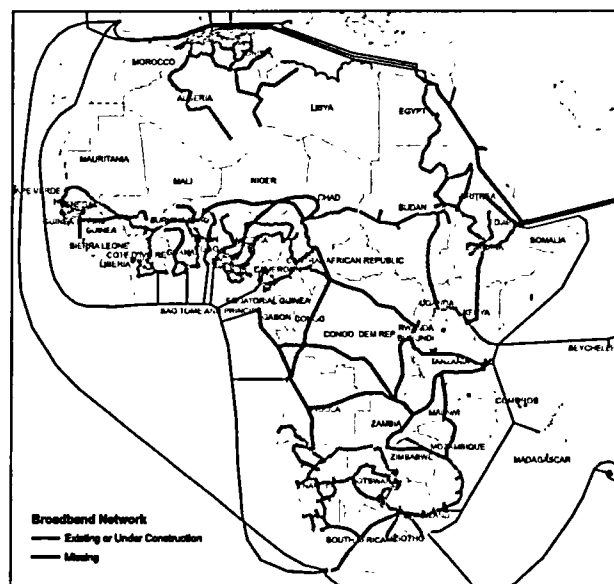
in 28 GW of inter-connectors to make Africa's regional power pools a reality and thus reduce the cost of power across the continent. That sounds like a high sum, but the returns on these investments are of the order of 20 to 30 percent, and as high as 160 percent in the case of southern Africa (Vennemo and Rosnes, 2008). The underlying reason for this is that trading power would lead to a net reduction in Africa's overall annualized energy costs of US\$2 billion.

Connectivity between African countries and the rest of the world remains poor. As much as 80 percent of the population of Sub-Saharan Africa, lack access to a submarine cable and continue to rely on satellite for international communications. Moreover, the intraregional ICT backbone that connects African countries with each other remains under-developed but is expanding rapidly. A fiber optic network of 36,000 kilometers would be required to inter-connect all capital cities, of which 16,000 kilometers remains to be built. Countries without access to submarine cables face international and Internet charges which can easily be twice as high as those that enjoy such access.

Figure 2 Africa's regional infrastructure challenge

a) ICT: closing the circle

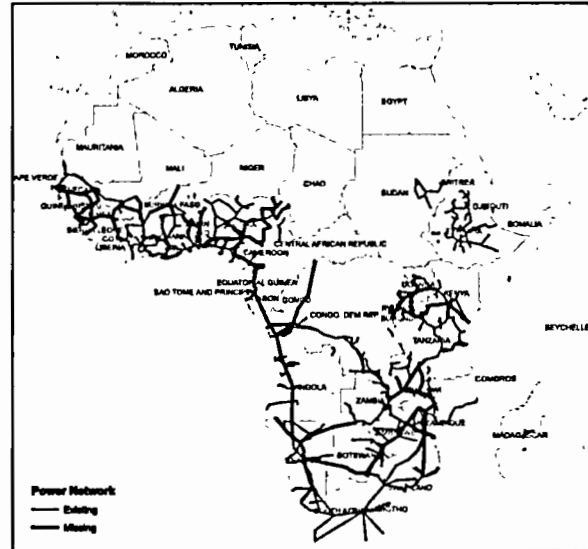
(b) River basins: managing commons



(c) Roads: connecting the dots



(d) Power: toward regional pools



Source: African Development Bank, 2008.

The concept of an intraregional trunk road network—the Trans-African Highway—has existed for some time, but owing to missing links and poor maintenance on key segments its potential to connect the continent remains unrealized. To provide a meaningful level of connectivity, between 60,000 and 100,000 kilometers of regional roads are required. At present, most attention focuses on the approximately 10,000 kilometers of road that constitute the various sea corridors into landlocked countries. While the condition of these strategic roads is generally good, the effective speed of international freight traffic is less than 10 kilometers per hour, when all the delays associated with clearing borders and ports are taken fully into account.

Greatly needed are measures to improve the efficiency of land frontier crossings through the creation of one-stop border posts, and other measures to improve the linkages between ports and upstream road and rail corridors, as well as the administrative efficiency of ports.

At present, the absence of a smooth interface between maritime and land transport systems means that most of Africa's containers are "stuffed and stripped" in the vicinity of the port, rather than used as a mean of facilitating multi-modal transport. This practice, combined with inefficient port management, leads to truck cycle times of 4 to 10 hours in Africa's ports, compared with one hour in other parts of the world. Similarly, container dwell times range from 6 to 15 days compared with 7 in other parts of the world (Ocean Shipping Consultants, 2008).

Rail links form an integral part of Africa's system of sea corridors. These sometimes provide the only connection to hinterland countries; more frequently, they compete with road connections. While rail has the competitive edge on certain bulk commodities, the volumes of traffic for these commodities in Africa is often below the minimum thresholds needed to make the rail corridors financially viable, particularly given that rail freight tariffs are effectively capped

by intermodal competition from road freight. Although there has been some discussion of providing transversal rail links to connect Africa's parallel sea corridors, it is hard to see how such links would be viable, given that intra-African trade volumes are so much smaller than the (already low) volumes observed on the sea corridors.

Recent years have witnessed significant progress in air transport connectivity within southern and eastern Africa, with strong traffic growth and the emergence of three strong regional hubs and associated major African carriers—Ethiopian, Kenyan, and South African. In contrast, in central and western Africa the sector is stagnating, with the vacuum created by the demise of several regional airlines still unfilled. Infrastructure is not at the heart of the problem. The number of airports is stable, and there are enough runways to handle traffic in the near future with better scheduling and fairly modest investments in parallel taxiways and some terminal facilities.

