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Liberia's Infrastructure

A Continental Perspective

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Abstract

Liberia's power generating capacity and national grid were completely demolished during 14 years of civil war. Piped water access fell from 15 percent of the population in 1986 to less than 3 percent in 2008. War also left the national road network in a state of severe disrepair. Since the return of peace, the port of Monrovia has resumed normal operations under private management, and progress has been made in securing donor finance for road reconstruction. Liberia has also successfully liberalized its mobile telephone markets, with low-priced access surging to 40 percent in 2009.

Liberia's starkest challenge lies in funding a more cost-effective power sector. The country's generation capacity is barely one-tenth of the benchmark level of Africa's other low-income countries. The cost of generating power is exorbitant, and the power tariff is three times the regional average.

Addressing Liberia's public infrastructure needs will require sustained expenditures of between $350 million and $600 million annually, mostly to fund power and transport. In the mid-2000s, with all sources of spending taken into account, Liberia spent around $90 million a year on infrastructure. An additional $17 million was lost to inefficiencies, such as underpricing of power.

Because Liberia suffers an annual funding gap of between $250 million and $500 million per year, it will need a combination of increased finance, improved efficiency, and cost-reducing innovations to reach its infrastructure targets in a reasonable time. Without these, Liberians may have to wait for up to 40 years to achieve the targets.

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Liberia's Infrastructure: A Continental Perspective

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Liberia's 14-year civil war left much of the country's infrastructure shambles. The country's 170 megawatt power generation capacity and national grid were completely destroyed. In Monrovia, just 0.1 percent of households had access to electricity. According to the 2008 National Census, access to piped water fell from 15 percent of the population in 1986 to less than 3 percent in 2008. The national road network was left in severe disrepair.

Peace brought many positive developments. The Freeport of Monrovia is now privately managed and has resumed normal operations. Essential rehabilitation work has been carried out, and the port's performance now matches that of neighboring ports along the West African coast. Liberia has also successfully liberalized its mobile telephone markets, with access surging to 40 percent in 2009, at some of the lowest prices in Africa.

But Liberia still faces critical infrastructure challenges. Perhaps the starkest lies in the power sector. The country's installed power generation capacity is little more than 2 megawatts per million people, barely one-tenth of the benchmark level for other low-income countries in Africa. The cost of generating power is $0.77 per kilowatt-hour, exceptionally high by any standard. Furthermore, the power tariff of $0.43 per kilowatt-hour is about three times the average for Africa, which is already very high by global standards. Investment in more cost-effective power generation is therefore an important strategic objective for the country if electrification is to reach the wider population.

Although good progress has been made in securing donor finance for road reconstruction, existing capital spending is about half the level that would be required to complete the rehabilitation process within five years, and existing maintenance spending is about half what would be needed to preserve these new investments into the future. Many countries have addressed this problem by establishing road funds financed by user charges. That approach is being considered in Liberia.

Addressing Liberia's public infrastructure needs will require sustained expenditure of between $350 million and $600 million per year, depending on the technologies and standards chosen. Power and transport account for the largest portion of this total—around one-third each.

When all sources of spending are taken into account, Liberia spent around $90 million a year on infrastructure in the mid-2000s. That is equivalent to about 10 percent of GDP, a relatively high share compared with other African countries though still only about half of the share that China has spent on infrastructure in recent years. About 80 percent of total infrastructure spending has been investment, and almost half has gone to the transport sector. Official development assistance is by far the largest source of investment, followed by private funds. Domestically financed public investment has been minimal. In addition, a total of $17 million is lost annually to inefficiencies, mainly because of the absence of road user charges and underpricing of power.

Assessing spending needs against existing spending and potential efficiency gains leaves an annual funding gap of between $250 and $500 million per year, most of it associated with power and transport. While the funding gap is very large relative to the economy, there are a number of options for making it more manageable. First, Liberia has established a strong track record in foreign direct investment: in recent years it has captured private investment for infrastructure (almost all for the ICT sector) equal to 2 percent of GDP. Power generation and ports may also be candidates for private finance. Several multinational companies have obtained concessions to exploit the country's abundant mineral, forestry,

and agricultural resources and are investing heavily in the transport and energy facilities needed to support their operations. Because of Liberia's policy of ensuring that such investments benefit the broader national economy, they could potentially contribute to meeting the country's overall infrastructure spending needs.

Despite the potential for private investment, Liberia will likely need more than a decade to reach the illustrative infrastructure targets outlined in this report. Under business-as-usual assumptions for spending and efficiency, it would take at least 40 years for Liberia to reach these goals. Yet with a combination of increased finance, improved efficiency, and cost-reducing innovations, it should be possible to significantly reduce that time.

The continental perspective

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

This report presents the key AICD findings for Liberia, allowing the country's infrastructure situation to be benchmarked against that of its African peers. Liberia is a low-income state richly endowed with natural resources; therefore, both low-income and resource rich benchmarks will be used to evaluate its performance. Detailed comparisons will also be made with immediate regional neighbors in the Economic Community of West African States (ECOWAS) and other states that have emerged from conflict such as the Democratic Republic of Congo and Rwanda.

Several methodological issues should be borne in mind. First, because of the cross-country nature of data collection, a time lag is inevitable. The period covered by the AICD runs from 2004 to 2009. Most technical data presented are for 2006 (or the most recent year available), while financial data are typically averaged over the available period to smooth out the effect of short-term fluctuations. Second, to ensure consistent comparisons across countries, the indicators and analysis were standardized. As a result, some of the indicators presented here may differ slightly from those that are routinely reported and discussed at the country level.

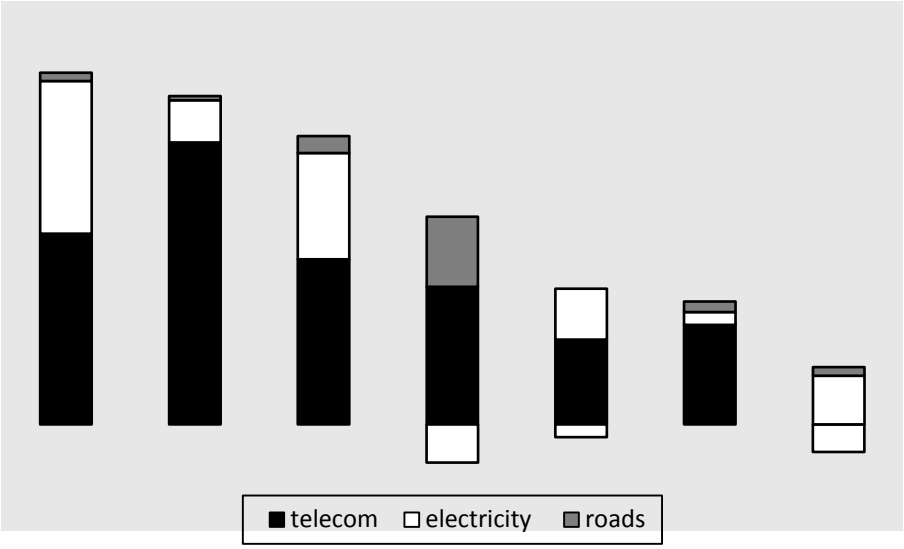
Why infrastructure matters

Most African countries enjoyed increased growth in the 2000s. The overall improvement in per capital growth rates since the 1990s has been estimated at just less than two percentage points, of which 1.1 percent is attributable to better structural policies and 0.9 percent to improved infrastructure. In West Africa, the ICT revolution contributed one percentage point of additional per capita growth, while deficient power and transport infrastructure has held growth back by 0.1 percentage points per year. Although there was not enough data to address the specific growth impact for Liberia, the experience of other post conflict countries—such as Cote d'Ivoire, Democratic Republic of Congo, Rwanda, Sierra Leone, and Sudan—indicates that the infrastructure growth effect also holds in fragile environments (figure 1a).

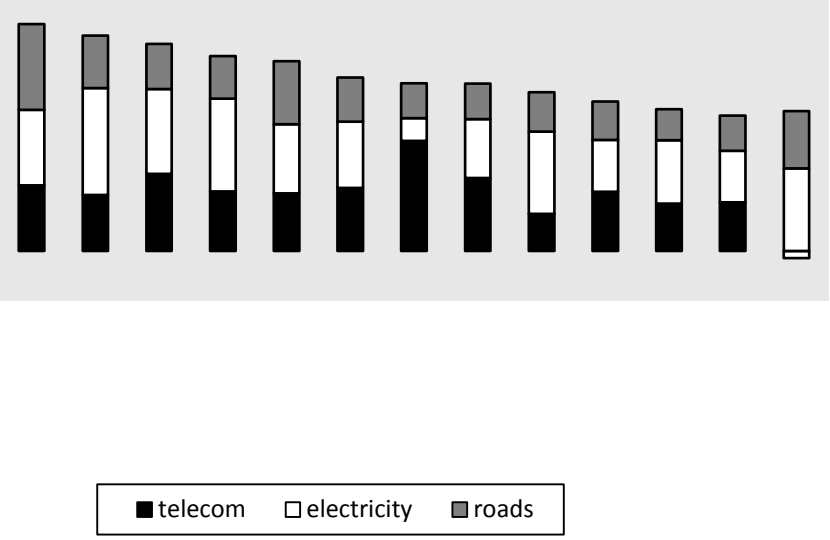
Simulations suggest that if West Africa were to improve infrastructure to the level of the African leader—Mauritius—annual per capita growth rates would increase by 2 to 4 percentage points. About half of this total would be a result of improvements in the power sector, which could contribute as much as 2.5 percentage points to the per capita growth rate (figure 1b). Although lack of data prevented us from performing the simulation for Liberia, the experience of other post-conflict countries illustrated below suggests that a similar effect applies. Overall, evidence from enterprise surveys suggests that infrastructure constraints are responsible for about 40 percent of the productivity handicap faced by African firms (figure 2).

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

a. Infrastructure's contribution to annual per capita economic growth across various subregions of Africa, 2003–07, in percentage points



b. Potential contributions of infrastructure to annual per capita economic growth across various subregions of Africa, in percentage points



Source: Calderon 2009.

The state of Liberia's infrastructure

The spatial distribution of Liberia's economy shows low population density, widespread poverty, and isolated pockets of economic activity (figure 2a and 2b). Mining activities are concentrated in the north and western parts of the country, while the most intensively farmed areas are along the country's central strip and in pockets of the far northwest and southeast (figure 2d).

In terms of infrastructure, Liberia has yet to develop full national backbones of paved roads, power transmission and fiber optic cable (figures 3a-d). As a result, is not yet in a position to connect fully with broader regional networks, although a regional power transmission line linking into Guinea and Sierra Leone is planned as part of the West Africa Power Pool. The main road artery in terms of traffic is the route inland from Monrovia towards the frontier with Guinea and Cote d'Ivoire, plus a relatively short coastal section on either side of Monrovia. Elsewhere on the network, traffic is sparse. Road network condition is quite patchy; many key routes alternate between sections in good, fair, and poor condition, which adversely affects national connectivity (figure 3a). GSM coverage is largely concentrated around Monrovia and to a lesser extent along the central strip inland towards Guinea (figure 3c). Liberia is not connected to the SAT3 submarine cable that skirts the West African coastline, although it has been assured a place in one of the new West Africa cable projects. There are a few pockets of irrigated farmland, most of which lie along the northerly land barrier (figure 3d). Looking ahead, the Freeport of Monrovia has the potential to become a maritime hub for mining traffic from the eastern side of Sierra Leone due to its geographical proximity, while the port of Buchanan could potentially serve iron ore exports from neighboring Guinea.

An important component of Liberia's infrastructure is built and operated by multinational companies that have taken on the national mining, forestry, and agricultural concessions (including rubber and palm

oil plantations). These companies develop their own port, rail, and energy infrastructure, and also operate significant portions of the rural road network. For example, Liberia has three privately operated mineral railways with a total of 2,600 kilometers of line, while the National Transport Strategy estimates that private concessionaires have been responsible for over 2,000 kilometers of the rural road network. The full extent of this privately developed infrastructure is not yet apparent, but it is certain to be quite large in relation to the public networks. Moreover, privately developed infrastructure is set to increase dramatically in the next few years as Liberia negotiates a major new round of concessions, each with major infrastructure requirements attached.

