ANNEX I

Infrastructure Needs Assessment

Introduction

1. Infrastructure is a critical driver of economic growth. A cross-country analysis indicates that raising the quantity of infrastructure by one standard deviation increases the growth rate by several percentage points (Calderón and Servén 2004a). Improved quality of infrastructure would also boost economic growth—a strong indication of the benefits of any effort to increase access to better infrastructure. Researchers estimate that a significant part of economic growth has been lost in Africa because of lack of access to quality infrastructure (Foster and Briceno-Garmendia 2010). If infrastructure quality in African countries matched that of the Republic of Korea, per capita growth in the African region could increase by 2.6 percentage points a year

2. However, infrastructure needs remain large and can dwarf available resources, particularly in low-income countries. With the exception of one sector (information and communication technology, or ICT), progress has been limited. Several billion people still do not have access to basic infrastructure services such as water and sanitation, transport, and modern energy services. Many developing countries are also estimated to have lost significant business opportunities because of unreliable infrastructure services.

3. Progress on the infrastructure agenda is suffering from the lack of reliable data on access, quality, needs, and actual spending. This note, like others before it, is a somewhat heroic attempt to gather estimates from various sources while relying on various methodologies. The picture that emerges is that about $1.0 trillion to $1.5 trillion in annual investments (approximately 6 percent to 7 percent of gross domestic product [GDP]) may be needed to allow developing countries to pursue a sustainable development agenda, but most countries allocate much less. This picture remains very incomplete and uncertain given the remarkable lack of available data on infrastructure and infrastructure finance.

4. Better data, such as those collected through the Africa Infrastructure Country Diagnostic (AICD) initiative, would permit more precise analysis of the extent of infrastructure needs, the financial challenges that exist and their variance across countries, and the opportunities for efficiency gains to help address the financing gap. This note highlights the impact of the AICD data achievements, and points to the relatively modest resources that would be needed to expand the AICD model to all developing countries.

Infrastructure Remains a Challenge

5. In developing countries, infrastructure deficits are still enormous in both quantity (read: access) and quality terms.

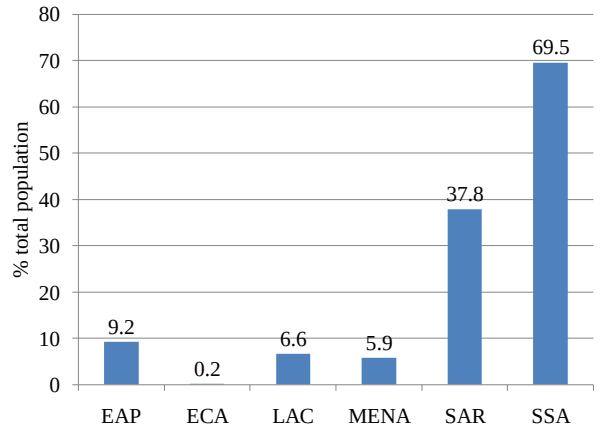
Basic access to infrastructure

6. Available data show that infrastructure access remains a challenge for many developing countries. About 1.4 billion people do not have access to electricity (Figure 1).[1] Without access to electricity, people cannot benefit from lighting and electric household appliances (see Khandker and others 2009). The lack of access to safe water also makes many women and children spend several hours a day gathering water (WHO and UNICEF 2005). About 880 million people still live without safe drinking water and 2.6 billion people without access to basic sanitation (Figure 2). Lack of access to the nearest market

[1] See Annex A for additional data on basic infrastructure access.

or health center significantly constrains people's economic and social opportunities. About 900 million rural dwellers worldwide live more than two kilometers—a 20 to 25 minute walk— from any all-weather roads (Figure 3).

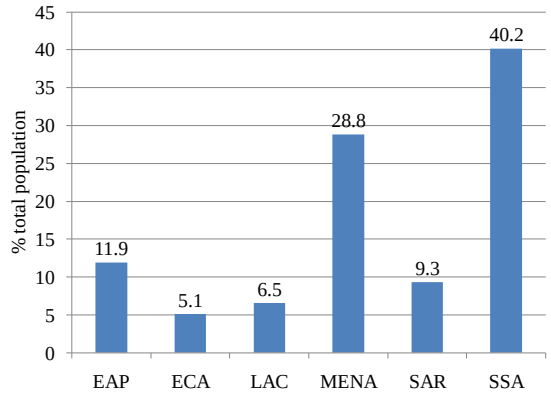
Figure 1: Share of Population without Access to Electricity, 2009



Source: IEA World Energy Outlook 2010.

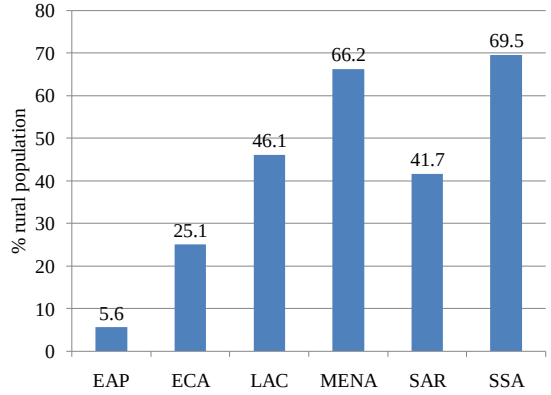
Note: EAP = East Asia and the Pacific, ECA = Europe and Central Asia, LAC = Latin America and the Caribbean, MENA = Middle East and North Africa, SAR = South-Asia Region, SSA = Sub-Saharan Africa.

Figure 2: Share of Population without Access to Improved Water, 2008



Source: WHO and UNICEF Progress on Sanitation and Drinking-Water 2010.

Figure 3: Share of Population without Access to an All-Weather Road, 1994–2004



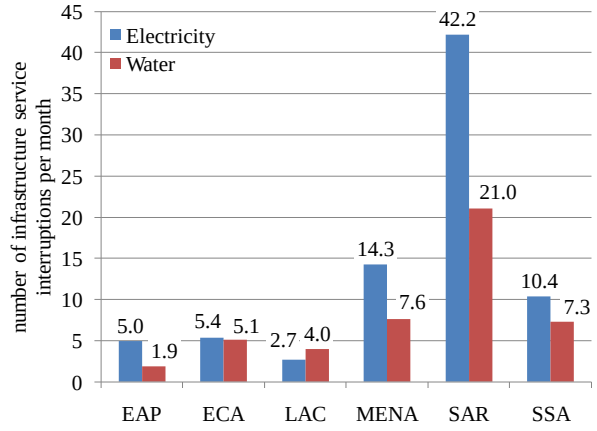
Sources: Roberts, Shyam, and Rastogi 2006; Rural Access Index: A Key Development Indicator.