High prices for infrastructure services

Not only are Africa's infrastructure networks deficient in coverage, but the price of the services provided is exceptionally high by global standards (table 2). Whether one looks at power, water, road freight, mobile telephone, or Internet services, the tariffs paid in Africa are several multiples of those paid in other parts of the developing world. The explanation for Africa's higher prices sometimes lies in genuinely higher costs; at other times it reflects relatively high profits. The policy prescriptions are, of course, radically different in each case.

Table 2 Africa's high-cost infrastructure

	Sub-Saharan Africa	Other developing regions
Power tariffs (US\$/kWh)	0.02–0.46	0.05–0.1
Water tariffs (US\$/m ³)	0.86–6.56	0.03–0.6
Road freight tariffs (US\$/ton/km)	0.04–0.14	0.01–0.04
Mobile telephony (US\$/basket/mo)	2.6–21.0	9.9
International telephony (US\$/3 min. call to US)	0.44–12.5	2.0
Internet dial-up service (US\$/mo)	6.7–148.0	11

Source: *Africa Infrastructure Country Diagnostic, 2008.*

Note: Ranges reflect prices in different countries and various consumption levels. Prices for telephony and Internet represent all developing regions, including Africa.

Power provides the clearest example of an infrastructure category in which costs are genuinely higher in Africa than elsewhere. As noted above, many smaller countries rely on small-scale diesel generation that can cost up to US\$0.40 per kilowatt hour in operating costs alone, about three times as high as those faced by countries with power systems of larger scale (above 500 megawatts), which typically are hydro-based (Eberhard and others, 2008).

On the other hand, high road freight tariffs in Africa have much more to do with high profit margins than with high costs; a new study finds (Teravaninthorn and Raballand, 2008). The costs faced by Africa's trucking operators are not significantly higher than those found in other

parts of the world, even when informal payments are taken into account. Profit margins, on the other hand, are exceptionally high, particularly in Central and Western Africa where they reach levels of 60 to 160 percent. The underlying cause is the limited competition in the sector, combined with a highly regulated market based on *tour de role* principles.

The high costs of international telephony and Internet services on the other hand reflect a mixture of cost and profit factors. Countries without access to a submarine cable must rely on expensive satellite technology for international connectivity and have charges that are typically twice as high as countries that do enjoy such access. Nevertheless, even when access to a submarine cable is obtained, countries with a monopoly on this international gateway still have tariffs that are substantially higher than those without (Minges and others, 2008).

The cost of catching up

The cost of redressing Africa's infrastructure deficit is estimated at around US\$80 billion per year, split evenly between investment and operations and maintenance spending (Briceño-Garmendia, 2008) (table 3). This is about double earlier estimates reported in the Commission for Africa report, which were not based on a less-detailed assessment than the one presented here.

The total required spending translates into some 12 percent of Africa's GDP. However, the magnitude of the burden varies greatly according to the type of country. While middle-income countries and oil-exporting countries could meet their infrastructure needs with an attainable commitment of less than 10 percent of GDP, low-income countries would need to devote an implausible 20 percent of GDP—and fragile states an impossible 40 percent of GDP (Briceño-Garmendia, 2008).

Around half of the total investment needs are associated with the power sector, reflecting the particularly large deficits that Africa has in this regard, and about two-thirds of this is associated with needed expansions in generation capacity to keep pace with escalating demand. A significant share of power investments are associated with hydro-power schemes, which provide multi-purpose water storage capacity that benefits a wide range of water users. Transport is a distant second in terms of spending requirements, and more than half of the total amount for this sector is associated with improvements and extensions to the rural network to reduce isolation.

Table 3 Infrastructure spending needs for Sub-Saharan Africa

	US\$ billion per year		
	Capital expenditure	Operations and maintenance	Total spending
ICT	0.8	1.1	1.9
Irrigation	4.1	0.8	4.9
Power	23.2	19.4	42.6
Transport	10.7	9.6	20.3
WSS	2.7	7.3	10.0
Total	41.5	38.2	79.7

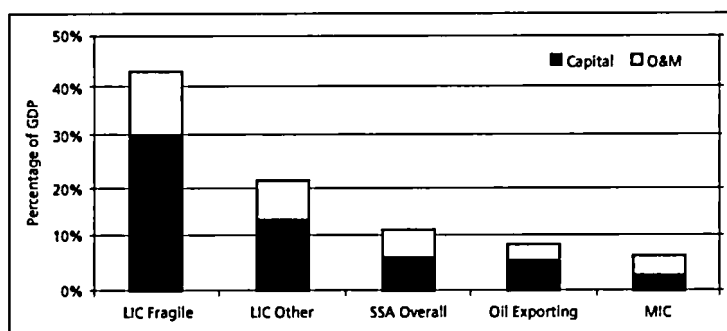
Source: Briceño-Garmendia and others, 2008.

Note: Figures refer to investment (except public sector) and include recurrent spending. Public sector covers general government and nonfinancial enterprises.

While middle-income countries need to devote a higher share to maintenance than to investment, low-income countries need to devote a higher share to investment (figure 3). This makes sense, since low-income countries have a far more pressing need for new infrastructure assets. However, for all countries, the share of spending that needs to go to operation and maintenance is very substantial.

Although the investment needs estimates presented here are based on the most accurate unit-cost data available, development agencies are reporting significant cost escalations on projects currently under implementation. For roads projects, these escalations have averaged at 35 percent, but have been as high as 50–100 percent in some cases. Closer inspection reveals that no single factor explains this phenomenon. Domestic inflation, tight construction industry conditions, oil price hikes and inadequate competition for tenders have all played their role. However, the latter is by far the strongest effect. The tendency of infrastructure costs to rise means that the spending estimates presented here can be regarded as a lower bound.

Figure 3 The burden of infrastructure needs



Source: Briceño-Garmendia and others, *Africa Infrastructure Country Diagnostic*, 2008.