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

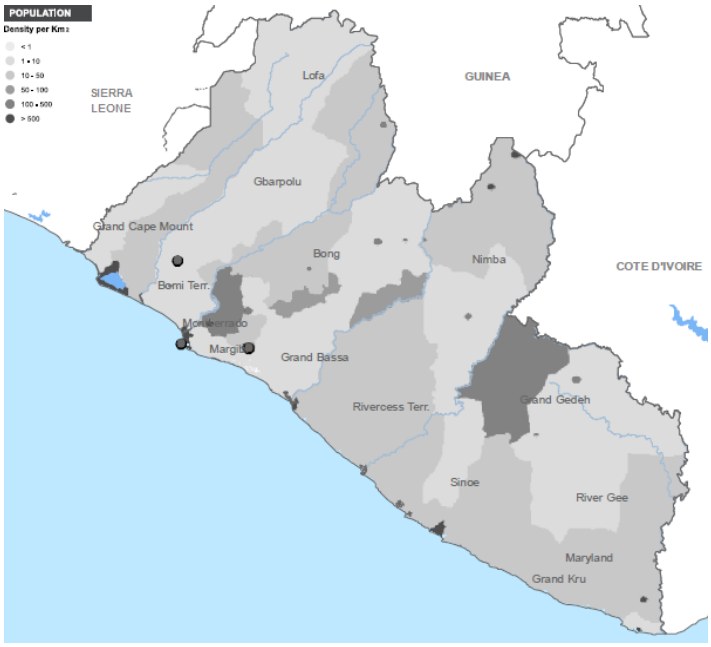
Table 1. Achievements and challenges in Liberia's infrastructure sectors

	Achievements	Challenges
Air transport	Resurgence of air traffic and improving connectivity	Improving air safety and security
ICT	Competitive market with burgeoning mobile penetration and very low prices.	Expanding mobile footprint into rural areas. Introducing high-speed Internet in urban areas via competitive access to the new submarine cable(s).
Ports	Relaunch and solid performance of Freeport of Monrovia.	Upgrading the port to keep pace with traffic growth. Implementing proposed concession arrangements.
Power	Reestablishment of minimal power supply in Monrovia	Expanding generation capacity via lower cost technologies. Interconnecting with the West Africa Power Pool to allow imports of relatively low-cost power. Increasing access to power once costs come down.
Roads	Capture of limited donor finance for road sector reconstruction.	Rehabilitating heavily deteriorated road network. Establishing sustainable funding for road maintenance. Creating institutional capacity for road works.
Water and sanitation	Relatively low reliance on surface water.	Implementing low-cost technologies to increase access to improved water and sanitation. Reducing drastically prevalence of open defecation.

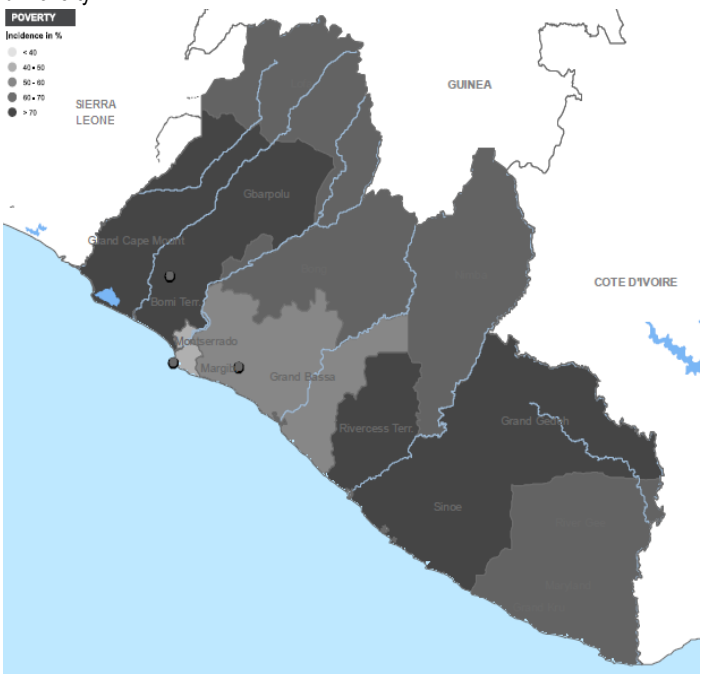
Source: Authors' elaboration based on findings of this report.

Figure 2. Liberia's demography, poverty, topography, and natural resources

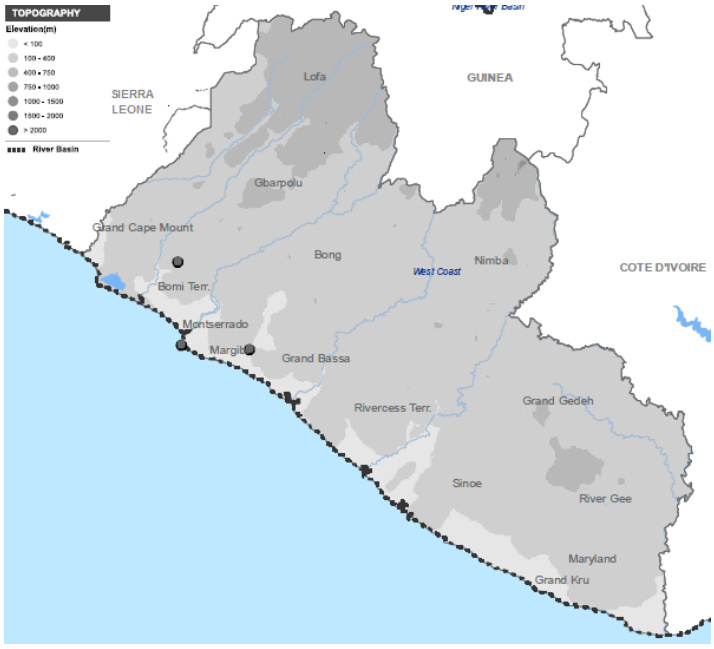
a. Population



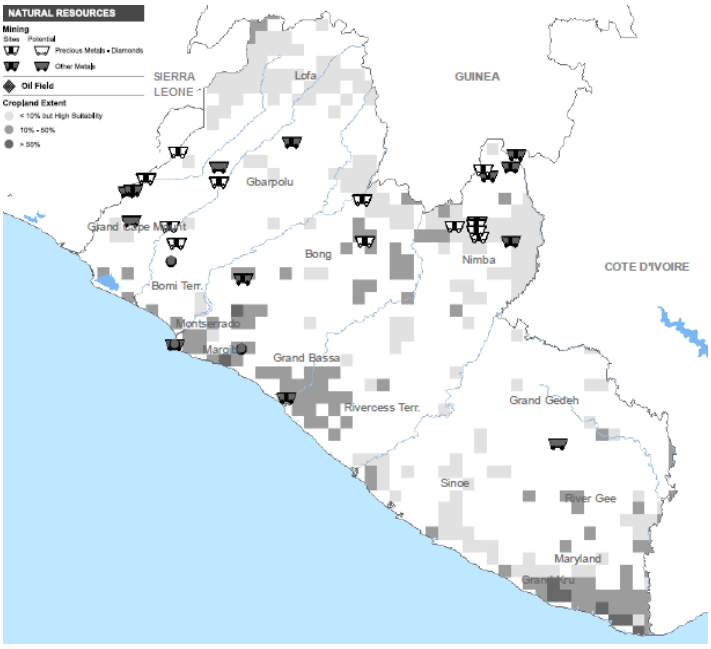
b. Poverty



c. Topography



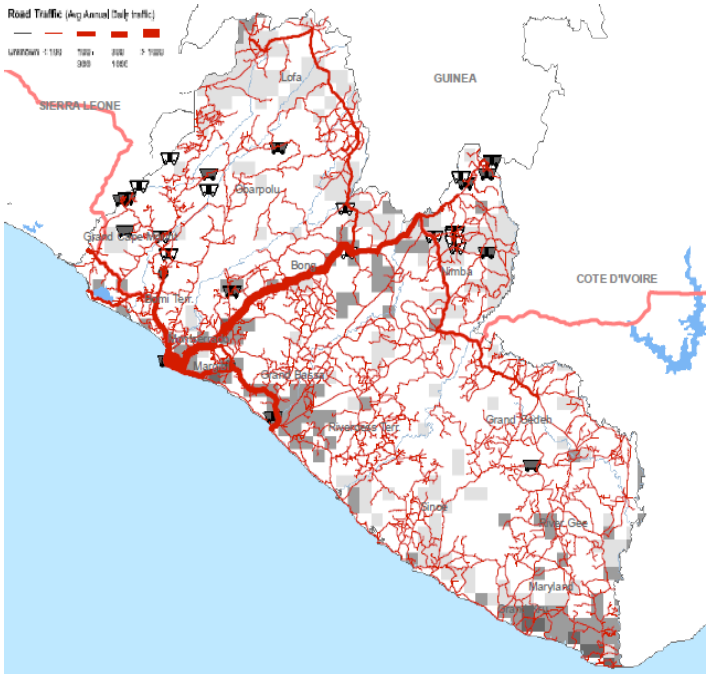
d. Natural resources



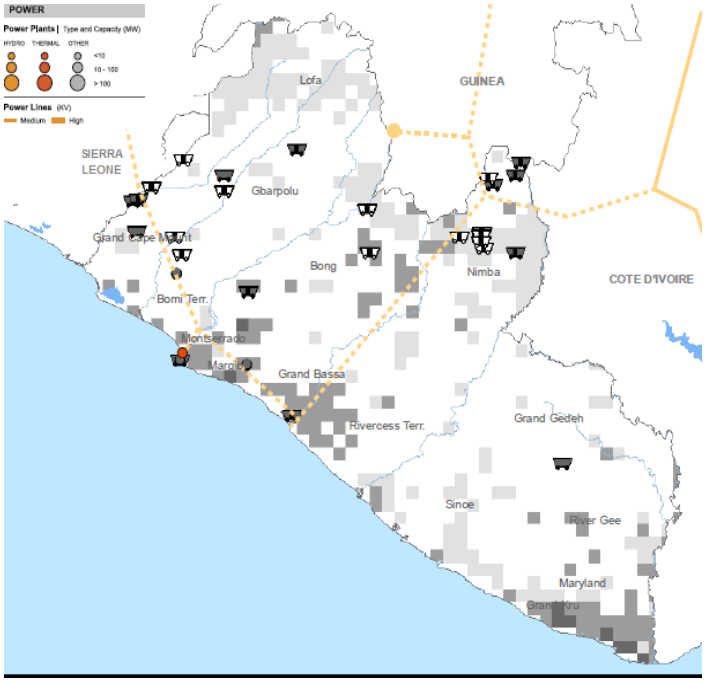
Source: AICD Interactive Infrastructure Atlas for Liberia downloadable from http://www.infrastructureafrica.org/aicd/system/files/lbr_new_ALL.pdf

Figure 3. Liberia has yet to develop national infrastructure backbones

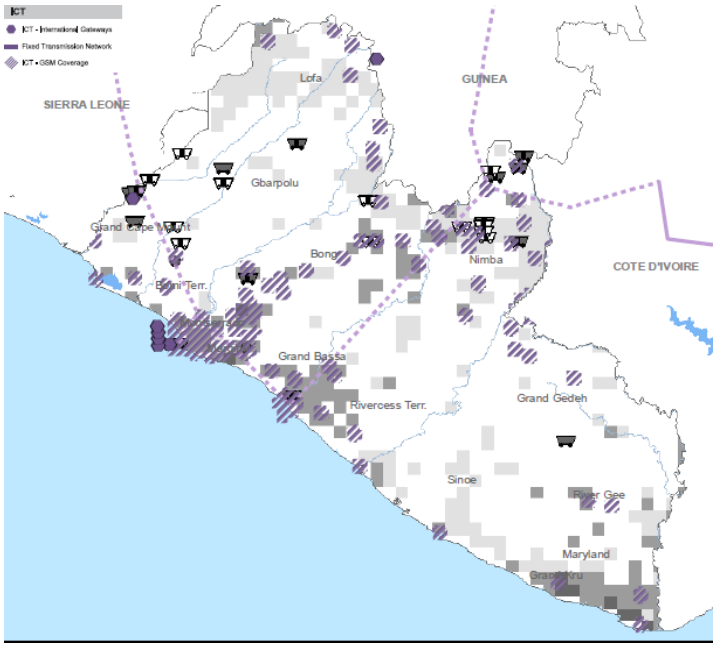
a. Roads



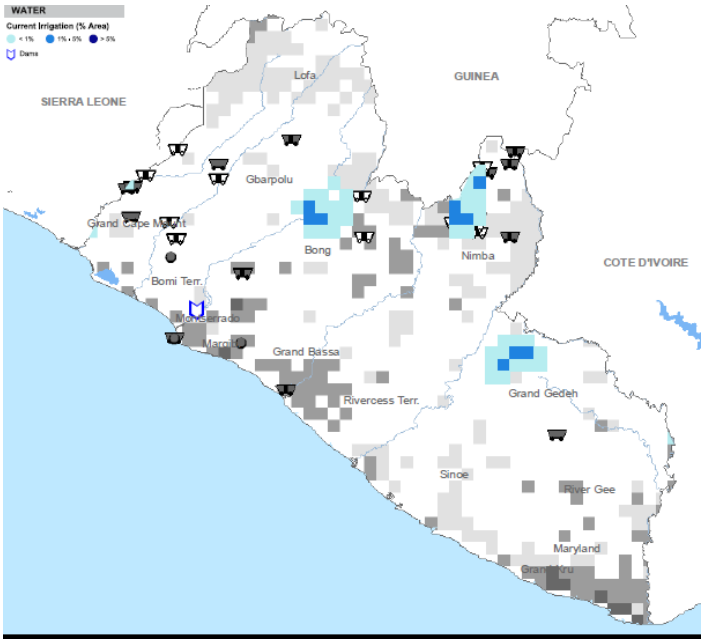
b. Power



c. ICT



d. Water



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

Roads

Achievements

Liberia is in the process of reconstructing its degraded road network. The re-engagement of donors since the mid-2000s has helped to ensure a source of funding for much-needed road reconstruction, and as a result Liberia has been spending around 1.4 percent of GDP on roads per year—one of the higher levels of transport spending in West Africa. The most recent available information suggests that 60 percent of the classified network is now in good or fair condition. This is an improvement on the immediate post-conflict situation but still falls well behind the values of 80 to 86 percent for the two benchmark groups.