Quality of infrastructure services

7. Quality of infrastructure services is also important for efficiency in production and transaction. In developing countries, frequent power outages and cuts in water services are still significant constraints (Figure 4). For firms, better access to quality infrastructure services is essential to enhance their competitiveness. Unpredictable electricity provision forces firms to invest in costly backup power generation facilities. On average, total sales of about 5 percent are estimated to have been lost because of electricity outages (Figure 5).

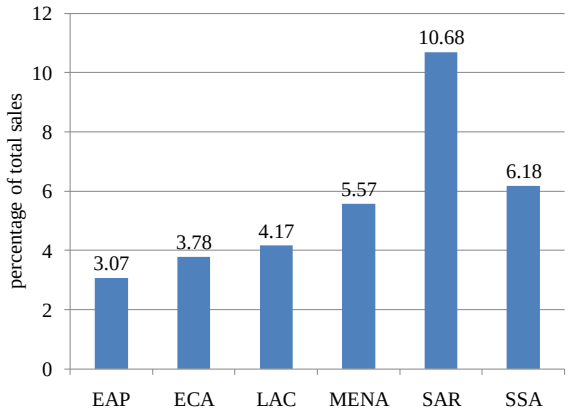
8. Better access to roads can also reduce transport and transaction costs and can help firms minimize inventory and distribution costs (Shirley and Winston 2004). Road infrastructure can also help countries attract foreign direct investment and increase exports (Boudier-Bensebaa 2005; Cieślik and Ryan 2004; Qureshi 2008; World Bank 2009b). Exporting firms generally prefer close access to motorways and access to interregional demands (Holl 2004).

Figure 4: Number of Infrastructure Service Interruptions per Month, Latest Available Year during 2004–10 Period



Source: Enterprise Surveys, accessed in February 2011.

Figure 5: Value Lost due to Power Outages, Latest Available Year during 2004–10 Period



Source: Enterprise Surveys, accessed in February 2011.

Better infrastructure investment decisions require better data

9. Beyond the data on basic access and some aspects of service quality (described earlier), infrastructure data remain very limited. Detailed data on spending, access, and service quality are crucial for making good investment decisions about infrastructure, such as where to invest, how much to invest, and how to invest.

10. Infrastructure spending is not systematically measured in developing countries. One reason is that infrastructure investments involve many players—from governments and state-owned enterprises to private investors and operators. Therefore, budgetary data are not sufficient. Off-budget spending through state-owned enterprises, special funds, and development banks is often sizeable. In Africa, more than two-thirds of infrastructure spending is off-budget (Briceno-Garmendia, Smits, and Foster 2008). In addition, the private sector is playing an important role in infrastructure, particularly in the ICT and electricity generation sectors. Large efforts are needed to compile all these data in a systematic way, as was done for the AICD.

The case for better infrastructure data

11. For such a massive economic sector as infrastructure, the striking absence of systematic, comprehensive, and reliable worldwide information on even the most elementary data (such as quantity and quality of infrastructure stocks, access to services, prices and costs, efficiency parameters, and historic spending) is quite remarkable. Without such information, it will be very difficult to evaluate the success of past interventions, prioritize current allocations, or provide a benchmark to measure future progress.

12. Recent evidence suggests that the costs of collecting and tracking such information would be about $60,000 to $80,000 per country, would amount to not much more than $3 million annually for the 40 low-income countries selected, and would be less than $10 million annually for developing countries worldwide. Those numbers represent about 0.001 percent of the funds that are at stake.

13. A salient example is the WHO-UNICEF Joint Monitoring Program (JMP) for the Millennium Development Goals on water and sanitation. By systematically reviewing and collating data on country-level trends in water and sanitation access, the JMP has succeeded in keeping global attention focused on progress toward these important development objectives. Another interesting example is the World Bank and International Finance Corporation's Doing Business Project that systematically tracks and benchmarks the investment climate at the national level using measures designed to capture the extent of red tape. The regular publication of such a benchmark has put a great deal of pressure on policy makers to improve investment climates and has led to some notable improvements in specific countries.

14. In the case of Africa, the Infrastructure Consortium for Africa the AICD, a major data collection initiative that, for the first time, has provided a clear picture of infrastructure needs and performance across the continent and that has succeeded in raising global and regional attention to infrastructure challenges. The African Development Bank is now taking over this data collection initiative under the Africa Infrastructure Knowledge Program, although a significant funding gap remains.

Infrastructure spending: A rough estimate

15. Available estimates place infrastructure spending around 5 percent of developing-country GDP (Table 1), varying from a low of 1.9 percent of GDP in Latin America to a high of 7.2 percent in East Asia

and the Pacific. These are rough estimates based on a number of assumptions and extrapolations, except in the case of Africa, where investment figures have been carefully collected following a common methodology. No data was available for Eastern Europe and Central Asia.

Table 1: Estimated Annual Infrastructure Spending

Region	Spending in 2005 US$ billions	% GDP
East Asia and the Pacific[a]	207.0	7.2
Central Asia	—	—
Eastern Europe	—	—
Latin America and the Caribbean[b]	43.5	1.9
Middle East and North Africa[c]	43.8	6.9
South Asia[d]	46.0	4.6
Sub-Saharan Africa[e]	45.3	7.1
Weighted average	—	5.2

Sources: Various sources as described below.