Note: Figures refer to investment (except public sector) and include recurrent spending. public sector covers general government and nonfinancial enterprises.

Current spending on infrastructure

Current spending on infrastructure in Africa is higher than originally thought, once on- and off-budget vehicles are taken into account. Indeed, as much as two thirds of Africa's

infrastructure spending is domestically re-sourced. The remaining third comes from a variety of external financing sources (table 4).

Table 4 Existing infrastructure spending in Sub-Saharan Africa

US\$ Billion per Year	Public Sector O&M	Capital Expenditure				Total	Grand Total Expenditure
		Public Sector	ODA	Non-OECD Financiers	PPI		
ICT	4.6	1.7	0.1	0.5	3.1	5.4	10.0
Power	7.0	2.7	0.8	2.2	1.1	6.8	13.8
Transport	8.8	5.5	1.7	1.1	0.6	8.9	17.7
WSS	3.1	1.4	1.1	0.4	0.0	2.8	5.9
Total	23.5	11.2	3.7	4.2	4.8	23.9	47.4

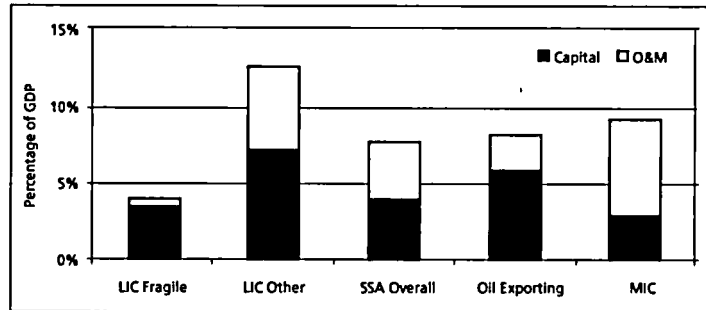
Source: Briceño-Garmendia and others, 2008.

Public finance remains the dominant source of finance for water, energy, and transport in all but the fragile states. Public investment is largely tax-financed and executed through central government budgets, while operating and maintenance expenditure is largely financed from user charges and executed via state-owned enterprises. Current levels of public finance are quite substantial relative to the GDP of the low income states, typically absorbing 6–8 percent of the total. However, in absolute terms spending remains very low (figure 4), and amounts to no more than US\$20–40 per capita per year (Briceño-Garmendia, 2008).

Official development assistance, private participation in infrastructure, and non-OECD financiers are all comparable in importance and each additionally contribute around US\$4 billion per year (Briceño-Garmendia and others, 2008). However, the focus of the finance differs markedly in each case. Official development assistance makes an important contribution to water and transport funding, particularly in fragile states. Non-OECD finance is particularly significant in the energy and rail sectors, above all in oil exporting countries. Private participation in infrastructure is heavily concentrated in ICT.

Notwithstanding these important contributions, an overall annual funding gap of close to US\$40 billion remains (Briceño-Garmendia and others,

Figure 4 Infrastructure spending by type of country

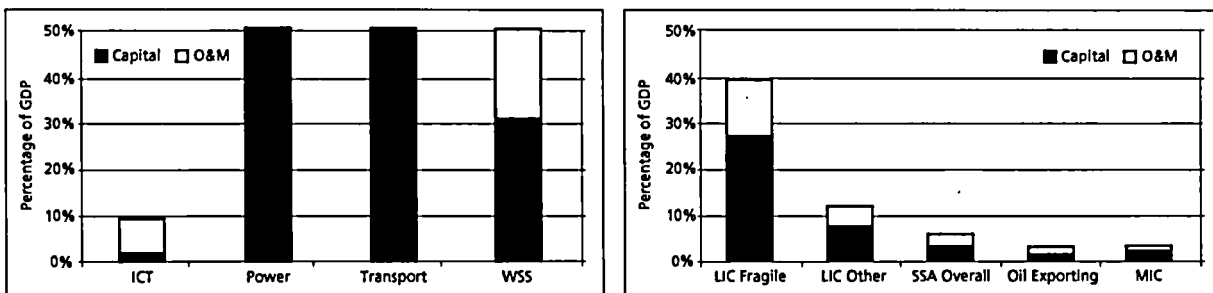


Source: Briceño-Garmendia and others, 2008.

2008). Looking across sectors, about 80 percent of this gap relates to power, with the remainder split across transport and water; there is no real gap for ICT (figure 5). Looking across countries, about 80 percent of this gap relates to the low-income countries and is evenly split between fragile and (the more numerous) nonfragile states. Overall, by far the largest financing gaps are found in the energy and transport sectors of fragile states. Although the largest financing gaps relate to capital investment, a substantial shortfall in funding for operations and maintenance also exists, particularly in fragile states.

How is Africa to close such a sizable gap in infrastructure finance? While efforts are certainly needed to raise additional funds, even greater attention needs to be paid to how existing resources are being used. There is substantial evidence that a lot more could be done within Africa's existing resource envelope.

Figure 5 The infrastructure funding gap by sector ... and by country typology



Source: Briceño-Garmendia and others, 2008.

Getting more out of current spending

Improvements in the budgeting process for infrastructure could increase the effectiveness of the existing budget envelope in a variety of ways.