Liberia has a relatively low share of paved roads, though its traffic is also rather low. Just under 40 percent of the country's primary road network is paved, compared with 70 to 80 percent for the benchmark groups. Nevertheless, the average traffic flow on Liberia's paved network is around 570 vehicles per day, which is less than half the paved network traffic for the benchmark groups (though this may reflect depressed traffic movements due to the post-conflict situation). While about one third of the main network looks to be over-engineered relative to traffic levels, it is likely that traffic levels in the country are artificially depressed due to the post-conflict situation.

Table 2. Liberia's road indicators benchmarked against African peers

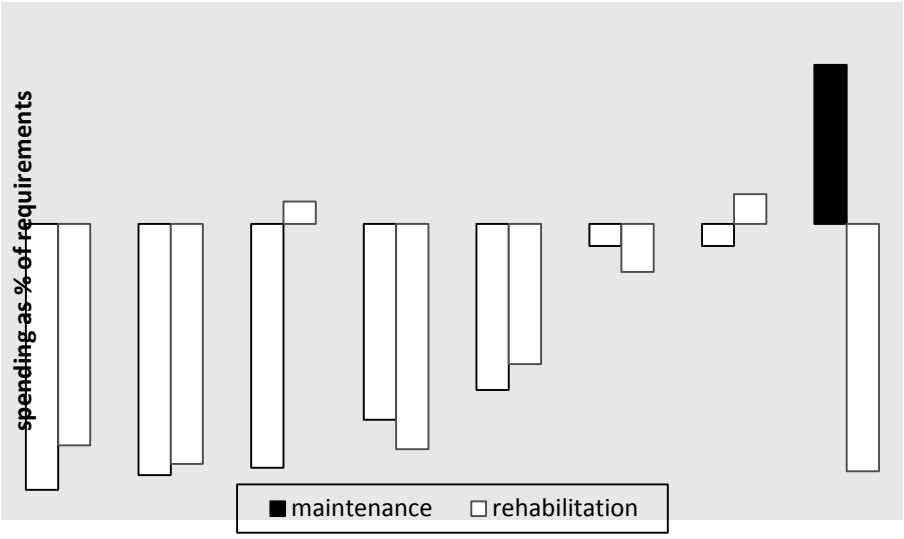
	Unit	Resource rich	**Liberia**	Low-income countries
Classified road density	Kilometers per 1,000 square kilometers of land area	57.1	**101.4**	55.9
Paving ratio	Percentage of primary network paved	82.1	**39.4**	71.6
GIS Rural accessibility	Percentage of rural population within 2 km of an all-season road	19.7	**23.7**	34.1
Paved road traffic	Average annual daily traffic (vehicles per day)	1,408.2	**573.9**	1,287.7
Unpaved road traffic	Average annual daily traffic (vehicles per day)	54.2	**17.1**	38.5
Classified network condition	Percentage in good or fair condition	79.9	**60.0**	86.2
Overengineering	Percentage of main road network over-paved relative to traffic flows	15.0	**32.2**	29.6

Source: Gwilliam and others 2009.
Derived from AICD national database downloadable from http://www.infrastructureafrica.org/aicd/tools/data

Challenges

Current spending on roads still falls short of what is needed, despite recent efforts to increase it. Based on the physical configuration and condition of Liberia's infrastructure network, it is possible to estimate the resources that would be needed to clear the current rehabilitation backlog and maintain the network in good condition. Comparing recent spending against these norms indicates that Liberia still has a substantial shortfall of around 40 percent both in capital spending for rehabilitation and in network maintenance spending (figure 4). This situation is not unusual in West Africa. Nonetheless, some countries—such as Ghana and post-conflict Rwanda—have succeeded in securing adequate resources for road network preservation.

Figure 4. Spending on road maintenance and rehabilitation falls well short of needs



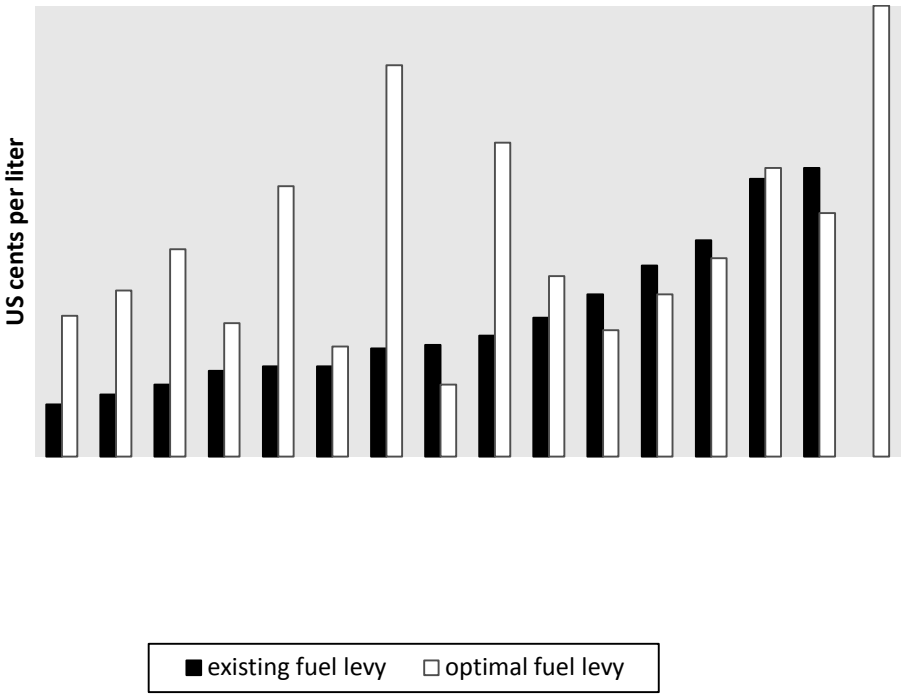
* Analysis of adequacy of road maintenance spending can only be performed for primary network under Federal jurisdiction.
Source: Gwilliam and others, AICD Background Paper No. 14, 2009

To meet its spending needs for road maintenance, Liberia may need to consider a combination of a fuel levy and increased budgetary resources. Most African countries have tried road user charges to secure adequate resources for road maintenance. These are typically channeled through a ring-fenced road fund. Liberia plans to introduce a Road Fund but has not yet implemented road user charges. Based on the estimated road network preservation requirements, it is possible to estimate the level of the fuel levy that would be needed to fully fund maintenance. In the case of Liberia, the estimated optimal fuel levy is $0.25 per liter of fuel, which is rather high. This reflects the fact that Liberia—like other countries such as Congo and Niger—has a large road network relative to the amount of traffic that currently circulates. As a point of reference, the highest fuel levies in Africa to date were around $0.15 per liter in Ethiopia and Tanzania (figure 5). While Liberia definitely needs to introduce road user charging, it may not be possible to levy charges at the level that would be economically needed. The funding of road maintenance may therefore also require the use of budgetary resources. Another interesting aspect of road maintenance is its potential to create employment, particularly when labor intensive methods are utilized

Transport spending needs can be estimated based on the assumption that key economic nodes should be connected. It is estimated that Liberia needs 800 kilometers of road to meet regional connectivity standards (linking Monrovia to the international frontiers), 1,500 kilometers to meet national connectivity standards (linking all provincial capitals to the regional network), and a further 5,700 kilometers to meet rural connectivity standards (linking land responsible for 80 percent of agricultural production value to the national network). In addition, the urban connectivity standard assumes an extension of the paved road network to within 500 meters of the population. Two scenarios are considered. In the base scenario, all infrastructure is maintained in good condition and higher end surfacing options are used (asphalt for all regional, national, and urban roads and single surface treatment for rural roads). In the pragmatic scenario, half the infrastructure is maintained in good condition and half in fair condition, and lower cost

surfacing options are used (single surface treatment for national and urban roads and gravel for rural roads).

Figure 5. Liberia's optimal fuel levy looks relatively high



Source: Gwillliam and others 2009.

Table 3. Liberia's spending needs for regional, national, rural, and urban connectivity

Connectivity	Road length in good condition (km)		Spending needs (US$ millions per year over 10 years)				
	Actual	Required	Improve condition	Upgrade category	Expand capacity	Maintenance	Total
Base scenario							
Regional	149	829	3.5	20.5	0.0	7.3	31.4
National	399	1,479	1.4	25.0	0.0	8.9	35.3
Rural		5,713	11.2	11.5	0.0	11.2	33.9
Urban	350*	4,289	2.8	11.4	63.6	9.9	87.7
Total		12,310	18.9	68.4	63.6	37.3	188.2
Pragmatic scenario							
Regional	149	415	1.2	9.2	0.0	5.9	16.3
National	399	739	0.5	18.7	0.0	8.1	27.3
Rural		7,713	1.3	3.7	0.0	12.7	17.7
Urban	350*	1,716	2.8	9.8	8.2	9.9	30.7
Total		10,583	5.7	41.4	8.2	36.6	92.0

Source: Carruthers and others 2008.
*Refers to kilometers of paved road already in place.

An initial evaluation of connectivity needs suggests that spending of between $90 and $190 million a year for ten years would be required to reach the goals outlined in the pragmatic scenario and the base scenario, respectively (table 3). The largest components of this total are the costs paving of roads associated with improving regional and national connectivity and the cost of expanding the urban paved road network (reported to be very limited at present). Once basic connectivity goals have been reached, an ongoing road sector maintenance budget of around $40 million a year would be required to sustain the network.

Rail

Liberia's railways will be restored and developed by the private sector through mining concessions under open access principles. Liberia has three private mineral railways—Bong, LAMCO, and NIOC. None is fully operational at present, although a third party runs an informal rail service over the Bong railway to collect scrap from the mine. Iron ore concession arrangements will include rehabilitation of these railways (along with new construction) funded by the mining sector. Liberia is enforcing a principle of open third party access to the mining railways to ensure that agriculture and other economic sectors benefit from the re-opening of the railways.

Ports

Achievements

Liberia has taken swift and comprehensive action to improve the situation at the Freeport of Monrovia. These actions include dredging works to allow port access, major port restructuring aimed at raising operational efficiency, and a series of governance reforms to improve the customs process. In addition, Liberia is adopting the landlord ports model and involving private participation in the terminal facilities at Monrovia. The National Ports Authority has been restructured and downsized and will play the role of landlord. This involves progressive withdrawal from front line cargo handling operations. As a result, the workforce has already been substantially downsized to 750 personnel. A concession for container and multipurpose facilities at the Freeport of Monrovia has also been issued. While immediate investment needs have been met, the concessionaire will need to rehabilitate the degraded marginal wharf and expand capacity to keep pace with anticipated traffic growth.

As a result of the changes mentioned above, Monrovia's port performance indicators are now at least on a par with those of neighboring West African ports. Benchmarking Monrovia's performance on a range of standard indicators against other West African ports suggests that performance is fairly typical (table 4). In fact, indicators on vessel waiting and turnaround time suggest that Monrovia may substantially outperform other ports, though this may simply reflect low traffic volumes. Nevertheless, performance does not compare well with global best practice. For example, container dwell time in Monrovia is 15 days, compared with a benchmark of 7 days. Port charges of $200 for a container are also at the upper end of the West African range.

Beyond the Freeport, ports such as Buchanan and Harper have the potential to benefit from foreign investment related to the development of specific commodity streams. For example, the Cavalla Rubber Corporation (CRC) plans to rehabilitate the port of Harper to secure an export platform for its rubber

production. Similarly, Arcelor Mittal has agreed to invest in the port of Buchanan and its associated railway line as part of its plans to expand iron ore production in the country.

Table 4. Benchmarking port indicators: Freeport of Monrovia as compared with selected other ports*

	Freeport of Monrovia Liberia	Cotonou Benin	Abidjan Cote d'Ivoire	Tema Ghana	Apapa Nigeria	Harcourt Nigeria	Dakar Senegal	Lome Togo
CAPACITY:								
Containers handled (TEU/year)	**50,000**	158,201	500,119	420,000	336,308	7,900	331,191	460,000
General cargo handling capacity (tons/year)	**700,000**	2,500,000		8,500,000	5,000,000	2,000,000		
EFFICIENCY:								
Average container dwell time (days)	**15**	12	12	25	42		7	13
Average truck processing time for receipt and delivery of cargo (turnaround time in hours)	**5.5**	6.0	2.5	8.0	6.0		5.0	4.0
Average general cargo vessel pre-berth waiting time (hours)	**3**	48	3	9.6	36	38	24	
Average general cargo vessel stay (turnaround time in hours)	**3**	48	2	48	41	46	60	
Container crane productivity* (containers per hour)			18	13	12			
Average general cargo crane/gang productivity (tonnes per hour)	**16**	15	16	14	9	8		23
TARIFFS:								
Average general cargo handling charge, ship to gate (US$/tonne)	**200**	180	260	168	155		160	220
Average dry bulk handling charge, ship to gate or rail (US$/tonne)	**10.5**	8.5	13.5	10	8	8	15	9
Average liquid bulk handling charge (US$/tonne)	**4**	5	5	3			5	5

* Data for the Freeport of Monrovia relate to 2008, but no data were available for the Port of Buchanan.

Source: Mundy and Penfold, AICD Background Paper No. 8, 2009.