Note: — = not available.

a. Source: ADB, JBIC, and World Bank's. 2005 *Connecting East Asia: A New Framework for Infrastructure*. Eight countries are covered. Infrastructure investment is estimated at be 2.0 percent of GDP for Cambodia, Indonesia, and the Philippines; 5.5 percent for the Lao People's Democratic Republic and Mongolia; and 8.0 percent for China, Thailand, and Vietnam. These figures are multiplied by 2005 GDP.

b. Source: Calderón and Servén. 2010. "Infrastructure in Latin America." Policy Research Working Paper No. 5317, World Bank. The six countries included are Argentina, Brazil, Chile, Colombia, Mexico, and Peru. The average infrastructure spending ratios during the 2001–06 period are multiplied by 2005 GDP.

c. Source: Arab Finance. January 13, 2011, "Infrastructure spending in MENA region ups 42% in 2010, Beltone." A recent infrastructure spending ratio of 6.9% is applied to 2005 GDP of MENA developing countries.

d. Source: Commission on Growth and Development 2008. "The Growth Report: Strategies for Sustained Growth and Inclusive Development." Infrastructure investment is estimated at 5 percent of GDP for India and 3 percent of GDP for Pakistan. For Bangladesh, 1.4 percent of GDP is assumed, which is the share of infrastructure investments in the Annual Development Program (Fiscal Year 2007), with private financing assumed to be negligible. Those ratios are multiplied by the 2005 GDP.

e. Source: Foster and Briceno-Garmendia 2010. "Africa's Infrastructure: A Time for Transformation."

Infrastructure Needs Depend on Policy Objectives

16. Infrastructure needs, or how much countries should be spending on infrastructure, depend on the policy objective. Universal access does not require large outlays, although it can add up to a large share of GDP for very poor countries. Responding to increased demand associated with GDP growth may require about 3 percent of GDP (Fay and Yepes 2003). Achieving the kind of growth the Republic of Korea experienced or following the rapid industrialization path of China requires about 6 to 10 percent of GDP annually. Hence, there is not an absolute measure of needs; any estimate corresponds to a given policy objective and an attempt to price that objective. [2]

[2] See Annex B for a brief review of methods.

An estimate and the many assumptions behind it

17. Except for the AICD, most recent needs estimates measure how much demand for infrastructure is expected to increase with economic and population growth (according to past cross-country trends) and then determine the value of this increase in demand by using standard unit prices. This model was used for the Asian and Latin American results presented in Table 2. When one uses this technique, the infrastructure needs in East Asia and South Asia are estimated at $400 billion and $190 billion (in 2005 constant dollar terms) respectively. For Latin America and the Caribbean, researchers added an estimate of the cost of providing for basic needs (water and sanitation), yielding an estimate of about $80 billion, or 2.6 percent of GDP.

18. The AICD approach was more sophisticated and captured not only the expected increase in demand, but also politically determined investments to meet social objectives.[3] The approach concluded that $93 billion per year would be needed for 2006–15, or 9.8 percent of GDP (projected).

19. Combining these estimates (derived from differing methodologies) yields a rough estimate of about 6 percent of GDP for infrastructure investment needs. This is broadly consistent with other estimates in the literature: 5.5 percent (Fay and Yepes 2003); 6.6 percent (Foster and Briceno-Garmendia 2010; Yepes 2007), or roughly $1.1 trillion per year.

Table 2: Annual Infrastructure Investment and Maintenance Needs

Region	Investment and Maintenance Needs (2005 constant $US, billions)	% projected 2010-20 GDP
East Asia and the Pacific[a]	406.7	5.5
Central Asia[b]	12.5	5.2
Europe	—	—
Latin America and the Caribbean[b]	81.2	2.6
Middle East and North Africa[c]	78.5	9.2
South Asia [a]	191.2	10.8
Sub-Saharan Africa [d]	93.3	9.8
Weighted average	—	6.1

Sources: Various sources as described in notes.

Note: — = not available.

a. Source: Bhattacharyay, Biswa, and Nath 2010. "Estimating Demand for Infrastructure in Energy, Transport, Telecommunications, Water and Sanitation in Asia and the Pacific: 2010–2020." Asian Development Bank Institute Working Paper No. 248. East Asia and the Pacific includes three original regions: East Asia, Southeast Asia, and the Pacific. Afghanistan and Pakistan are included in South Asia instead of Central Asia. The needs are estimated for the 2010–20 period.

b. Source: Fay and Morrison 2007. "Infrastructure in Latin America and the Caribbean: Recent Developments and Key Challenges." The needs are estimated for the 2005–15. The model assumes 2.7 percent real growth.

[3] The electricity needs are estimated using a least-cost optimization model to develop 7,000 megawatts of new generation capacity every year to serve an additional 6 million new connections. The water needs follow the Millennium Development Goals target. For transport, 250,000 kilometers of good-quality road networks would be built to meet regional and national connectivity standards. The amount of the rural population with access to an all-season road within less than 2 kilometers is aimed to double. Universal access to mobile voice signals and broadband is assumed in the ICT sector. See Annex B for details.

c. Source: World Bank. 2009. "MENA Regional Conference on Infrastructure Reform and Regulation: Taking the Infrastructure Agenda Forward in the Middle East and North Africa." The needs are estimated for the period 2008-2015.

d. Source: Foster and Briceno-Garmendia 2010. "Africa's Infrastructure: A Time for Transformation." The needs are for the 2006–15 period. The share of GDP is re-calculated and is based on the projected GDP in that period (not 2005 GDP).

Different needs estimates under various scenarios

20. Infrastructure needs could be different if the underlying assumptions and targets are changed. For instance, a different growth trajectory provides a different figure of the needs. The needs for Latin America and the Caribbean would be doubled to between 4 and 6 percent of GDP per year if the goal were for the region's infrastructure to catch up with that of the Republic of Korea (Fay and Morrison 2007).

21. National development plans may represent another estimate of infrastructure needs. For example, India's infrastructure investments are planned to increase from 4 to 5 percent of GDP in the 1990s to more than 10 percent of GDP in 2016-17.

22. Climate change may increase infrastructure needs, for both mitigation and adaptation. The incremental costs required for developing countries to adapt their infrastructure to a changing climate are estimated at $17 billion to $30 billion per year. In addition, the financing needs for mitigation measures in infrastructure in developing countries could reach $324 billion (World Bank 2009).

Many Ways of Closing Infrastructure Financing Gaps

23. Available policy options for closing the remaining financing gaps vary, depending on the country. The main internal financing sources are technical and nontechnical efficiency gains, as well as internal resource mobilization such as user fees. External resources are official development assistance (ODA), other official flows (OOFs), South–South cooperation, and collaboration with the private sector. In developing countries, the role of internal sources cannot be underestimated. In the case of Africa, about one-third of the estimated funding gap could be met by technical and nontechnical efficiencies (Table 3).