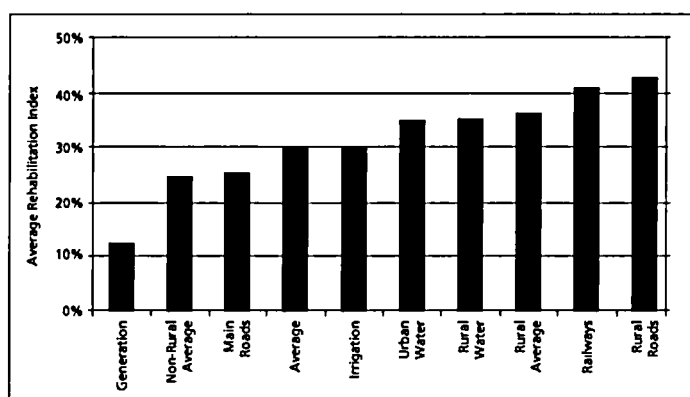
First, some countries are allocating more resources to specific areas of infrastructure than would appear to be warranted (Briceño-Garmendia, 2008). This "excess expenditure" amounts to US\$8 billion per annum overall. While some of it may be justified by phasing or sequencing issues, it is possible that at least part of these resources could be reallocated to underfunded sectors. There is a need to more closely monitor infrastructure expenditure against identified needs and priorities.

Second, a major finding is that African countries are typically only managing to execute about two-thirds of the budget allocated to public investment in infrastructure (Briceño-Garmendia, 2008). Or put differently, public investment could increase by 50 percent without any increase in spending, but simply by addressing the institutional bottlenecks that inhibit capital budget execution. These include better planning of investment projects, earlier completion of feasibility studies, more efficient procurement processes, and a move to medium term multi-year budgeting. Increasing capital budget execution to 100 percent could potentially capture an additional US\$3 billion per annum in public investment.

Third, on average about 30 percent of the infrastructure assets of a typical African country are in need of rehabilitation (Briceño-Garmendia and others, 2008) (figure 6). This share is even higher for rural infrastructure, and for countries affected by violent conflict. This reflects a legacy of underfunding for infrastructure maintenance, and over time represents a major waste of resources since the cost of rehabilitat-

ing infrastructure assets is several times higher than the cumulative cost of a sound preventive maintenance regime. This suggests that some reallocation of resources from investment to maintenance may be warranted, particularly in low income countries that show particularly low levels of maintenance expenditure. The clearest example of this is the roads sector, where many countries fail to cover basic maintenance and rehabilitation needs, and thus find themselves on a downward spiral with respect to road quality.

Figure 6 Rehabilitation liabilities, by sector



Source: Briceño-Garmendia and others, 2008.

Note: Rehabilitation index shows the average percentage across countries of each type of infrastructure that is in poor condition and hence in need of rehabilitation

Tackling inefficiencies

Africa's power and water utilities present very high levels of inefficiency in terms of under-collection of revenues and distribution losses (figure 7). Utilities typically collect only 70 to 90 percent of billed revenues, and experience distribution losses that can easily be twice as high as technical best practice. According to household surveys, around 40 percent of those connected to utility services do not appear to be paying for them, and the share rises to 65 percent for a significant minority of countries. It is not unusual for the revenues lost as a result of these inefficiencies to exceed the current turnover of the utilities by several multiples. In the case of the power sector, these losses are

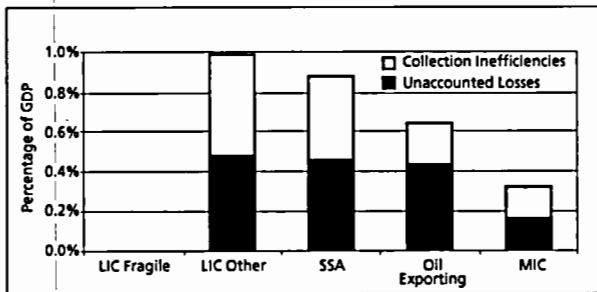
also material at the national level, absorbing 1.9 percent of GDP on the average (Briceño-Garmendia and others, 2008). In the case of water utilities, the absolute value of the inefficiencies is smaller, with the average amount accounting for 0.6 percent of GDP. In the case of ICT, countries retaining state-owned incumbents are often incurring significant losses due to overstaffing that average at 0.3 percent of GDP.

is estimated that as much as 50 percent of fuel levies fail to be captured by the road sector.

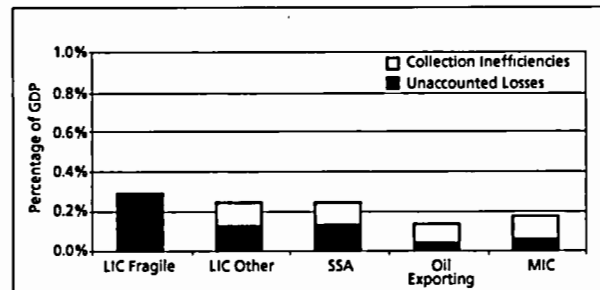
Raising user charges

Although African infrastructure charges are comparatively high by international standards, so are Africa's infrastructure costs. As a result, even these relatively high tariffs often fail to cover more than operating costs. On aggregate,

Figure 7 Hidden costs of utility inefficiency
(a) Power



(b) Water



Source: Briceño-Garmendia and others, 2008.

These quasi-fiscal costs represent a real financial burden on the public budget, since utilities that incur such deficits must ultimately resort to the state for investment finance and periodic bail-outs. They may also represent a real economic burden for the country, as underfunded utilities tend to run down their assets and as a result provide low quality services to the general public. On aggregate, the revenues lost as a result of undercollection, distribution losses and other inefficiencies associated with power and water utilities amount to US\$3.4 billion per annum.

the revenues that fail to be collected due to under-pricing of power and water services amount to as much as US\$4 billion per annum (Briceño-Garmendia and others, 2008).