Derived from AICD ports database downloadable from http://www.infrastructureafrica.org/aicd/tools/data

TEU = 20-foot equivalent units.

Challenges

Port security is an issue for Liberia. The National Port Authority's Work Plan for 2008 included obtaining ISPS certification for the port of Monrovia as one of its objectives, but as of mid-2009 this certification had not been obtained. No ports in Liberia possess ISPS certification. In 2005, the port of Monrovia was removed from the US Coast Guard restricted list after the United Nations Mission in Liberia assumed overall responsibility for it. Security remains crude at the ports, although efforts are underway to achieve ISPS compliance at the port of Monrovia.

Air transport

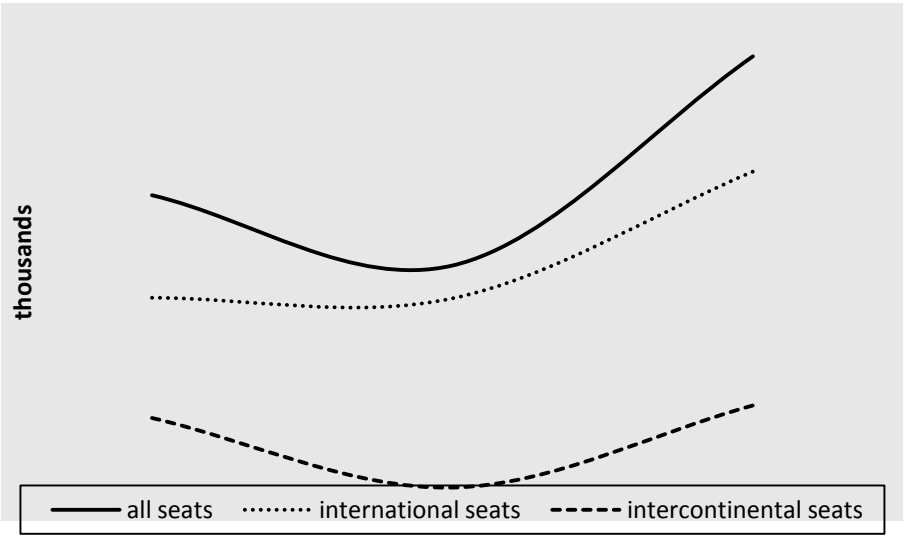
Achievements

Liberia's air transport market is among the smallest in the West African region (table 5). Like other West African nations, Liberia's air transport figures declined substantially between 2001 and 2004 (figure 6a), which reflects the demise of a number of important regional airlines—notably Air Afrique and Ghana Airways. Liberia's air traffic had more than recovered by 2007, however, reaching 160,000 seats. While still a very modest amount of capacity, this represents an increase of 33 percent over 2001 levels. The recovery of seat capacity reflects the entry of new players into the regional air transport market, notably Slok Air and Bellview, which have 33 percent and 21 percent of the market share in Liberia, respectively.

Challenges

Connectivity has not improved to the same extent that capacity has. While the overall volume of seats has risen significantly, the number of city pairs served—nine in total—is no larger than it was in 2001 (figure 6b). There has, however, been a shift in the composition of the city pairs, with fewer intercontinental flights and more intra-African flights. Analysis of connectivity patterns indicates that Liberia's main air connections are with Ghana, to which flights were available almost daily in 2007, and (to a lesser extent) Cote d'Ivoire. Accra is effectively acting as a local hub for Liberia. Strikingly, the percentage of seats flown on large aircraft fell from 89 percent in 2001 to 8 percent in 2007, while the share of seats flown on midsized aircraft grew. The use of smaller planes, such as commuter jets, was not yet widespread as of 2007.

Figure 6. Trends in Liberia's air traffic and connectivity



A troubling trend in Liberia's air transport market is the substantial increase in the share of seats flown in older aircraft. As of 2001, about 52 percent of seats serving the Liberian market were in old aircraft. That figure had climbed to 67 percent by 2007. This is worrisome from a safety perspective. By comparison, only 20 percent of seats are flown on older aircraft for the ECOWAS market as a whole.

Table 5. Liberia's air transport indicators benchmarked against West African neighbors

	Benin	Cote d'Ivoire	Gambia	Ghana	Guinea	Guinea-Bissau	Liberia	Sierra Leone
Total seats (millions)	0.42	1.15	0.25	1.88	0.32	0.07	0.16	0.23
City pairs served	19	23	7	19	8	2	8	8
Percent of seat kilometers flown in older aircraft	7	9	5	3	5	0	67	45
International market Herfindahl index (measure of competition)	0.1	0.1	0.1	0.1	0.2	0.5	0.2	0.2

Source: Gwillliam and others 2009.

Derived from AICD national database downloadable from http://www.infrastructureafrica.org/aicd/tools/data

Water supply and sanitation

The civil conflict in Liberia adversely affected water and sanitation infrastructure in two ways. First, there was direct destruction and disrepair of existing infrastructure, as well as decline of the related institutions. Second, the conflict led to huge shifts of population out of rural areas into the cities and related camps and informal settlements, which put additional strain on urban utilities. The urban growth rate over the period between 1980 and 2000 was 3.8 percent annually. The population of Monrovia alone grew from 0.7 to 1.2 million people during the last decade of the conflict.

Achievements

Relative to benchmark countries Liberia has relatively limited reliance on surface water and a high level of coverage for groundwater. The standardized Demographic and Health Surveys conducted across Africa provide the best basis for making international comparisons (table 5). According to this source, access to private taps and public stand posts in Liberia is just under 3 and 7 percent of the population, respectively, well below what is found in other resource-rich and low-income countries. This appears to be compensated by high access to wells and boreholes, which serve 76 percent of the population, a much higher level than in the peer groups. Less than 15 percent of the population in Liberia is forced to rely on surface water.

Table 5. Benchmarking water and sanitation indicators

	Unit	Resource-rich countries	**Liberia**	Low-income countries
Access to piped water*	% pop	12.0	**2.9**	10.5
Access to stand posts*	% pop	12.6	**6.8**	16.2
Access to wells/boreholes*	% pop	49.0	**76.2**	38.3
Access to surface water*	% pop	23.7	**14.4**	37.4
Access to flush toilets*	% pop	1.6	**13.4**	4.9
Access to improved latrines*	% pop	6.4	**14.9**	9.9
Access to traditional latrines*	% pop	54.8	**15.5**	50.1
Open defecation*	% pop	27.6	**55.8**	40.3
Domestic water consumption	liter/capita/day	90.3	**55.7**	95.7
Revenue collection	% sales	69.7	**75.0**	92.7
Distribution losses	% production	43.6	**28.8**	34.3

Operating cost recovery	% total costs	55.6	**100**	110
Connections per employee	number	95.7	**195.5**	158.6
Total hidden costs as % of revenue	%	286.7	**102.7**	121.4

U.S. cents per m3	**Liberia**	Scarce water resources	Other developing regions
Residential tariff (at 10 m3)	**44.5**	60.3	3.0 – 60.0
Non-residential tariff (at 100 m3)	**221.3**	120.7	

*Access data for Liberia is taken from the Demographic and Health Survey 2007 to ensure comparability with the benchmarks. More recent data and comprehensive data exist from the 2008 National Census.

** Utility data are taken from the AICD utility database for 2005. The year 2005 is used to ensure consistency across countries benchmarked.

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

According to the 2010 Joint Monitoring Program (JMP), access to improved water sources increased from 58 percent in 1990 to 68 percent in 2008 (table 6). Over the same period, however, access to piped water fell from 11 percent to 2 percent. The resulting shortfall was met by an expansion in intermediate options, such as stand posts and boreholes, although the exact mix of this expansion is hard to determine from the survey evidence.

Challenges

The JMP reports that access to improved sanitation in Liberia rose from 11 percent in 1990 to 17 percent in 2008. Over the same period, however, open defecation increased from 44 to 47 percent (table 6). The availability of unimproved facilities, such as traditional latrines, seems to have fallen significantly.

Table 6. Long-term trends in access to improved water and sanitation

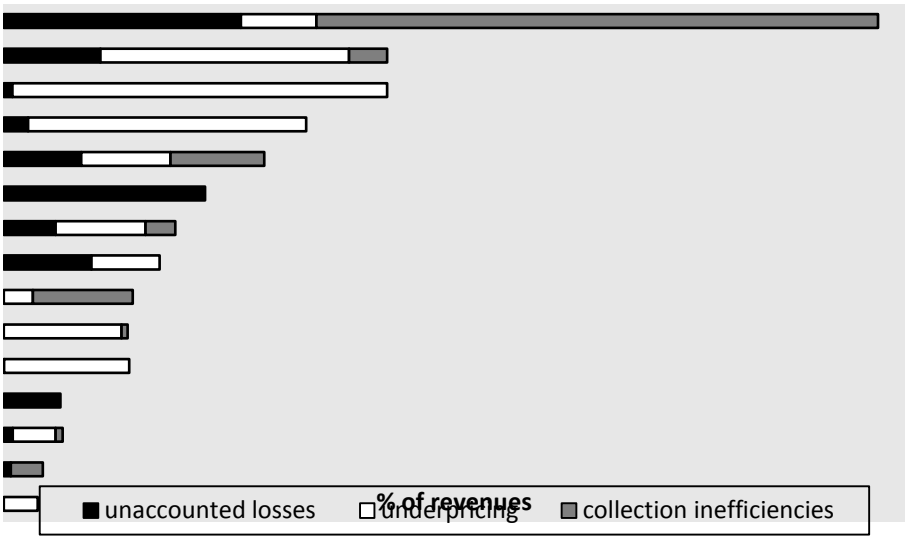
	Joint Monitoring Program		
	1990	2000	2008
Water			
Total improved	58	65	68
Piped on premises	11	7	2
Other improved	47	58	66
Unimproved	42	35	32
Sanitation			
Improved	11	14	17
Shared facilities (unimproved)	16	18	20
Unimproved facilities	27	22	14
Open defecation	44	46	47

Source: UNICEF-WHO Joint Monitoring Program 2010.

In addition to problems of access in the country, deficiencies in the operation of the water utility have led to significant hidden costs. In particular, the revenue collection ratio stood at 63 percent in 2005, but had improved to 75 percent in 2006, the last year for which data was available. This is still substantially below the benchmarks of 90 to 100 percent. Distribution losses, though far from best practice, are comparable to the benchmarks. There is also evidence of significant over-manning, with only 61

connections per employee, which is only a third of the value for the peer group. Water tariffs appear to cover operating costs, but do not make any allowance for capital costs. Overall, the financial value of these inefficiencies adds up to 124 percent of utility revenues, meaning that the utility loses about as much money as it collects. This level of inefficiency is quite typical of water utilities in neighboring countries and is somewhat better than the performance in some other post-conflict countries, such as Democratic Republic of Congo and Rwanda (figure 7).

Figure 7. Benchmarking hidden costs of water utility inefficiencies



Liberia is not currently on track to meet the MDG targets. Reaching the MDG targets would require sustained increased levels of spending on the water and sanitation sector (table 7). Under the assumption that Liberia keeps its existing mix of water and sanitation technologies, the cost of meeting the target would be around $120 million per year for a decade.

Table 7. Liberia's spending needs to reach Water and Sanitation MDGs

	Capital expenditure, of which:				
	Expansion	Rehabilitation	Total	O&M	Total
Base scenario					
Water	33.6	18.2	51.7	22.7	74.4
Sanitation	23.6	6.6	30.1	17.1	47.2
Total	57.1	24.7	81.8	39.8	121.6
Pragmatic scenario					
Water	10.5	18.2	28.6	16.3	45.0
Sanitation	16.2	6.6	22.7	9.7	32.4
Total	26.6	24.7	51.4	26.0	77.4

Source: Banerjee and others 2010.

If services are instead expanded exclusively using lower end technologies, such as stand posts and improved latrines, costs could be as low as $80 million annually. In either case, spending of $25 million a year would be required to redress the rehabilitation backlog, which is mainly in the water sector. Ongoing operations and maintenance requirements are around $30 million a year.

Power

During the Liberia's recent civil conflict period, the country's key generation, transmission, and distribution assets were almost entirely looted or destroyed. Prior to the conflict, Liberia's installed generation capacity was relatively high at 67 megawatts per million of people. Today the country runs on a single new small diesel plant of 9.6 megawatts. This level of power generation capacity amounts to less than 3 mega-watts per million people—barely a tenth of what is found in neighboring countries. Moreover, access to utility power is close to zero, even in the capital city where only 0.1 percent of households are connected. Due to some prevalence of household generators, the 2007 Demographic and Health Survey reports that 3 percent of households have access to electricity. Liberia's mining and natural resource concessionaires have significant isolated generation capacity of their own, although the exact amount is not known.