Table 3: Efficiency Gaps and Infrastructure Funding Gap in Sub-Saharan Africa

	Electricity	ICT	Irrigation	Transport	Water supply and sanitation	Cross-sector gain	Total
Infrastructure needs	40.8	9.0	3.4	18.2	21.9		93.3
Existing spending	11.6	9.0	0.9	16.2	7.6		45.3
Efficiency gap	6.0	1.3	0.1	3.8	2.9	3.3	17.4
Gain from raising capital execution	0.2	0.0	0.1	1.3	0.2		1.8
Gain from eliminating operational inefficiency	3.4	1.2		1.9	1.0		7.5
Gain from tariff recovery	2.3			0.6	1.8		4.7
Potential for reallocation						3.3	3.3
Remaining funding gap	23.2	-1.3	2.4	-1.9	11.4	-3.3	30.6

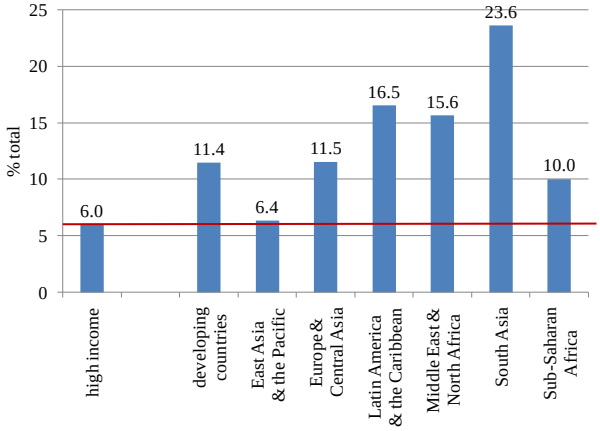
Source: Foster and Briceno-Garmendia 2010.

Technical efficiency gains

24. Infrastructure in developing countries often involves large technical inefficiencies. Eliminating inefficiency may require additional investments, but those investments would benefit countries in the long run. In general, returns on infrastructure maintenance are high. In Africa during the 1970s and 1980s, it is estimated that road assets valued at about $40 billion to $45 billion were lost because of inadequate maintenance, which would have cost only $12 billion (Harral and Faiz 1988). In many countries, roads are still poorly maintained. In Sub-Saharan Africa, only half of the main road network is in good condition (Foster and Briceno-Garmendia 2010).

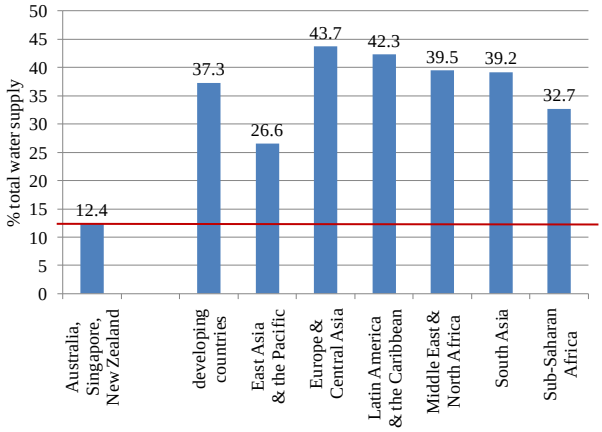
25. In the electricity sector, 5 percent or more of the electricity generated is unnecessarily lost for technical reasons. In South Asia, power transmission and distribution losses amount to more than 20 percent. If these losses were reduced to the level of loss in advanced countries, the reduction would have the same effect as 30 gigawatts of new capacity being installed, or $50 billion being invested. Similarly, 25 to 40 percent of water is leaked from the network or is otherwise not accounted for in developing countries. The data signal significant losses of water resources, thereby exacerbating the financial gap in the sector.

Figure 6: Electricity Transmission and Distribution Losses, Latest Available Year



Source: World Development Indicators accessed in November 2010.

Figure 7: Nonrevenue Water Supply



Source: IBNET accessed in March 2011.

Regional integration

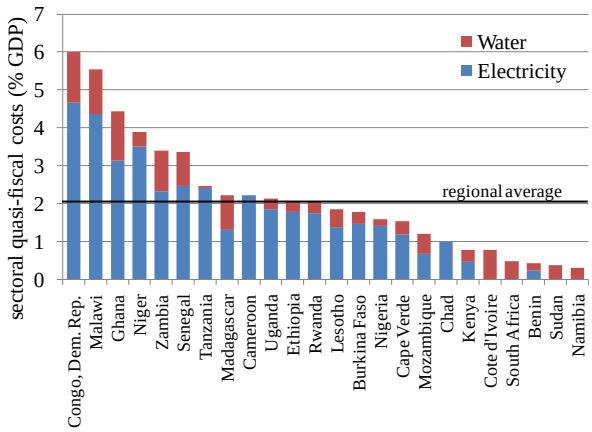
26. Infrastructure is a typical network industry. Well coordinated infrastructure could generate additional savings. On the other hand, spatially blind infrastructure planning will lead to a considerable waste of public resources. Thick borders—in both physical and institutional terms—add to the trade and transaction costs of developing countries. The World Bank (2009) clearly shows that regional integration of logistic infrastructure and enabling institutions, such as regulations and border controls, can facilitate exports and economic growth.

27. For electricity, creating a regional power pool is of particular importance because storing electricity is prohibitively costly given the current technology. Therefore, trading extra power among countries could result in significant savings and reduced investment needs. In the case of Africa, it is estimated that $2 billion a year could be saved if power trade took place to the maximum extent (Foster and Briceno-Garmendia 2010).

Nontechnical efficiency gains

28. Nontechnical efficiency gains can also be significant, particularly in low-income countries. Quasi-fiscal deficits caused by underpricing, technical losses, or nonpayment in infrastructure can amount to about 2 percent of GDP (or possibly up to 5 to 6 percent of GDP) (Figure 8). In most African countries, the electricity sector incurs the majority of hidden infrastructure costs. Underpricing is the major reason for the deficits. In Malawi, as much as 3.3 percent of GDP is considered to have been spent for implicit power subsidies. Thus, reducing these quasi-deficits, especially by achieving cost recovery tariffs, could generate additional resources for governments, and consumers would have more incentive to use utility services wisely.

Figure 8. Quasi-Fiscal Deficits Caused in Sub-Saharan Africa, 2005



Source: Briceno-Garmendia and others 2008.