Utilities are not the only sector where revenue collection represents a challenge. A significant number of countries are facing problems in capturing the fuel levies that are due to their Road Funds for the financing of road maintenance (Gwilliam and others, 2008). In some cases, tax evasion has become a major issue. In others, revenues are collected by one set of authorities but never duly transferred to the roads sector. It

This amounts to an implicit subsidy for infrastructure consumers. However, due to the very regressive patterns of access to infrastructure services in Africa, around 90 percent of those that have access to piped water or electricity services belong to the richest 60 percent of the population (Banerjee and others, 2008) (figure 8). As a result, any subsidy to these services is largely captured by better-off households. In fact, targeting is so deficient that a completely random process for allocating subsidies across the population would perform three times better at reaching the poor.

Given that utility services are so concentrated among upper-income groups, it would appear that there is not much of a social case for subsidizing these services at all at present.

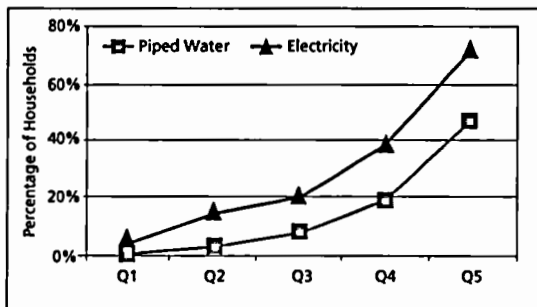
The typical African household of five persons survives on less than US\$200 per month, and that the difference in budgets between richer and poorer households is not large in poor countries. A monthly utility bill of around US\$10 per month—which in most cases is sufficient to provide full cost recovery on a typical level of consumption—would absorb only 1 to 4 percent of the household budgets of the kind of higher income customers that currently enjoy access to these services. This is well below the widely used affordability threshold of 5 percent. However, the same utility bill would absorb between 7 to 15 percent of the household budget of the poorer groups that are currently excluded from these services, making it prohibitively expensive in this case. The implication is that cost recovery tariffs may be affordable with today's patterns of access, but might not provide a basis for reaching universal access.

enjoy network access. If provided with access to utility networks, even at cost recovery prices, poor households would still be better off than they are today using alternative services, and would continue to have the option of restricting consumption to keep their overall utility bills affordable.

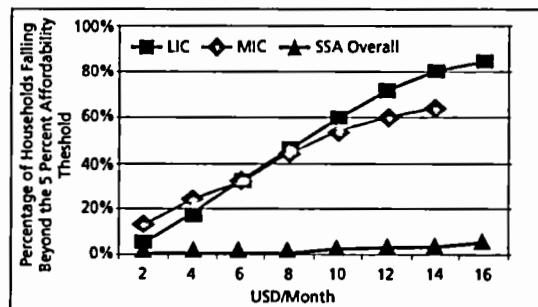
This suggests that, ultimately, subsidization of connection costs may be a more equitable and cost-effective way of targeting public resources. On the one hand, connection subsidies may be easier to target since a high percentage of the unconnected population is poor. On the other hand, connection subsidies provide poor households with the possibility to access water at a much lower cost than many of the alternatives.

Nevertheless, the ability to provide any form of subsidy to the sector is tightly circumscribed by limited public budgets. The cost of providin

Figure 8 Affordability of household services
(a) Access by quintile



(b) Affordability curve



Source: Banerjee and others, 2008.

Nevertheless, unserved customers often end up having to use alternative sources of water and energy—such as vendor water or kerosene—with relatively higher prices than those that the public utility would need to charge to reach cost recovery, as high as four or five times in many cases (Luengo et al, 2008). Poor households are only able to afford this by cutting back heavily on the quantity consumed, thereby end up paying similar monthly amounts to households that

subsidies on the scale needed to achieve universal access goals could easily reach 1 percent of GDP for a service such as water, which would imply doubling current levels of funding to the sector.

It is therefore also important to rely on lower cost solutions to the provision of infrastructure services, such as stand posts and improved latrines. The prevalence of these

'intermediate solutions' is surprisingly low in Africa and strikingly skewed toward the upper income echelons, as if even these second best services are functioning as luxury goods.

Once again, utilities are not the only sector where cost recovery is proving challenging. The vast majority of African countries have now established second generation road funds, which are based on the principle of covering maintenance requirements through indirect user charges applied in the form of fuel levies. However, only a minority of countries has set fuel levies high enough to cover the costs of road network maintenance—at around US\$0.10 per liter—and none have levies high enough to clear the road rehabilitation backlog (Gwilliam and others, 2008).

Raising additional finance

Even if all the efficiency measures described above could be fully implemented, which of course may not be feasible, a substantial funding gap would remain (table 5). This gap can only be addressed by raising additional finance, or alternatively adopting lower cost technologies or less ambitious targets for infrastructure development.

Table 5 Closing the gap: is money the issue?

	US\$ billion
Financing gap	+40
Reallocate spending across categories	-8
Raise capital budget execution	-3
Reduce operating inefficiencies	-3
Improve cost recovery	-4
Remaining gap	+22

Source: Africa Infrastructure Country Diagnostic.

All three of the major external sources of finance (ODA, PPI, and non-OECD donors) have exhibited considerable buoyancy in recent years, reaching a historic high point in 2008. However, it is likely that all three sources of external finance may suffer in the next few years due to the global financial crisis. Furthermore, these flows will likely continue to be skewed toward the current pattern of funding specialization. To really contribute to closing the gap, these financing sources (particularly ODA) would need to shift their focus toward the major gaps for energy and transport in fragile states.

With regard to public finance, the scope for raising additional tax finance and moreover the political will to allocate this toward infrastructure appears more limited. The fragile states, in particular, where the gaps are largest also have the least potential to tap into domestic finance. Oil exporting, and resource rich countries more generally, are—on the contrary—enjoying major fiscal windfalls as a result of the current commodity price boom. However, at least to date, they have not shown any significant propensity to channel such resources toward infrastructure. Moreover, international experience suggests that public spending on infrastructure projects and associated maintenance is particularly vulnerable to fiscal compression in times of financial hardship.