Table 8. Benchmarking power indicators

	Unit	Resource-rich countries	**Liberia**	Low-income countries
Installed power generation capacity	MW/mil. people	43.2	**2.7**	20.2
Power consumption	kWH/capita	205.7	**87.0**	107.4
Power outages	day/year	14.5	**12.7**	10.4
Firms' reliance on own generator	% consumption	44.9	**97.1**	21.2
Firms' value lost due to power outages	% sales	7.0	**2.9**	6.5
Access to electricity (from utility)	% population	46.1	**0.0**	15.0
Urban access to electricity	% population	79.4	**0.0**	57.6
Rural access to electricity	% population	28.0	**0.0**	3.9
Growth in access to electricity	% population/year	2.4		0.8
Revenue collection	% billings	81.1	**93.0**	93.1
Distribution losses	% production	25.8	**24.8**	23.7
Cost recovery	% total cost	53.9	**55.8**	84.4
Total hidden costs	% of revenue	168.3	**158.0**	68.8

U.S. cents	**Liberia**	Predominantly thermal generation	Other developing regions
Power tariff (residential at 75 kWh)	**43.0**	14.5	5 – 10
Power tariff (commercial at 900 kWh)	**43.0**	18.8	5 – 10
Power tariff (industrial at 50,000 kWh)	**43.0**	14.2	

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

Achievements

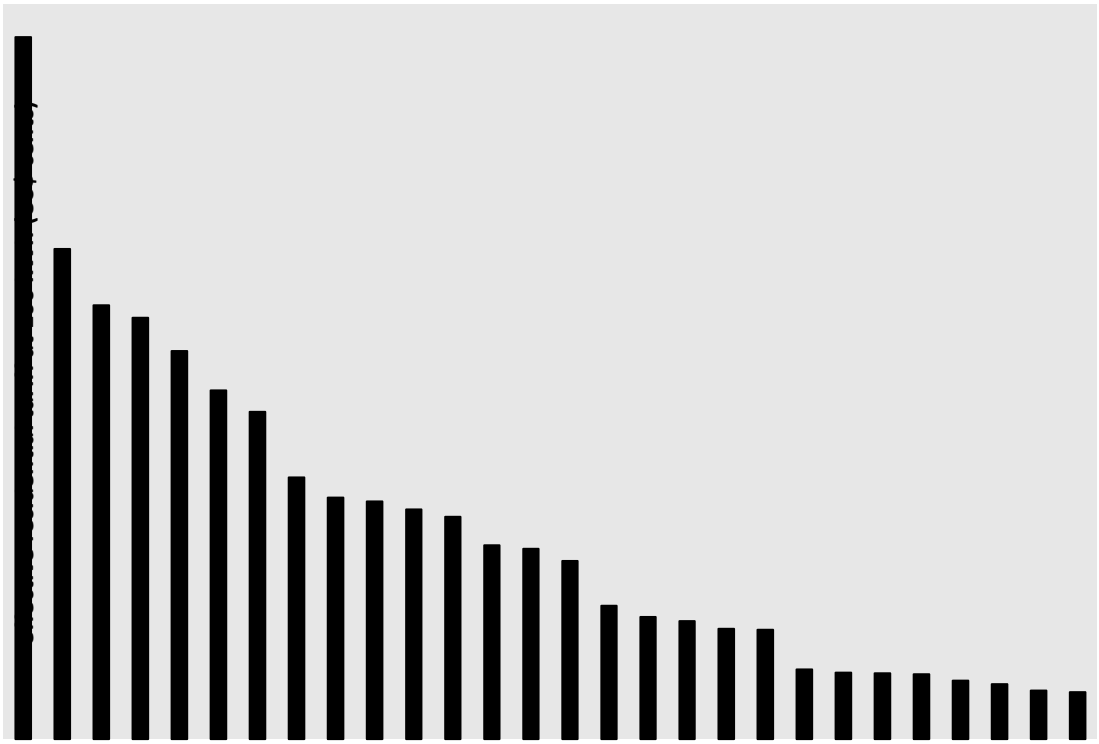
Despite high tariffs, revenue collection ratios for Liberia's power utility are very high at 93 percent (table 8). This can largely be attributed to the practice of charging for power up front, one month ahead of actual consumption. By comparison, the utility only collected 50 percent of billed revenues prior to the war. The power utility also seems to be performing relatively well in terms of distribution losses. System

losses are reported to be close to 25 percent, well below benchmark levels. The very limited physical extension of the distribution network undoubtedly helps to minimize losses.

Challenges

Power tariffs in Liberia are probably the highest in Africa at $0.43 per kilowatt-hour. This is about three times the average power tariff in Sub-Saharan Africa of around $0.14 per kilowatt-hour, and about six times higher than typical power tariffs elsewhere in the developing world of around $0.07 per kilowatt-hour. Chad has the second highest power tariffs in Africa at $0.30 per kilowatt-hour (figure 8).

Figure 8 Liberia's power tariffs are the highest in Africa (average effective tariff)



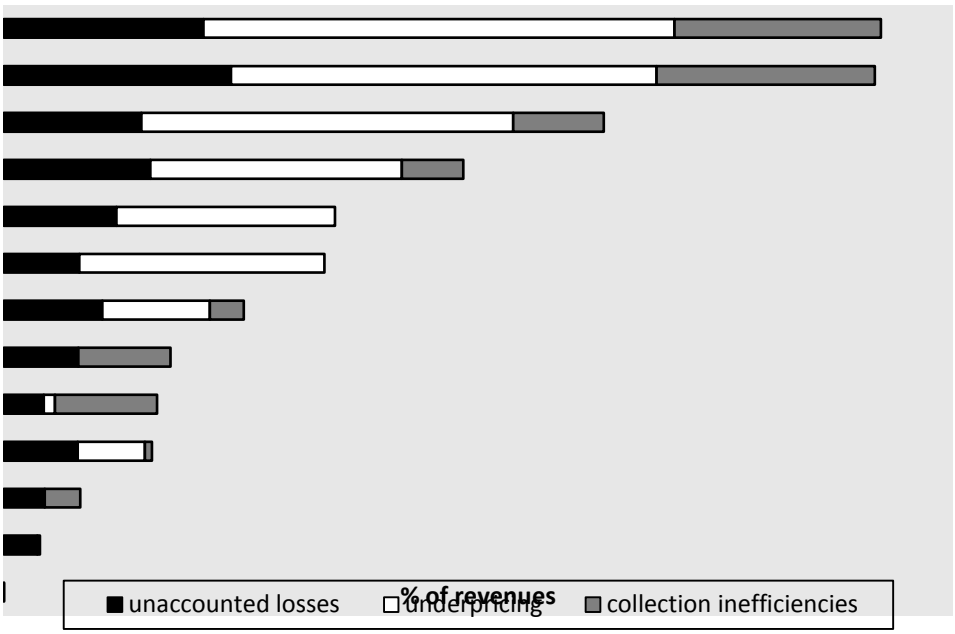
Source: Derived from Eberhard and others 2009.

Although power tariffs in Liberia are very high, they are still substantially lower than the true cost of producing power. The exceptionally high cost of generating power in Liberia is a result of several factors, including very small scale of production, the high cost of importing diesel, and the destruction of facilities for the import of more cost-effective heavy fuel oil (HFO). As a result, the true cost of generating power for Liberia's public grid stands today at around $0.77 per kilowatt-hour, of which $0.63 per kilowatt-hour relates to operating costs alone. Therefore, power tariffs are in fact being subsidized. There is a capital subsidy provided by donors who grant funded the installation of the diesel plant, and an operating subsidy from government, which covers the $0.20 per kilowatt-hour difference between the tariff and the operating costs.

When operational efficiencies and under-pricing are taken into account, Liberia's power utility generates hidden costs equivalent to 158 percent of revenues. This is relatively high compared to the performance of neighboring countries in Africa (figure 9).

Figure 9. Liberia's power sector performs relatively well on hidden costs

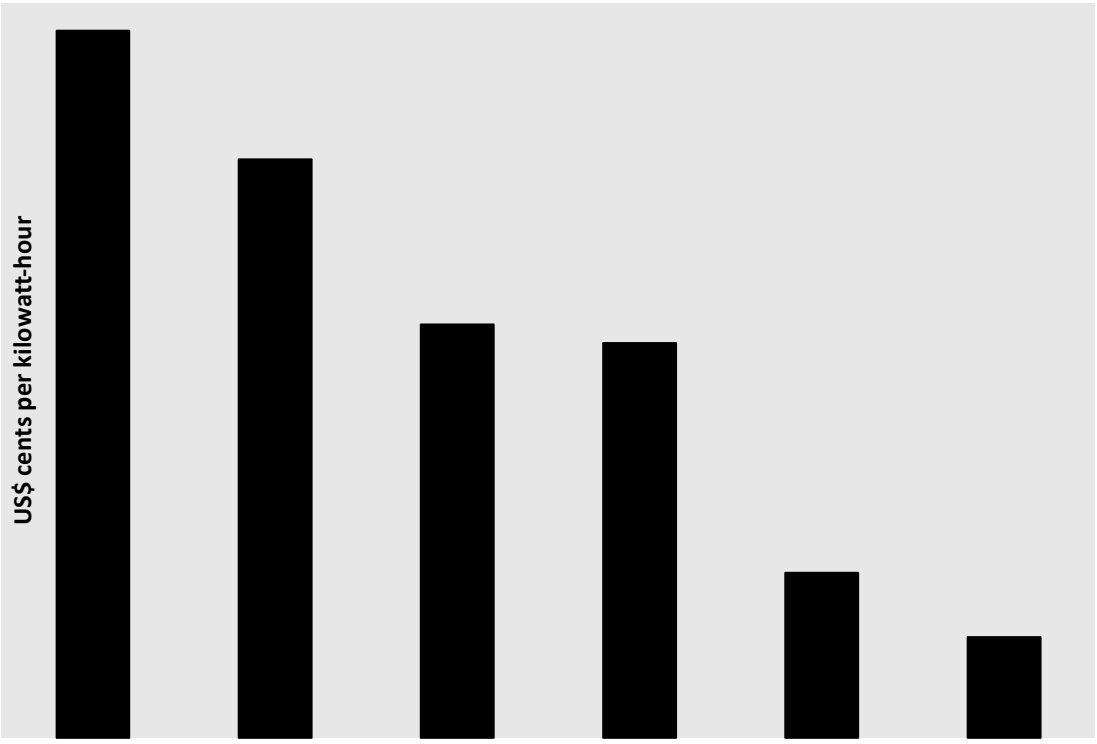
Hidden costs of power utilities in selected countries



Source: Eberhard and others 2009.

In the medium term, reducing the cost of producing power in Liberia is a key strategic objective. The country has a number of power options that are much more cost-effective, including biomass generation at around $0.20-0.25 per kilowatt-hour, heavy fuel oil at around $0.15-20 per kilowatt-hour, hydropower at around $0.10-0.20 per kilowatt-hour, and power imports at around $0.10-0.15 per kilowatt-hour. (Hydropower resources in Liberia are relatively costly to develop compared to other hydropower resources in Africa. This is due to highly seasonal flows and relatively flat terrain, which complicate the development of reservoirs and necessitate significant thermal back-up generation.) Given the available options, the cost of producing power in Liberia is likely to fall substantially over time towards $0.15 per kilowatt-hour, or even lower if trade is fully exploited (figure 10). Making the necessary investments to bring additional cost-effective sources of power on stream is a pressing matter for the country.

Figure 10: Comparison of Liberia's power tariffs against various cost benchmarks



Source: Derived from Eberhard and others 2009.

Imported power is an attractive option in the medium term for Liberia, but it will require development of the transmission network to link with Cote d'Ivoire and Guinea. Cote d'Ivoire is the largest power exporter in the West Africa Power Pool today, supplying Burkina Faso and Guinea with 1.8 terrawatt-hours, which is much more than Liberia's total estimated grid demand in 2020 of 1.2 terrawatt-hours. Furthermore, Cote d'Ivoire fully honored its power export contracts during the recent crisis period, and it has therefore earned a reputation as a reliable supplier. Cote d'Ivoire has a very strong track record of harnessing independent power projects to privately finance new gas-fired plant in a relatively short period and is starting a new round of investment in power generation. Exploratory discussions with Cote d'Ivoire could therefore help Liberia to identify feasible trading possibilities. In the long term, Liberia could also import power from Guinea, which has abundant low cost hydropower and an export potential of 17.4 terrawatt-hours. Currently, however, Guinea must overcome many technical, financial, and political obstacles if it is to fully realize its power export potential.

In addition to importing power from neighboring countries, Liberia may be able to integrate major planned power generation investments by the mining sector into national power development plans. It is estimated that over the next 30 years, Liberia's mining concessions will require 840 megawatts of power generation capacity, for which they will provide financing. Plans are already underway for private development of the first few hundred megawatts. Both the country and the concessionaires may benefit from coordinating these investments so as to obtain higher economies of scale and create surplus capacity for public supply. To do so it will be necessary to have a clearer picture of the power generation plans of

the mining concessions, examine how these relate to each other and to key power generation sites in the country, and to consider the implications for a future national power grid.

Until Liberia finds ways to substantially decrease power costs, it will not be feasible to accelerate the electrification process. Household access to power in Liberia is extremely low. Yet at today's prices and costs, even if power were widely available, it would be unaffordable to the vast majority of the population. Even a very modest household consumption of 25 kilowatt-hours per month (barely enough to power a couple of light bulbs and a small radio) at today's prices would cost around $11, which is equivalent to 7 percent of the monthly budget of a typical family of five living on one dollar per capita per day. Once power costs fall below $0.20 per kilowatt-hour, the service starts to look much more affordable and a significant push on electrification could take place.