Mobilizing domestic resources

29. Significant domestic resources can be mobilized by raising user charges and removing inefficient infrastructure subsidies. Road pricing (such as toll roads and cordon pricing) has proven effective in high-traffic areas for generating revenues and reducing congestion in many countries. It also helps reduce emissions and congestion. In some developing countries, fossil fuel–related consumption remains

heavily subsidized, adding up to some $312 billion in 2009 (IEA 2010).[4] Eliminating these harmful subsidies could generate significant resources for meeting the infrastructure financing gap.

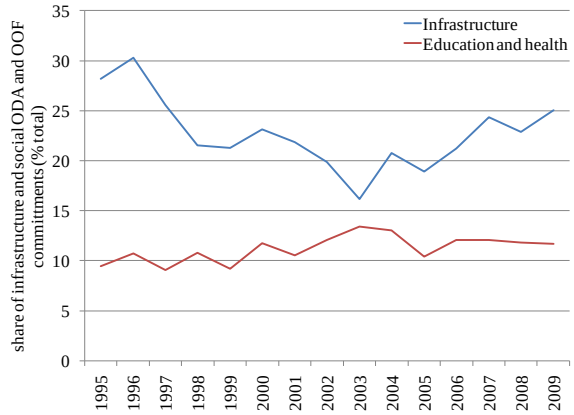
External resources

30. ODA and OOF can be used more effectively with better prioritization of projects and more competitive public procurement. ODA and OOFs have been contributing significantly to financing infrastructure projects in developing countries. Although the relative contribution was stagnant in the late 1990s (Figure 9), the involvement of the international donor community has been vigorous in the infrastructure sector since 2005. International financial institutions also responded strongly to the global financial crisis and posted the largest ever financial flows to the developing world in 2008(?). Further, as in the case of ODA and OOF, increased transparency and competition in public procurement can foster the requisite enabling environment and increase investors' confidence, promoting their involvement in infrastructure development.

31. Bilateral ODA for infrastructure financing accounted for about $21 billion in 2008 and US$19 billion in 2009 (Figure 10). Multilateral ODA and OOFs amounted to $23 billion and $67 billion in 2008 and 2009, respectively. However, this level is unlikely to be sustained going forward. Thus, recipient countries must use currently available resources more efficiently.[5]

32. South–South cooperation is emerging as an additional source of infrastructure funding. Countries that are not part of the Organization for Economic Cooperation and Development (notably China and India) began to take a growing interest in financing infrastructure in Africa and other regions. Their commitments increased from almost nothing in the early 2000s to $2.6 billion per year in Africa alone (Foster and Briceno-Garmendia 2010). For a country or region to manage all available resources effectively, it is useful to track and report these assistance and commitments in the same format as the Development Assistance Committee's Credit Reporting System.

Figure 9. Sectoral Allocation of ODA and OOF to Social and Infrastructure Sectors

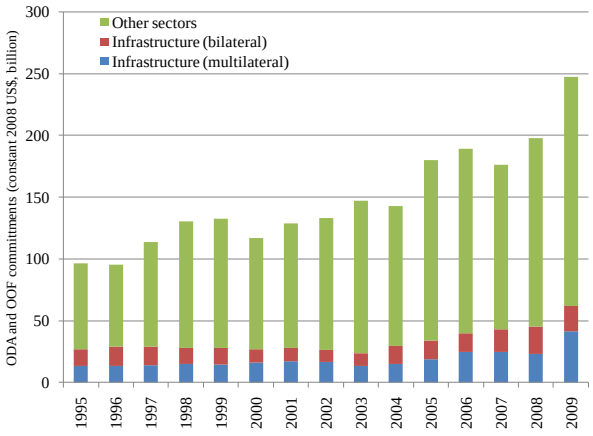


Source: OECD Stat Extracts, accessed in March 2011.

[4] Most of these subsidies are granted to four or five countries. The energy subsidy covers fossil fuels consumed by end-users and subsidies to fossil fuel inputs to electric power generation.

[5] These ODA and OOFs have already largely been included in the existing spending displayed in Table 1, except for the recent hike in multilateral lending to infrastructure. Thus, this funding is not new money that can be invested to meet the remaining financing gap.

Figure 10. ODA and OOF Commitments to Infrastructure



Source: OECD Stat Extracts, accessed in March 2011

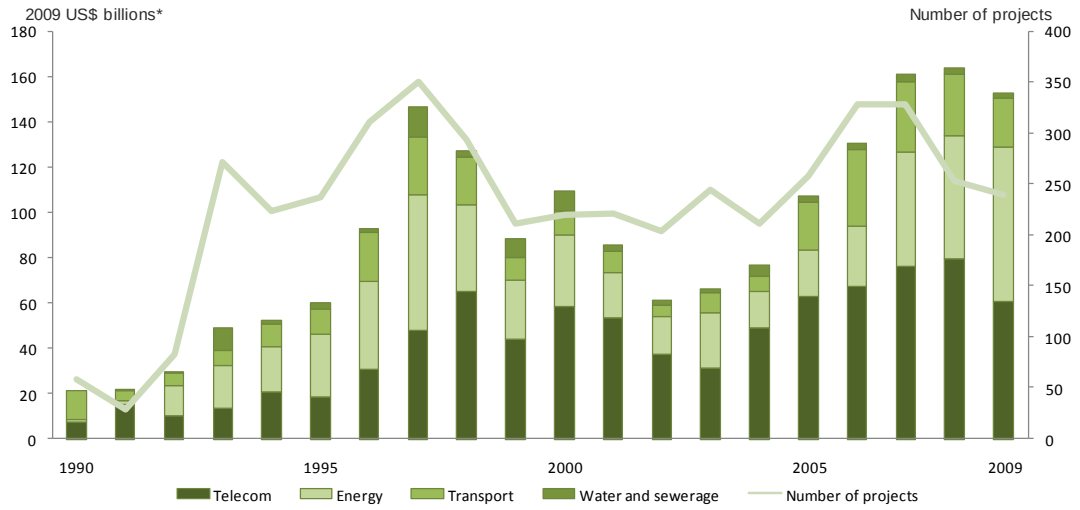
Catalyzing private financing

33. Private participation in infrastructure continues to play a critical role in infrastructure investment. It has reached close to $160 billion per year, growing at an average of 13 percent per year since the early 1990s (Figure 11). Importantly, however, private participation remains selective by sector and country. The ICT sector has traditionally been the prime destination of private investment. There has also been a flight to quality following the global economic downturn, with a handful of emerging large economies attracting the majority of private resources for infrastructure.