In a handful of African countries, domestic capital markets are beginning to look wide and deep enough to provide significant volumes of infrastructure finance; Nigeria being the most salient example (Irving, 2008). Nevertheless, most of this finance at present takes the form of relatively short maturity commercial bank lending, often not the best suited for infrastructure projects. There is a need to further develop corporate bond markets and to create regulatory conditions for greater participation by institutional investors.

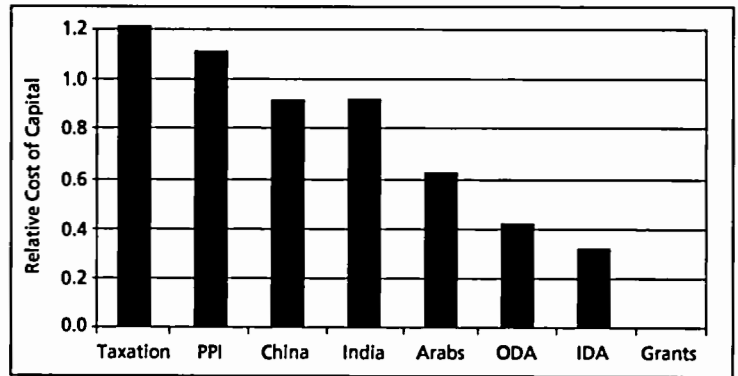
In seeking the appropriate financing mix to bridge the infrastructure financing gap, countries need to be mindful of the widely differing cost of capital from different sources (Briceño et al, 2008). The cost of raising one dollar of tax revenue in Africa is estimated at US\$1.20 due to the cost of the economic distortions associated with levying taxes (figure 9). Any source of external borrowing will ultimately need to be repaid through tax revenues at this cost, but the payment is deferred until a future date. Viewed from this perspective, money raised from private capital is only slightly more attractive than tax funding. Funds that are raised from non-OECD financiers such as China and India come at a discount of about 25 percent, money from Arab donors offers a discount of 50 percent, and ODA offers a discount of around 70 percent at least. In recognition of these differences, it makes sense to match higher cost sources of funding to projects that yield a high financial return, and lower cost sources of funding to projects that yield a high economic return but a more limited financial one.

The institutional agenda

It is clear that bridging Africa's infrastructure funding gap is as much about improving the performance of the relevant institutions as it is about raising additional finance. Institutional reform, then, remains at the heart of the infrastructure agenda.

During the last decade, there have been concerted efforts toward institutional reform in the infrastructure sectors across Africa.

Figure 9 The cost of raising more funds

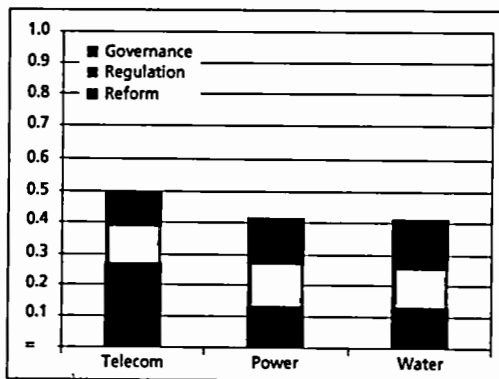


Source: Africa Infrastructure Country Diagnostic.

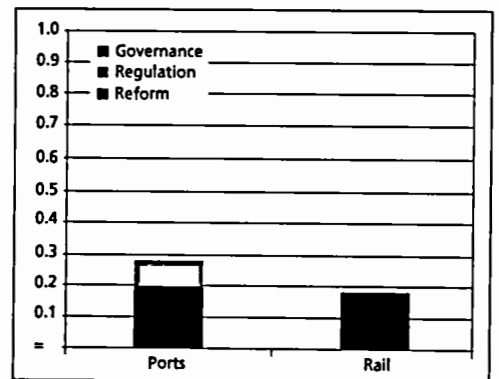
As of today, it is probably fair to say that the institutional reform process is half way along (Vagliasindi and Nellis, 2008). Significant progress has been made, but few countries have yet achieved a modern institutional framework for these sectors. Overall, the greatest progress has been made in the telecom sector, while the transport subsectors lag further behind (figure 10). Moreover, the focus of efforts also varies significantly across sectors. Whereas in the telecom sector the emphasis has been on implementing sector reform, for example, in the water sector the emphasis has been on improving governance.

Figure 10 Status of institutional reform across

(a) Utilities



(b) Transport



Source: Vagliasindi and Nellis, 2008.

Over this period, the nature of that institutional agenda has broadened and deepened (Vagliasindi and Nellis, 2008). As recently as the 1990s, the emphasis of institutional reform was on sector restructuring and private participation, transplanting to Africa experiences from other parts of the developing world. This approach yielded dramatic results in the telecommunications sector, but elsewhere the benefits were more limited and the experiences more problematic. Nevertheless, overall private finance to African infrastructure came from nowhere to provide a flow of funds comparable in magnitude to traditional ODA.

A more nuanced, less dogmatic, view of the private sector has subsequently emerged, which values the significant private financing contribution that can be made in certain key areas (mobile telephony, power generation, ports) while recognizing its limitations in others (roads, power and water distribution) (table 6). Even for infrastructures where the proven appetite for private finance is very limited, the potential contribution of the private sector to tackling

costly management inefficiencies (such as under-collection of utility revenues or neglect of road maintenance) remains very valuable.

Moreover, the very concept of private sector participation has itself undergone significant expansion. There has been greater emphasis on the role of the local (as opposed to the international) private sector, and increasing exploration of hybrid models that experiment with different ways of allocating responsibilities between public and private sector partners.