Public demand for electricity in Liberia (excluding the demand of the mining sector, which will be self-funded) is expected to climb to between 140 and 280 megawatts over the next decade. Meeting this demand is estimated to require spending of between $120 and $240 million per year over the next decade (table 9). About $40 million is associated with transmission and distribution and the balance with generation. About one-third of the total relates to operations and maintenance alone and the balance to investment. These estimates are based on the assumption that availability of power imports is limited to 40 megawatts of capacity. If additional import capacity is secured, costs could be further reduced.

Table 9. Liberia's spending needs to meet estimated power demand for public supply in 2020

	Generation	Transmission & distribution	Total
Low Case: 140MW			
Investment	48	37	85
Operations & maintenance	31	5	36
Total	79	43	122
High Case: 280 MW			
Investment	121	37	159
Operations & maintenance	80	5	85
Total	201	43	243

Source: Generation estimates taken from World Bank Liberia Energy Sector Policy Note, 2010, and transmission and distribution estimates taken from Vennemo and Rosnes 2008.

Information and communication technologies

Like other infrastructure sectors in the country, Liberia's fixed-line telephone network was almost entirely destroyed during the conflict period. As of today, fixed-line telephone penetration is estimated to be less than 0.1 percent, or one-hundredth of the levels typically found in the peer group. In contrast to other infrastructure sectors, however, technological developments during the same period have allowed Liberia to rapidly rollout a modern wireless telecommunications system.

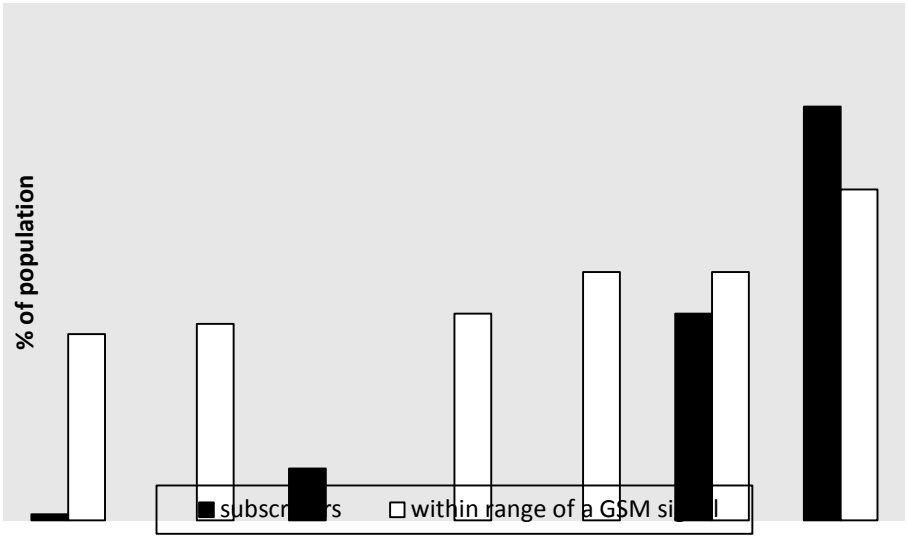
Achievements

Liberia has developed a dynamic and competitive mobile sector. The country has already licensed four mobile operators and has a highly competitive market. The first licensee, Lonestar, still holds 40

percent of the market. Two other operators each hold over a quarter of the market, however, so that the overall market concentration is quite good with a Herfindahl index of 0.31.

Liberia's mobile footprint (the percentage of the population living within range of a mobile signal and hence able to subscribe to service) grew substantially between 2003 and 2009, from 18 percent to 32 percent. At the start of the period, there were many more potential subscribers than actual subscribers, with penetration rates of less than 0.1 percent in 2003 (figure 11). This shortfall took some time to bridge, but by 2008 penetration rates were around 20 percent and had almost caught up to the mobile footprint. The latest figures for 2009 suggest that penetration has exceeded the population within the signal area. This is possible if individuals subscribe to more than one service, which is not unusual in Africa. The evidence based on industry statistics is corroborated by Liberia's 2007 Demographic and Health Survey, which found that 29 percent of households had a mobile telephone—a coverage level many times higher than the electrification rate for the country. In fact, Liberia's mobile penetration rates are now on par with other low-income countries in Africa (table 10).

Figure 11. Liberia's mobile footprint has grown steadily while penetration has burgeoned



Source: Mayer and others 2008.

While no official statistics on mobile prices could be found for Liberia, there is evidence to suggest that prices have fallen over time. The cost of a SIM card, for example, is reported to have fallen from $65-85 in 2001 to $3-5 at present. The average revenue per user (ARPU) for the main operator fell from $43 per month in 2003 to $11 per month by late 2009. This is in line with trends elsewhere in Sub-Saharan Africa. Falling prices following entry of new operators may account for the increase in penetration rates described above (figure 11). Between 2003 and 2004, three new mobile operators were licensed, and it is in the two to three years that followed that penetration really accelerated.

Table 10. Benchmarking ICT indicators

	Unit	Resource-rich countries	**Liberia**	Low-income countries
GSM coverage	% population	66.9	**32.0**	42.4
International bandwidth	Mbps/capita	4.1	**0.1**	3.0
Internet	subscribers/100 people	0.1	**1.0**	0.1
Landline	subscribers/100 people	19.3	**0.1**	7.5
Mobile phone	subscribers/100 people	11.4	**34.0**	6.4

	Liberia*	Countries without access to submarine cables	Other developing regions
Price of monthly mobile basket	**5.21**	11.12	9.9
Price of monthly fixed-line basket		13.58	—
Price of 20-hour Internet package	**140.00**	67.95	11.0
Price of a 3-minute call to the United States		2.59	2.0
Price of inter-Africa calls, mean		0.72	n.a.

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

Challenges

Liberia is not currently connected to the SAT3 submarine cable that skirts the coast of West Africa or to the backbone networks of neighboring countries with submarine cable access. As a result, internet access is only available through small scale VSAT systems. Service costs $140 per month, which is about double the average for other African countries lacking access to a submarine cable. Compared to other developing regions, the cost is about ten times as high.

Given the imminent arrival of several new submarine cables along the West African coast, Liberia is likely to develop a connection in the near future and is considering various options. The experience of other African countries suggests that achieving cable access can substantially reduce the costs of internet and international connectivity. Nevertheless, the extent to which these cost savings are passed on to consumers depends critically on the regulatory environment. In other words, countries that preserve a monopoly on access to the international gateway will experience a more modest price reduction than those that ensure competition between multiple international gateway providers.

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

US$	**Percent of cases**	**Call within region**	**Call to U.S.**	**Internet dial-up**	**Internet ADSL**
Without submarine cable	67	1.34	0.86	68	283
With submarine cable	33	0.57	0.48	47	111
monopoly on international gateway	16	0.70	0.72	47	120
competitive international gateway	16	0.48	0.23	47	98

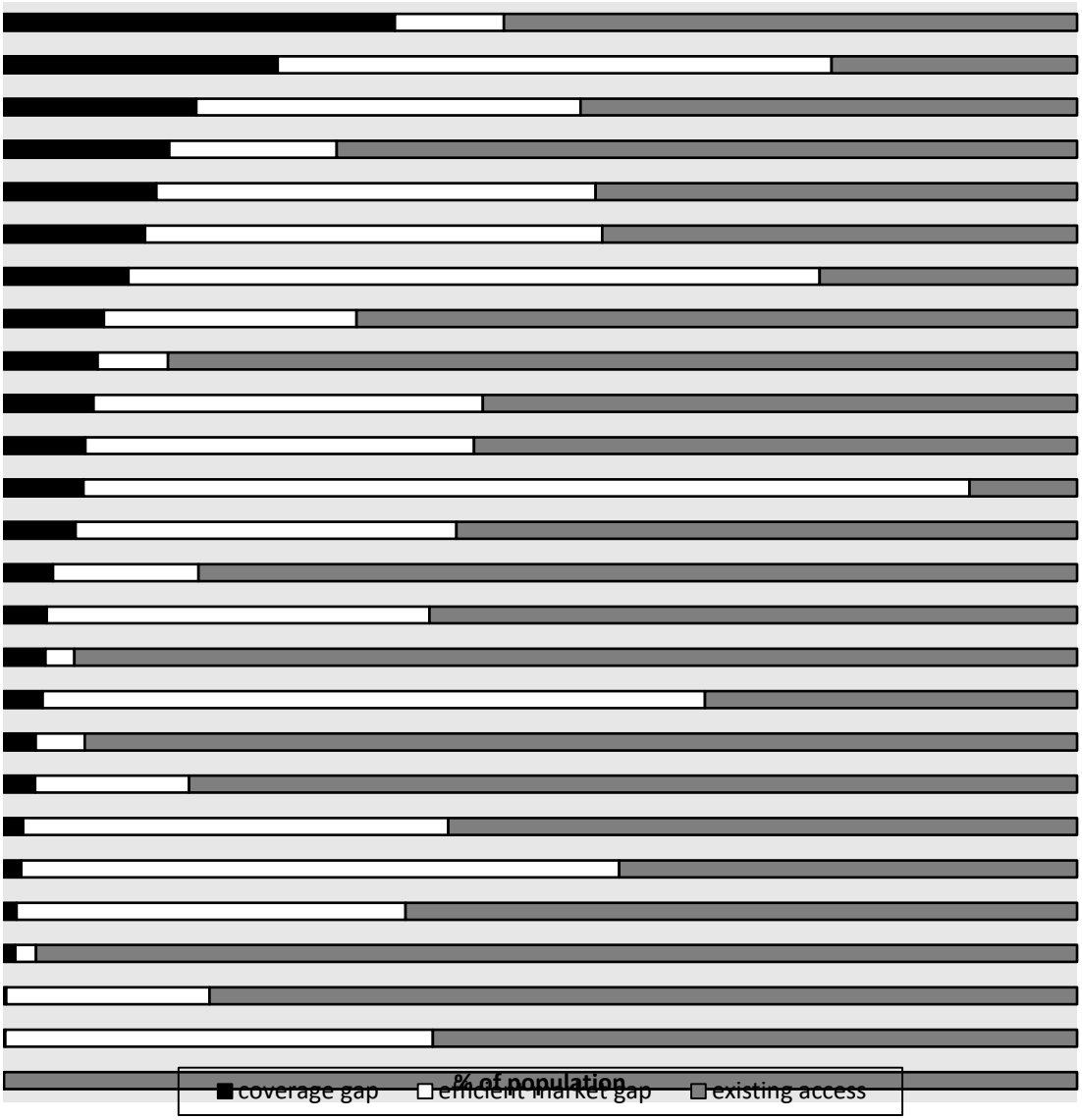
Source: Minges and others 2009.

By the end of 2009, an estimated 32 percent of the population in Liberia will be within reach of a GSM signal. While this represents a great improvement over the recent past, it still falls well short of the GSM footprint found elsewhere in the region. Across Sub-Saharan Africa more than 60 percent of the

population now lives within range of a GSM signal. Simulations undertaken for the AICD study indicate if all regulatory barriers to entry to the mobile market are removed, GSM coverage could be extended to 60 percent of Liberia's population on a commercially viable basis. At the same time, providing coverage to the remaining 40 percent of the population would require some degree of public subsidy. This coverage gap for Liberia is the highest in Sub-Saharan Africa; most countries could reach 90–95 percent of their populations on a commercially viable basis, and a few (such as Kenya, Malawi, and Uganda) have already done so (figure 12). Bridging this gap would require the government to entice operators to service unprofitable areas by providing capital and operating subsidies totaling approximately $11 million per year for a decade.

Extending limited performance wireless broadband access to the entire population via public access facilities will also require substantial public support. Once Monrovia is connected to the submarine cable, more cost-effective broadband access will become available in the country. However, the issue still remains of how to expand this access to secondary cities or rural areas. A second set of simulations therefore explores the possibility of using limited performance wireless technology to provide broadband to a limited number of institutional connections (such as municipalities and companies) as well as public access facilities (such as telecenters). This type of technology does not provide the same speed as a national fiber optic backbone, but may be serviceable for some areas. About one-third of Liberia's population could be reached with such services on a commercially viable basis, but the remaining two-thirds could only be reached with public subsidy to cover capital and some operating costs. The associated subsidy is estimated to be approximately $8 million per year for a decade.

Figure 12. Liberia could further expand GSM coverage on a commercial basis



Source: Mayer and others 2008.

Financing Liberia's infrastructure

To meet its most pressing infrastructure needs and catch up with developing countries in other parts of the world, Liberia needs to expand its infrastructure assets in key areas (table 12). The targets outlined below are purely illustrative, but they represent a level of aspiration that is not unreasonable. They are standardized to allow for cross-country comparisons of the affordability of meeting them and can be modified or delayed as needed to achieve financial balance.

Table 12. Illustrative investment targets for infrastructure in Liberia

	Economic target	Social target
ICT	Install fiber optic links to neighboring capitals and submarine cable	Provide universal access to GSM signal and public broadband facilities
Irrigation	Develop additional 221 hectares of economically viable small scale irrigation	n.a.
Power	Develop 258 MW inter-connectors (no-trade scenario). Could be replaced under trade expansion with 369 MW of generation capacity.	Raise electrification to 66 percent (100 percent urban and 6 percent rural)
Transport	Achieve regional (national) connectivity with good quality 2-lane (1-lane) paved road.	Provide rural road access to 66 percent of the highest-value agricultural land, and urban road access within 500 meters
WSS	n.a.	Achieve Millennium Development Goals, clear sector rehabilitation backlog

Sources: Mayer and other 2009; Rosnes and Vennemo 2009; Carruthers and others 2009; You and others 2009.
n.a. = not applicable.