34. However, private financing cannot substitute public financing. Governments' strong commitments and other legal and institutional frameworks in the infrastructure sector are important to catalyze more private investment. In Latin America, more private investment has been attracted where public investment has remained high, as in Chile and Colombia. When public spending is tightened under the fiscal pressure, private participation in infrastructure also tends to decrease, as illustrated by the experiences of Argentina and Mexico in the 1990s (Calderón and Servén, 2004b).

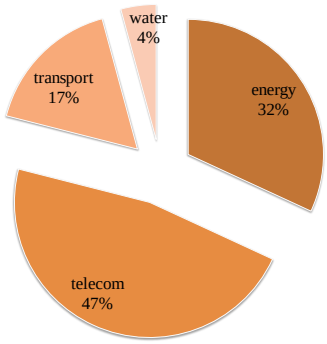
35. Domestic capital markets can also finance more purchasing power parities in infrastructure. Where domestic capital markets are active (such as in Brazil, Egypt, India, and Mexico), local commercial banks and privately managed pension funds can finance infrastructure projects, but better institutions to secure bonds and earn high credit ratings need to be developed. Corporate bonds, equity issues, and syndicated lending are emerging as important sources of private financing for developing countries, including in Africa. In that region, the disparity in financial intermediaries' assets is still large between South Africa and other countries. South Africa has well developed pension and insurance subsectors, accumulating $500 billion of financial intermediaries. More cross-border listings and investment could help overcome local capital markets' impediments (Irving and Manroth 2009).

Figure 11. Investment Commitment to PPI Projects Reaching Closure in Developing Countries



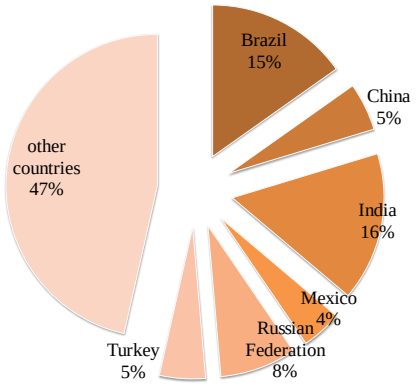
Source: PPI Database.
Note: PPI = private participation in infrastructure.

Figure 12: PPI Investment by Sector, 1990–2009



Source: PPI Database.
Note: PPI = private participation in infrastructure.

Figure 13: PPI Investment in the Past 5 Years by Country, 2005–09



Source: PPI Database.

Concluding Remarks

36. Infrastructure is essential for economic growth. Unsatisfied demand remains large in developing countries, and available resources are limited. Needs appear to significantly exceed resources in Sub-Saharan Africa and South Asia and, to a much lesser extent, in Latin America and the Middle East and North Africa. Investment levels appear broadly adequate in East Asia. No data are available for Eastern Europe and Central Asia.

37. The global economic downturn and the fiscal pressures that it has placed on the budgets of many countries imply that resources will continue to be limited, suggesting a greater need than ever to invest efficiently and to leverage existing resources. In that context, two priorities emerge: (a) to gather good infrastructure data, which is critical for understanding where the investment priorities are and where the potential efficiency gains lie, and (b) to leverage public (domestic and donor) resources to attract more private investment. Private investment has been hugely successful in the ICT sector and has a large, unexploited potential in other sectors, particularly in low- and lower-middle–income countries. Private investment should not, however, be considered a substitute for public resources. The two sources of funds can usefully complement each other, particularly if public resources are judiciously used to develop a solid pipeline of high-quality projects to sectors and settings in which private investment can be successful.

Sub-Annex A: Selected Infrastructure Data

Table A.1: Basic Infrastructure Access by Region

Region	Population without electricity (millions)	% total population	Population without improved water (millions)	% total population	Rural population without access (millions)	% rural population
East Asia and the Pacific	186	9.2	237	11.9	57	5.6
Europe and Central Asia	3	0.2	18	5.1	29	25.1
Latin America and the Caribbean	31	6.6	38	6.5	24	46.1
Middle East and North Africa	24	5.9	107	28.8	26	66.2
South Asia	612	37.8	149	9.3	410	41.7
Sub-Saharan Africa	585	69.5	330	40.2	238	69.5

Sources: IEA World Energy Outlook 2010; Roberts, Shyam, and Rastogi 2006 "Rural Access Index"; WHO and UNICEF Progress on Sanitation and Drinking-Water 2010.

Table A.2: Infrastructure Quality and Business Losses by Region

Region	Number of power outages in a typical month	Duration of power outage if it happens (hours)	Value lost because of power outages (% sales)	Number of incidents without sufficient water in a typical month	Duration of water shortage if it happens (hours)
East Asia and the Pacific	5.0	3.2	3.1	1.9	8.2
Europe and Central Asia	5.4	4.5	3.8	5.1	15.0
Latin America and the Caribbean	2.7	7.6	4.2	4.0	16.0
Middle East and North Africa	14.3	3.5	5.6	7.6	11.4
South Asia	42.2	4.6	10.7	21.0	10.8
Sub-Saharan Africa	10.4	6.8	6.2	7.3	14.1

Source: Enterprise Surveys accessed in February 2011.

Sub-Annex B: Main Findings of the Africa Infrastructure Country Diagnostic

After an unprecedented attempt to collect and analyze primary data, the Africa Infrastructure Country Diagnostic (AICD) yielded the following findings (Foster and Briceno-Garmendia 2010):

- Infrastructure has been responsible for more than half of Africa's recent improved growth performance and has the potential to contribute to even more growth in the future.
- Africa's infrastructure networks increasingly lag behind those of other developing countries and are characterized by missing links and stagnant household access.
- The spatial distribution of economic activity presents a challenge for the region's infrastructure development.
- Africa's infrastructure services are twice as expensive as elsewhere, reflecting both diseconomies of scale in production and high profit margins because of lack of competition.
- Power is by far Africa's largest infrastructure challenge, with 30 countries facing regular power shortages and many countries paying high premiums for emergency power.
- The cost of closing the infrastructure deficit is more than twice that estimated by the Commission for Africa: roughly $100 billion per year, about one-third of which is for maintenance.
- The infrastructure challenge varies greatly by country type; fragile states face an impossible burden, and resource-rich countries lag despite their wealth.
- A large share of Africa's infrastructure is domestically financed, with central government budgets constituting the main driver of infrastructure investment.
- Africa faces an infrastructure financing gap, the bulk of which is in the power sector, of more than $50 billion per year that could be reduced, but not eliminated, by efficiency gains.
- Africa's institutional, regulatory, and administrative reforms are only halfway along, but they are already generating positive effects on operational efficiency.