Another important way in which the institutional reform agenda has broadened is the greater focus on the quality of governance for enterprises that remain state-owned (Vagliasindi and Nellis, 2008). The recognition that the private sector will never be a ubiquitous service provider has come with the realization that state-owned enterprises are here to stay. Therefore some other means must be found to improve what has—with some notable exceptions—been their traditionally lackluster performance.

Table 6 Overview of experience with PPI in infrastructure

	Extent of PPI	Nature of experience	Prospects
ICT			
Mobile telephony	Over 90 percent of countries have licensed multiple mobile operators	Extremely beneficial with exponential increase in coverage and penetration	A number of countries still have potential to grant additional licenses
Fixed telephony	60 percent of countries have undergone divestiture of SOE telecom incumbent	Controversial in some cases, but has helped to improve overall sector efficiency	A number of countries still have potential to undertake divestitures
Power			
Power generation	34 IPPs provide 3,000 MW of new capacity investing US\$2.5 billion	Few cancellations but frequent renegotiations, PPA have proved costly for utilities	Likely to continue given huge unsatisfied demands and limited public sector capacity
Power distribution	16 concessions and 17 management or lease contracts in 24 countries	Problematic and controversial with one quarter of contracts cancelled before completion	Movement toward hybrid models involving local private sector in similar frameworks

Table 6 Overview of experience with PPI in infrastructure (cont.)

Transport			
Airports	4 airport concessions, investing <US\$0.1 billion, plus some divestitures	No cancellations but some lessons learned	Limited number of additional airports viable for concessions
Ports	26 container terminal concessions, investing US\$1.3 billion	Processes can be controversial but cancellations have been few and results positive	Good potential to continue
Railroads	14 railroad concessions, investing US\$0.4 billion	Frequent renegotiations, low traffic and costly PSOs keep investment below expectations	Likely to continue but model needs to be adapted
Roads	10 toll road projects almost all in RSA, investing US\$1.6bn	No cancellations reported	Limited as only 8 percent of road network meets minimum traffic threshold, almost all in RSA
Water			
Water	26 transactions mainly management or lease contracts	Problematic and controversial with 40 percent of contracts cancelled before completion	Movement toward hybrid models involving local private sector in similar frameworks

Source: Adapted from Vagliasindi and Nellis, 2008.

Governance reforms comprise a wide range of measures such as increasing board and managerial autonomy, strengthening accounting and disclosure systems, tightening supervision and oversight, and exposing enterprises to a wider range of product, labor and capital market disciplines. The empirical evidence suggests that two of these measures in particular are having a discernible impact on sector performance. These are the use of performance contracts as long as these incorporate explicit managerial incentives, as well as independent external audits of operational and financial performance.

Evidence on the links between the introduction of an independent regulator and improvement in performance is currently mixed (Vagliasindi and Nellis, 2008). For the water sector, where the vast majority of service providers are

state-owned enterprises there is no evidence of any benefit from regulation. Some impact is discernible in the power and telecommunications sectors, although it is far from unambiguous. Weak regulatory autonomy and capacity constraints undermine the credibility of independent regulators. Most Sub-Saharan regulatory agencies are embryonic, lacking funding and in many cases qualified personnel. Improving regulatory performance and impact is a long term process that deserves to be pursued in sectors where private participation and competitive pressures play a significant role. Given capacity limitations, the emphasis should be on reducing discretion in regulatory decision making through more explicit rules and procedures, or through regulatory contracts and the outsourcing of regulatory functions to expert panels.

Furthermore, the institutional reform agenda can no longer be confined to the infrastructure service providers alone. As noted above, the bulk of public investments in infrastructure are executed through the central government budget rather than by public enterprises. Numerous inefficiencies arise both in the planning, selection and execution of these infrastructure investment projects. Unless these are tackled head on, the impact of reforms at the service provider level will remain limited.

The institutional reform agenda therefore has to provide for stronger sector planning capabilities in the infrastructure line ministries, to ensure that critical national investments in infrastructure, such as power generation capacity, will be planned far enough in advance to ensure that the infrastructure will come on stream when needed. The agenda also needs to incorporate a more rigorous project-screening process to ensure that infrastructure investments are selected according to their expected returns, and that those investments are appropriately sequenced and synchronized with each other and with broader development plans, so as to maximize synergies and avoid the creation of costly bottlenecks. On the implementation side, multi-year budgeting frameworks and greater capacity to plan and implement complex procurement processes would help to ensure that budget execution ratios increase and that projects are seen through to completion.

Sector-by-sector views

The ICT sector has led the way in terms of the reform process and the establishment of regulatory institutions. Nevertheless, in a significant number of countries, telecom incumbents remain in public hands, and often exhibit serious deficiencies with respect to governance. Although the ICT reform process to date has already yielded impressive results, there is evidence that markets are still not as competitive as they may appear to be on paper (Minges

and others, 2008). Constraints on competition often appear in the licensing process. In some countries, murky procedures for obtaining a license perpetuate the de facto monopoly. In other countries, the complexity of the licensing process discourages new entrants and often obscures the real scope of a license. Further liberalization measures are needed to intensify competition in the mobile telephone, Internet, and international calling markets. For example, in the case of mobile telephony, it is estimated that an additional 40 percent of Africa's population could be covered by GSM signals without any public subsidy if only markets could operate more efficiently. Less than 5 percent of the population would require some degree of subsidy (Mayer and others, 2008).

In the power sector, almost all countries have taken some steps toward sector modernization, but the extent and payoff of reform remain limited. Nowhere in Sub-Saharan Africa does one encounter the "standard" reform model, that is, unbundling and privatization paving the way for wholesale and retail competition. Instead one finds what might be termed hybrid power markets. In most countries, the national state-owned utility retains its dominant market position. Private sector participation is either temporary or marginal. The poor payback from reform has forced reconsideration of whether certain reform principles and programs—notably the unbundling of the incumbent power utility to foster competition—are appropriate for Sub-Saharan Africa, where most power systems are simply too small to make competition viable.