Meeting these illustrative infrastructure targets for Liberia would cost between $615 to $345 million per year through 2015, depending on the standards applied. Capital expenditure would account for 80 percent of this requirement. Power and transport each account for about one-third of the total (table 10). The pragmatic scenario—based on lower standards for meeting similar infrastructure targets—costs almost half as much as the base scenario, which highlights the importance of careful consideration about which standards to adopt.

Table 13. Indicative infrastructure spending needs in Liberia for 2006 to 2015

US$ million per year

Sector	Capital expenditure	Operations and maintenance	Total needs
Base scenario			
ICT	31	14	45
Power	233	18	251
Transport	157	40	198
Water supply and sanitation	82	40	122
Total	503	112	615
Pragmatic scenario			
ICT	31	14	45
Power	79	43	122
Transport	61	39	100
Water supply and sanitation	51	26	77
Total	222	122	344

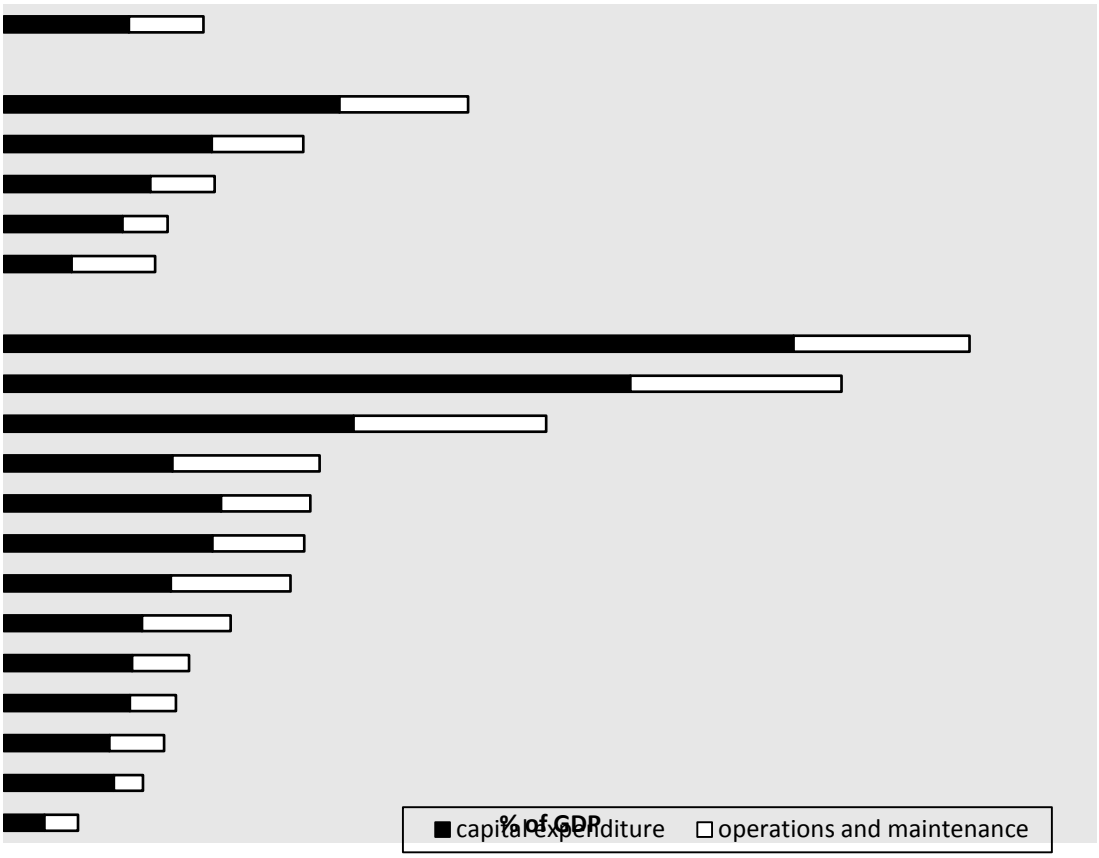
Sources: Mayer and other 2009; Rosnes and Vennemo 2009; Carruthers and others 2009; You and others 2009. Derived from models that are available on-line at http://www.infrastructureafrica.org/aicd/tools/models.

Liberia's infrastructure spending needs are high relative to the size of its economy —a staggering 70 percent of GDP under the base scenario and 40 percent under the pragmatic scenario (figure 13). This is much higher than any other country in West Africa and exceeds the 20 percent of GDP spent by China

during the mid-2000s. The only other country in Africa that has a comparable burden of infrastructure spending is Democratic Republic of Congo with needs estimated at around 60 percent of GDP.

Figure 13. Liberia's infrastructure spending needs are greater than those of comparable countries

Estimated infrastructure spending needed to meet targets, as percentage of GDP



Source: Foster and Briceño-Garmendia 2009.
ECOWAS = Economic Community of West African States.

Between 2004 and 2008, Liberia spent an average of $90 million per year to meet its infrastructure needs (table 14). About 80 percent of that total was allocated to capital expenditure and the remaining 20 percent to operating expenditures. Operating expenditure is entirely covered by budgetary resources and payments from infrastructure users. The largest source of funding for infrastructure investment is overseas development assistance (ODA), which has averaged $44 million in recent years after a long period of inactivity (figure 15). After ODA, the second largest source of investment finance has been the private sector, which has invested $17 million a year in telecommunications. Domestically-funded public investment is very low. Almost half of total spending has been allocated to the transport sector.

Compared to other Africa countries, Liberia spends a relatively high amount on infrastructure—around 10 percent of its GDP on infrastructure, which is equivalent to $40 per capita per year (figure 14). That total is much higher than what is observed in a number of other post-conflict countries; for example, Democratic Republic of Congo spends little more than 2 percent of GDP, and Rwanda spends just over 6

percent of GDP. Furthermore, investment occupies a higher share of total infrastructure spending in Liberia than in all other countries considered in the benchmarking exercise (figure 14).

Table 14. Financial flows to Liberian infrastructure, average 2004 to 2008

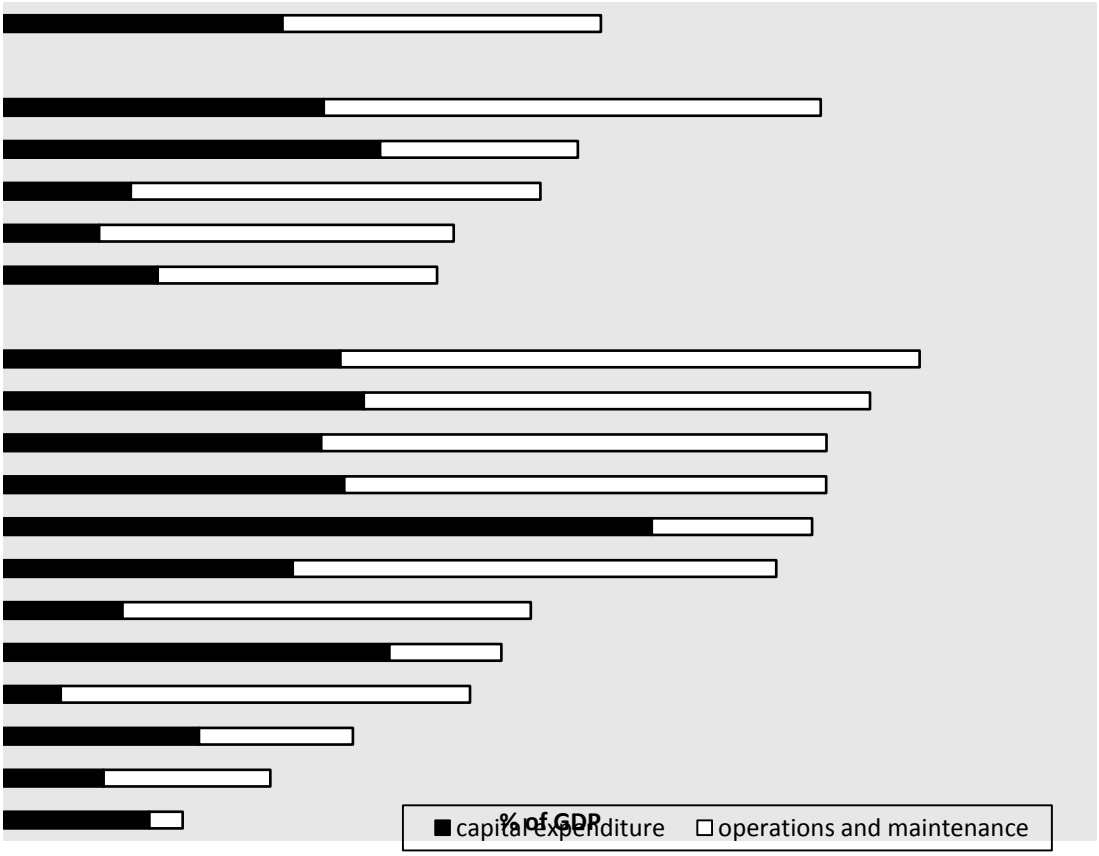
US$ millions per year

	O&M	Capital expenditure					
	Public sector	Public sector	ODA	Non-OECD financiers	PPI	Total CAPEX	Total spending
Information and communication technologies	2	0	0	1	17	18	19
Power	7	1	13	1	0	15	23
Transport	7	6	26	1	0	33	39
Water supply and sanitation	2	2	5	0	0	7	8
Total	16	9	44	2	17	72	90

Source: Derived from Foster and Briceño-Garmendia 2009.

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

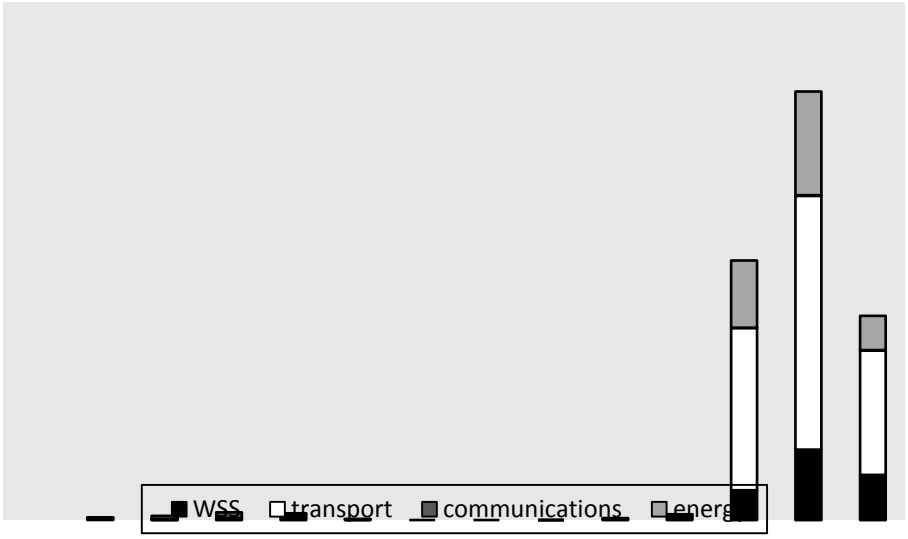
Figure 14. Spending allocated to address infrastructure needs



Source: Foster and Briceño-Garmendia 2009.

Figure 15. Liberia is beginning to capture significant amounts of development aid

Investment in infrastructure sectors as percentage of GDP



Source: World Bank 2010.

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

Even without increasing spending, more resources could be directed towards infrastructure by eliminating inefficiencies. The largest potential source of efficiency gains is improving cost recovery. In the road sector, for example, charging the a fuel levy designed to permit full cost recovery of maintenance expenditures—around $0.25 per liter—could raise $9 million annually for road maintenance. Setting the fuel levy that high probably would not be feasible due to the impact on end-user prices for fuel. So in practice only about half of this amount could be recovered through road user charges. Despite today's elevated tariffs, the power sector still benefits from an annual operating subsidy of $2.3 million a year. About half of that total was covered by a capital grant for power sector development from donors, but the remaining half constitutes an ongoing operating subsidy. Once again, however, it may not prove feasible to raise power tariffs further above their existing level, even if it could be argued that in today's circumstances power is a luxury in Liberia that should be priced at full cost. Finally, the water and power utilities could recoup some $2.9 million each year by reducing distribution losses and increasing revenue collection. Overall, around $17 million of additional resources could be recovered each year by improving efficiency (table 15).

Table 15. Potential gains from greater operational efficiency

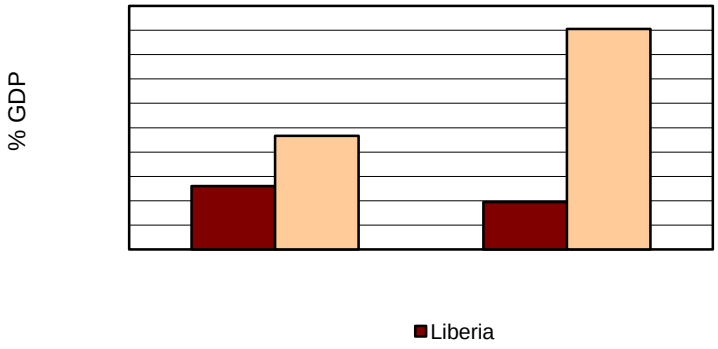
	ICT	Power	Transport	WSS	Total
Over manning		0.7		0.0	0.7
Losses		0.8		1.0	1.8
Undercollection		0.6		0.6	1.1
Budget execution	0.0	0.2	0.0	0.3	0.5
Tariff cost recovery		2.3	9.0	1.7	13.0
Total	0.0	4.5	9.0	3.6	17.1

Source: Derived from Foster and Briceño-Garmendia 2009.