Sub-Annex C: Review of Methods for Estimating Infrastructure Needs

1. Assessing infrastructure needs is still challenging because the demand for infrastructure services is highly heterogeneous across countries, or even across regions in a country. In addition, political considerations and pragmatic approaches also may need to be reflected. The available literature shows at least four methods for estimating infrastructure needs.

Sectoral basic needs assessment

2. The Africa Infrastructure Country Diagnostic (AICD) project studied investment needs in five sectors: information and communication technology (ICT), irrigation, power, transportation, and water and sanitation. The objective of the studies was to develop a simple but robust country-based microeconomic method that would be significantly more accurate than the "top-down" macro studies, yet substantially more straightforward and standardized than the "bottom-up" engineering studies. The method aims to capture both (a) market-driven investments to keep pace with the demands generated by a growing economy and (b) politically determined investment targets to meet social needs that may not be commercially lucrative without government subsidy. In addition to estimating the magnitude of investment needs, the models consider spending requirements for the rehabilitation of existing infrastructure assets and the maintenance of networks.

3. The goal was not so much to produce an estimate as it was to create a model that would allow exploration of investment needs under a variety of assumptions about economic growth, social objectives, unit costs, and other relevant parameters. Projections were based on the World Bank gross domestic product (GDP) growth projections for the next decade and the United Nations demographic forecasts.

4. In most cases, no clear methodological precedents existed for producing such country-level estimates of investment needs using microeconomic modeling. A technique adopted across the five studies was spatial modeling using geographic information systems (GIS) tools. Creation of an African GIS database collating data from diverse sources and permitting the overlay of geophysical, agro-ecological, demographic, and economic features with infrastructure networks made this approach possible. The input parameters required to run the investment needs models were derived largely from an extensive desk review of available information.

5. Although efforts were made to develop methods that were consistent across sectors, the specifics of each sector raised particular challenges that called for some adaptation.

    - For ICTs, the spatial analysis was used to estimate the costs, revenues, and, hence, financial viability of rolling out services to remote, rural communities.
    - For irrigation, the financial viability of irrigating crops in various locations was prescreened as suitable for large- or small-scale irrigation development according to a large-scale project's proximity to large dams and a small-scale project's proximity to a road network.
    - For transport, spatial analysis was used to measure the extent of road networks needed to meet a set of regional, national, urban, and rural connectivity standards. Linking those standards directly to economic objectives did not prove feasible.
    - For power, the model is based on a least-cost optimization model that selects the most cost-effective expansion path for national or regional power-sector development to meet a given projection of demand.
    - For water and sanitation, the model uses demographic growth trends to analyze the number of new connections needed to meet the Millennium Development Goals (WHO-UNICEF 2006) under various technological choices. The model also incorporates an estimate of the rehabilitation and maintenance needs for existing infrastructure. Unit costs for facilities

were estimated at various levels of population density in urban and rural areas. All model inputs reflect operational experience in Africa. The model builds on and extends recent work by the World Bank's Water and Sanitation Program (Mehta, Fugelsnes, and Virjee 2005; Water and Sanitation Program 2006).

6. With this approach, AICD arrived at the following goals, which then translated into spending needs of about 15 % of 2008 GDP or 9.8 percent of Africa's 2010-20 projected GDP:
    - Develop an additional 7,000 megawatts per year of new power-generation capacity.
    - Increase household electrification rates by 10 percent.
    - Interconnect capitals, ports, border crossings, and secondary cities with a good-quality road network.
    - Provide all-season road access to Africa's high-value agricultural land.
    - Meet the Millennium Development Goals for water and sanitation.
    - Provide global mobile voice signal systems and public access to broadband to the entire population.
    - More than double Africa's number of irrigated areas.
    - Enable regional power trade by laying 22,000 megawatts of cross-border transmission lines.
    - Complete the intraregional fiber-optic backbone network and the continental submarine cable loop.

Cross-country econometric modeling

7. Cross-country econometric modeling is a typical top-down approach in which the demand for infrastructure is estimated using cross-country panel data without looking at any specific needs at the project level (Fay and Yepes 2003). This model has the advantage of analyzing multiple factors, such as national income and urbanization, in the growth-infrastructure context. As a result, the method is applicable to middle-income countries in which basic standards have already been met. The needs can be assessed according to an assumed growth trajectory.

8. The African Development Bank's infrastructure needs assessment (Bhattacharyay 2010) is based on the econometric approach, with the needs for regional projects added individually. The basic model is the same as the employed by Fay and Yepes (2003). Because the needs for regional projects cannot be captured by this cross-country regression, the regional projects identified are added to the estimated needs.

9. Fay and Morrison (2007) use the cross-country econometric approach combined with basic needs estimates in Latin America and the Caribbean. To help achieve universal coverage, researchers estimate basic needs in the electricity and water sectors. The econometric approach is used for estimating the infrastructure service demand derived by further economic growth. Although the basic needs of the electricity and water sectors are about 0.24 percent of GDP, infrastructure service demand induced is estimated at 2.4 percent of GDP.

Cross-country benchmarking

10. Benchmarking is a powerful tool for demonstrating to policymakers how countries are surpassing or lagging other countries in particular areas. It is a common practice to compare infrastructure access and performance across countries, within a region, or among countries having similar socioeconomic characteristics. A disadvantage of this approach is that it is not always easy to find proper comparators. In other words, countries are fundamentally different. Therefore, researchers may not agree on the comparators to be used.

11. Benchmarking can be combined with the econometric approach. For Latin America and the Caribbean, for instance, the needs would be doubled to between 4 and 6 percent of GDP if the goal was for the region's infrastructure to catch up with the Republic of Korea's level of infrastructure (Fay and Morrison 2007).