Hybrid power markets will not disappear from the African landscape anytime soon. To make the best of them, African governments must strive to develop a robust institutional foundation for the single buyer model, with clear criteria for power-purchase agreements and associated dispatch of power. They must nurture their planning capabilities, establish clear policies and

criteria for allocating new plant opportunities, and commit to competitive and timely bidding processes.

In the transport sector, by contrast, there is a relatively high degree of consensus around the direction of institutional reform. As regards roads, most countries are moving toward a framework comprising road funds and road agencies. There is evidence that road funds are having an impact in terms of securing higher volumes of funding for road maintenance. However, this is true only if the fuel levy is set at a level commensurate with maintenance costs and is effectively collected, which is not always the case. Countries with the combination of a road fund and road agency seem to do best with regard to road quality. Only 1 percent of Africa's road network meets the minimum traffic threshold for the viability of toll road concessions, making private finance of limited relevance except in a handful of cases.

Institutional reforms in the ports sector to date have been limited, with only Ghana and Nigeria adopting the internationally preferred landlord model, and only South Africa introducing an independent regulator (Ocean Shipping Consultants, 2008). Nevertheless, even in the absence of broader sector reform, a substantial number of container terminal concessions have now been awarded, notably in Nigeria, and there is evidence that those concessions are yielding results in terms of productivity. The growing presence of private operators should help to create pressure for broader institutional reforms.

A significant share of Africa's rail corridors have recently been awarded as concessions to the private sector, and further concessions are planned. While there is some evidence that concessions have helped to improve the commercial and technical performance of the railways, the associated traffic volumes have not produced the revenues needed to fully finance track rehabilitation and renewal of rolling stock. As a

result, most concessions have undergone major renegotiation episodes. A common problem is the imposition of unfunded social obligations to provide passenger services. Greater realism is therefore needed in the design of private contract structures for this sector.

In air transport, the key institutional issue is the persistence of numerous—and nonviable—state-owned operators that depend on subsidies and a domestic monopoly. But there are some promising signs. Routes and aircraft sizes are being adapted to the market, and the large carriers are viable and expanding. Further liberalization can only encourage this. The Yammassoukro Decision of 1999 set the stage for full air transport liberalization in Africa, but it has yet to be fully implemented. A good measure of the extent of implementation of this decision is the percentage of fifth freedom flights; which is to say flights that are operated by carriers who do not belong either to the country of origin or the country of destination. The percentage of flights undertaken by fifth-freedom carriers has been on the rise, especially in Central and Western Africa, where they account for 30–40 percent of seats, compared with 5–15 percent in Eastern and Southern Africa.

In the water sector, the financial viability of water utilities seems to be a key driver of service provision in urban areas. The adoption of certain institutional reforms such as decentralization, private sector participation and SOE governance reforms all seem to be making a difference in strengthening the financial performance of utilities. In rural areas, countries that have moved further along the reform agenda, in terms of establishing clear a water rural policy, applying cost recovery principles and adopting rural funding and agency mechanisms, seem to be more successful in expanding rural coverage.

For sanitation, households are the protagonists in the provision of on-site facilities. Nevertheless, government's catalytic role in

promoting demand for services and addressing supply bottlenecks remains key. Too often, dispersion and duplication of sanitation roles—even within the public sector—prevent one entity from leading, and sanitation issues fall through the cracks. A key policy issue is therefore to identify and empower a clear sanitation champion within the public sector. Perhaps the best example is Senegal, where the decision to take sanitation seriously was expressed through the creation of a ministry of sanitation and a dedicated sanitation utility. While it may not always be necessary to go to this extreme, there is an important lesson in singling out one entity with a clear mandate to lead.

With respect to water resources, a critical challenge is to build the capacity of transboundary river basin organizations able to facilitate rational management and investments in Africa's numerous international rivers. Cooperation among riparian countries offers possibilities for mutual gain that could not otherwise be achieved through unilateral action (Yu and Mody, 2008). These mutual benefits may be from hydropower generation, irrigation, fisheries, water supply, environmental protection, or navigation. Between the 1960s and 1980s many countries created institutional river basin arrangements, with significant donor support. However, nearly three decades later, with a few exceptions, the

transboundary organizations have yet to reach maturity, though they have faced many challenges. Among those challenges are waning political commitment, dwindling donor support, poor cooperation, management and technical difficulties, armed conflict resulting in political instability in member states, poorly defined goals, and insufficient capacity to execute the proposed plans.

In a nutshell

The limited coverage and high cost of Africa's infrastructure—even when measured against the modest standard of other low-income countries around the world—are extreme. Improved infrastructure can make a critical contribution to sustaining and improving the recent upturn in the continent's growth performance. The cost of fixing the problem is a lot higher than previously reckoned, however, particularly with regard to the power sector and fragile states. Nevertheless, the price tag is comparatively modest by global standards. Additional funding will be needed. External finance has gone through a major upswing in recent years, but this is now threatened by the global financial crisis. All the more important, therefore, to pursue the institutional and structural reforms needed to ensure that current and future resources will deliver on their full potential.

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Africa's infrastructure is by far the most deficient and costly in the developing world. Inadequate infrastructure is holding back economic growth by two percentage points each year. Solving the problem will cost US\$80 billion per year, about twice what is currently being spent. More money is desperately needed, particularly for the power sector. But money alone is not the answer. Prudent policies, wise management, and sound maintenance can make current resources go much further, and contribute significantly to narrowing the infrastructure gap.



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Africa's Infrastructure: a time for transformation

Africa Infrastructure Country Diagnostic

Africa Infrastructure Country Diagnostic

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