Both water and power are priced below cost in Liberia. At $0.43 per kilowatt-hour, power tariffs still fall well short of the estimated total cost of $0.77 per kilowatt-hour. Similarly, water tariffs at $0.45 per cubic meter also fall well short of the $1.00 typical cost recovery benchmark for the sector. Nevertheless, the macroeconomic impact of under-pricing water and power is relatively small in Liberia. Under-pricing of power and water services each amount to foregone revenues of around $2 million annually—around 0.2 percent of GDP for each sector. This is much lower than what is found in the low-income fragile state benchmark group. However, to some extent this simply reflects the fact that access to services is exceptionally low in Liberia. Thus, while the subsidy figures look small in absolute terms and relative to GDP, they look much larger when one considers that less than 1 percent of the population receives power and less than 3 percent receives piped water.

Figure 16. Underpricing of water in Liberia relatively low but still material

Financial burden of underpricing in 2008, as percentage of GDP



Source: Derived from Briceño-Garmendia and others 2009.

A key question is whether full cost recovery tariffs for power and water would be affordable to a broader swathe of the population. To answer this question, the case of a household of five persons living on one dollar per capita per day is used as a point of reference. The monthly budget of this household would be $150. Based on a standard affordability threshold of 5 percent of budget for a water or utility bill, such a household could reasonably devote up to $7.50 per month on either service.

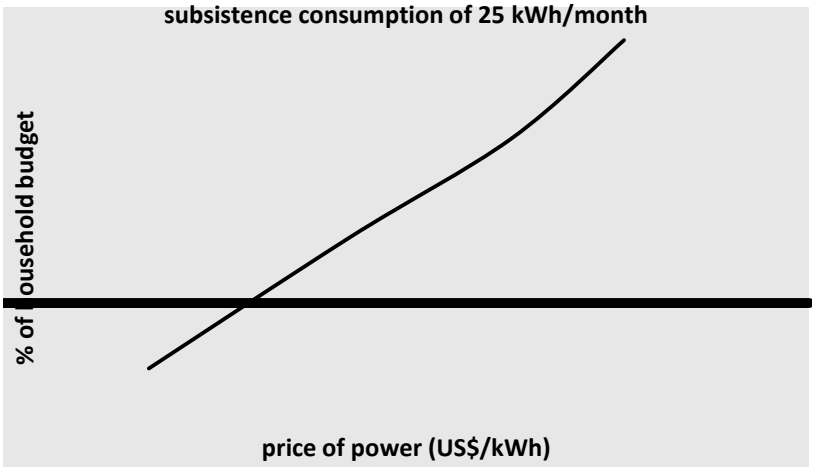
For such a household, subsistence power consumption of 25 kilowatt-hours per month (enough to power a couple of light bulbs and a small radio) would cost $19 per month at cost recovery tariffs—

equivalent to an impossible 13 percent of the monthly budget, well beyond the affordability threshold. In fact these calculations suggest that power will not become widely affordable to any significant share of the population until costs (and hence prices) can be reduced to below $0.30 per kilowatt-hour.

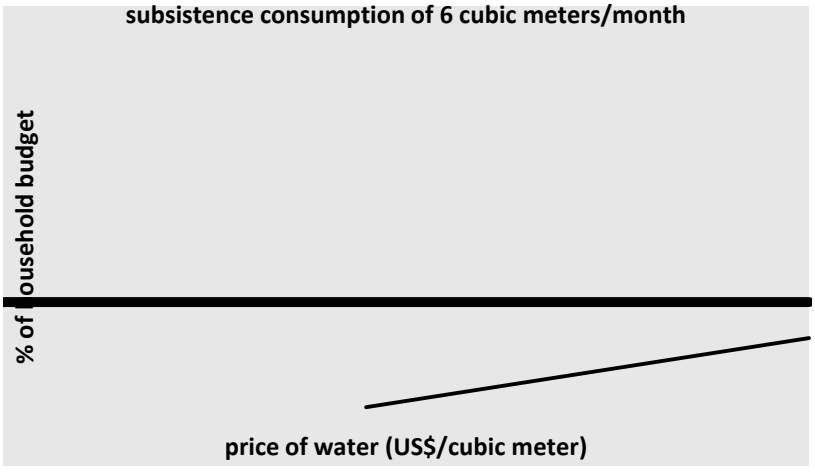
In the case of water, subsistence water consumption of 6 cubic meters per month (equivalent to 40 liters per capita per day) would cost $6 per month at cost recovery tariffs. That total would absorb 4 percent of the monthly budget of the illustrative household, which may be affordable. At existing tariffs that largely cover operating costs, subsistence consumption would only represent 2 percent of household budgets, which would be quite affordable for the population.

Figure 17. Affordability of subsistence utility bills for representative family living under poverty line

a. Power



b. Water



Source: Illustrative calculations based on Liberia Poverty Assessment.

At first glance, utility operational inefficiencies do not look very significant relative to GDP. Distribution losses of power and water utilities total $1.8 million annually, while under-collection amounts to a further $1.1 million annually. This amounts to no more than 0.2 percent of GDP for each sector, which is much better performance than that found in the benchmark group of low-income fragile

states (figure 18). Nevertheless, as before, this is partly explained by the fact that the level of coverage is very low.

Figure 18. Liberia's power and water utilities are more efficient than those in other low-income countries

a. Uncollected bills and unaccounted losses in the power sector, as a percentage of GDP



b. Uncollected bills and unaccounted losses in the water sector, as a percentage of GDP



Source: Derived from Briceño-Garmendia and others 2009.

Annual funding gap

Liberia's annual infrastructure funding gap ranges between $250 million in the pragmatic scenario to $500 million in the base case (table 16). The largest funding gaps are found in the power and transport sectors. The funding gap looks implausibly large when measured relative to existing GDP—between 40 and 60 percent. The wide variation between the two scenarios illustrates the importance of making shrewd choices with respect to infrastructure standards. At the same time, in this case even the pragmatic scenario

looks daunting relative to the available resource envelope. As noted above, the funding gap includes only public interest infrastructure. It is assumed that infrastructure relating to the development of mining and natural resource concessions will be fully funded by the concessionaires.

Table 16. Funding gaps by sector

US$ millions

	ICT	Power	Transport	WSS	Total
Basic scenario					
Spending needs	(45)	(251)	(198)	(122)	(615)
Existing spending	19	23	39	8	90
Efficiency gains	0	5	9	4	8
Funding gap	(25)	(224)	(149)	(110)	(508)
Pragmatic scenario					
Spending needs	(45)	(122)	(100)	(77)	(344)
Existing spending	19	23	39	8	90
Efficiency gains	0	5	9	4	8
Funding gap	(26)	(94)	(52)	(65)	(246)

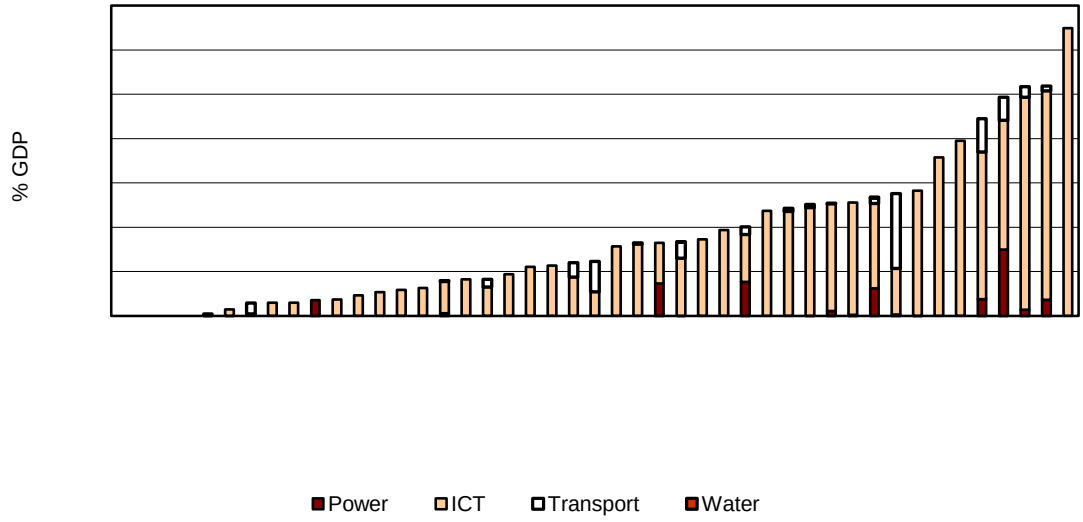
Source: Derived from Foster and Briceño-Garmendia 2009.
— = data not available.

What else can be done?

Liberia's funding gap is very large relative to the size of its economy. Nevertheless, there are a number of options for making it more manageable, including raising additional finance, taking additional cost-cutting measures, and lengthening the period of time allotted for meeting the illustrative infrastructure targets. In any case, given the magnitude of the gap, difficult decisions will have to be taken regarding the prioritization of the different investments.

In addition to any measures that the public sector can take to close the funding gap, the private sector can also contribute. Liberia has already established a strong track record on foreign direct investment, and has in recent years captured 2 percent of GDP as private investment for (ICT) infrastructure, which is a strong performance relative to African peers (figure 19). Although not all components of the required infrastructure platform are suitable for private finance (particularly roads, water, and sanitation), other components may be (for example, ICT, power generation, and ports). Nevertheless, due to significant country risk, the costs associated with private investment in infrastructure may be relatively high. Private investors will have to carefully consider whether Liberia provides the best value for their money. Risk mitigation instruments available from international financial institutions may be relevant in this context.

Figure 19. Liberia has done relatively well at capturing private investment in infrastructure



Note: Average annual private sector commitments to infrastructure projects for the period 2002/07.
Source: Derived from World Bank, Private Participation in Infrastructure Database, 2008.

There is also scope for integrating national infrastructure development with substantial privately funded infrastructure development by concessionaires. A number of large multinational companies are taking on the country's numerous mineral, forestry, and agricultural concessions and will need to invest heavily in the necessary transport and energy platforms to support their operations. It is estimated that power demand from mining, natural resources, and agriculture could climb to 1,000 mega-watts by 2040, about 84 percent of it associated with mining (table 17). A recent study by the Ministry of Planning and Economic Affairs estimates that mining sector investments over the coming years could amount to around $5 billion in railways and $1 billion in power. Liberia has a policy of ensuring that such investments are done in such a way as to benefit the broader national economy, avoiding the formation of enclaves with high quality infrastructure that are insulated from and fail to benefit the broader economy. In the case of transport investments, a principle of open access to roads, railways, and ports developed by private concessionaires has been established, and this will help to ensure that these assets become integrated with the national transport network.

In the case of power, similar issues arise but their resolution is more complex due to the absence of a transmission grid to integrate private power development with the national system. In principle, both the country and concessionaires could benefit from coordinated development of larger, more cost-effective power generation options (including power imports). Capturing these benefits will require a clear national energy plan that explicitly provides for the inter-connection of Monrovia, the key power generation sites, the key mining sites, and the West Africa Power Pool. Private power development could then be required to be consistent with the national plan.

Table 17. Estimated demand for power from mining, forestry and agriculture by 2040

US$ millions

	MW
Mines	
- Iron ore (close to grid)	332
- Iron ore (far from grid)	400
- Gold	110
Forestry	116
Rubber	30
Oil Palm	10
Agriculture	5
Total	1,003

Source: World Bank, 2010

— = data not available.

Given the size of the funding gap, clear principles for prioritization and sequencing of infrastructure investments are essential. Since infrastructure is only a means to an end, it is important to define infrastructure development plans in close coordination with the national growth vision. The government of Liberia is currently envisaging a growth strategy based around key development corridors that anchor economic activities in a number of key sectors including agriculture, forestry, and mining. Scoping out the infrastructure packages needed to support development along these corridors would help to prioritize the overall national requirements identified in this report.

In addition to looking at domestic corridors, Liberia needs to examine ways to exploit regional corridors. Regional integration relates Liberia's infrastructure development path in a variety of ways. For example, Monrovia's transport infrastructure can provide a platform for exports from eastern Sierra Leone. Similarly, the power and transport infrastructure in the region of Saint Pedro in western Cote d'Ivoire may be relevant to the development of Liberia's isolated southeastern region. Finally, regional power trade is potentially a significant component in Liberia's long-term power development strategy.

In any case, it will likely take Liberia longer than a decade to reach the illustrative infrastructure targets outlined in this report. Under business as usual assumptions on spending and efficiency, it would take at least forty years for Liberia to reach these goals. Yet with a combination of increased finance, improved efficiency, and cost-reducing innovations, the goals should be attainable within a significantly shorter period.

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

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AICD
AFRICA INFRASTRUCTURE COUNTRY DIAGNOSTIC

About AICD and its country reports

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

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

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

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

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

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

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

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

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

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