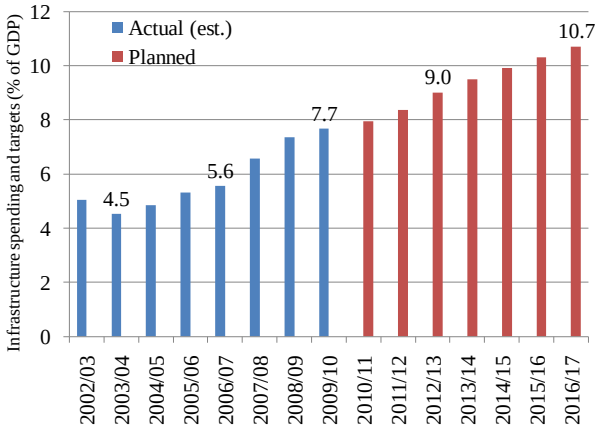
National development targets

12. Countries often have their own national targets of infrastructure development for the medium to long term (for 5–10 years). An advantage of this approach is that it accounts for country specifics. National targets are in line with priority development projects, thereby reflecting the concrete needs for infrastructure projects. Thus, it is easy to track correspondingly the needs and actual spending on projects.

13. However, it is not clear whether national targets really represent the needs for infrastructure. In practice, national targets are often a combination of the demand and supply. They have already accounted for the past spending history, and they reflect the financing constraints that the country would continue to face. In addition, political considerations and compromises may have already been made. Thus, the national targets often represent the practical, but not the potential, needs for infrastructure.

14. In India, infrastructure investments are planned to double in the next 10 years. The infrastructure spending has been about 4 percent to 5 percent of GDP until recently. In the current 5-year plan, infrastructure spending is increased to between 6 and 8 percent of GDP. By 2016/17, spending will be raised to 10.7 percent of GDP. This increase may not reflect the real demand growth for infrastructure, but it indicates the amount of investments needed to be in line with the country's growth target.

Figure C.1. Infrastructure Investment in India



Source: India Planning Commission.

References

ADB, JBIC and World Bank. 2005. *Connecting East Asia: A New Framework for Infrastructure*.

Arab Finance. January 13, 2011. Infrastructure spending in MENA region ups 42% in 2010, Beltone.

Bhattacharyay, Biswa Nath. 2010. Estimating demand for infrastructure in energy, transport, telecommunications, water and sanitation in Asia and the Pacific: 2010-2020. Asian Development Bank Institute Working Paper No. 248.

Boudier-Bensebaa, Fabienne. 2005. Agglomeration economies and location choice. Economics of Transition 13: 605–28.

Briceno-Garmendia, C., K. Smits, and V. Foster. 2008. Financing public infrastructure in Sub-Saharan Africa: Patterns and emerging issues. Background Paper No. 15, Africa Infrastructure Country Diagnostic, The World Bank.

Calderón, César, Luis Servén. 2004a. The effects of infrastructure development on growth and income distribution. Policy Research Working Paper No. 3400, The World Bank.

Calderón, César, Luis Servén. 2004b. Trend in infrastructure in Latin America, 1980-2001. Policy Research Working Paper No. 3401, The World Bank.

Calderon, Cesar, Luis Serven. 2010. Infrastructure in Latin America. Policy Research Working Paper No. 5317, World Bank.

Cieślik, Andrzej, and Michael Ryan. 2004. Explaining Japanese direct investment flows into an Enlarged Europe: A comparison of gravity and economic potential approaches. Journal of the Japanese and International Economies 18: 12–37.

Commission on Growth and Development. 2008. *The Growth Report: Strategies for Sustained Growth and Inclusive Development*.

Fay, Marianne, and Tito Yepes. 2003. Investing in infrastructure: What is needed from 2000 to 2010? Policy Research Working Paper No. 3102, World Bank, Washington, DC.

Fay, Marianne and Mary Morrison. 2007. *Infrastructure in Latin America and the Caribbean: Recent Developments and Key Challenges.*

Harral, Clell, Asif Faiz. 1988. Road deterioration in developing countries: causes and remedies. World Bank Policy Study No. 13370. The World Bank.

Holl, Adelheid. 2004. Manufacturing location and impacts of road transport infrastructure: Empirical evidence from Spain. Regional Science and Urban Economics 34: 341–63.

IEA. 2010. *World Energy Outlook 2010*. International Energy Agency.

Irving, Jacqueline and Astrid Manroth. 2009. Local sources of financing for infrastructure in Africa : a cross-country analysis, Policy Research Working Paper No. 4878. The World Bank.

Khandker, Shahidur, Douglas Barnes, Hussain Samad, and Nguyen Huu Minh. 2009. Welfare impacts of rural electrification: Evidence from vietnam. Policy Research Working Paper No. 5057, World Bank, Washington, DC.

Foster, Vivien, and Cecilia Briceno-Garmendia. 2010. Africa's Infrastructure: A Time for Transformation. The Agence Francaise de Developpement and The World Bank.

NSTIFC. 2009. *Paying Our Way: A New Framework for Transportation Finance*. Washington DC: National Surface Transportation Infrastructure Financing Commission.

Qureshi, Mahvash. 2008. Africa's oil abundance and external competitiveness: Do institutions matter? IMF Working Paper WP/08/172, International Monetary Fund, Washington, DC.

Roberts, P., K. C. Shyam and C. Rastogi. 2006, Rural Access Index: a key development indicator, The World Bank Group, Transport Papers, TP10.

Shirley, Chad & Winston, Clifford, 2004. Firm inventory behavior and the returns from highway infrastructure investments, Journal of Urban Economics, Elsevier, vol. 55(2), pages 398-415, March.

WHO and UNICEF (World Health Organization and United Nations Children's Fund). 2005. Water for Life: Making It Happen. WHO and UNICEF. Geneva.

WHO and UNICEF (World Health Organization and United Nations Children's Fund). 2010. *Progress on Sanitation and Drinking-Water 2010 Update.*

World Bank. 2006. Infrastructure in Europe and Central Asia region: Approaches to sustainable services. Infrastructure Department, Europe and Central Asia Region, The World Bank.

World Bank Group. 2009. MENA regional conference on infrastructure reform and regulation: Taking the infrastructure agenda forward in the Middle East and North Africa.

World Bank. 2009. World Development Report: Reshaping Economic Geography. Washington, DC: World Bank.

World Bank. 2010. World Development Report 2010: Development and Climate Change. Washington DC: The World Bank.

Yepes, Tito. 2008. Investment needs for infrastructure in developing countries: 2008-2015.