INFRASTRUCTURE
FOR ECONOMIC DEVELOPMENT AND POVERTY REDUCTION
IN AFRICA

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FOREWORD

Urbanization is one of the most powerful, irreversible forces in the world. It is estimated that 93 percent of the future urban population growth will occur in the cities of Asia and Africa, and to a lesser extent, Latin America and the Caribbean.

We live in a new urban era with most of humanity now living in towns and cities.

Global poverty is moving into cities, mostly in developing countries, in a process we call the *urbanisation of poverty*.

The world's slums are growing and growing as are the global urban populations. Indeed, this is one of the greatest challenges we face in the new millennium.

The persistent problems of poverty and slums are in large part due to weak urban economies. Urban economic development is fundamental to UN-HABITAT's mandate. Cities act as engines of national economic development.

Strong urban economies are essential for poverty reduction and the provision of adequate housing, infrastructure, education, health, safety, and basic services.

The *Global Urban Economic Dialogu*e series presented here is a platform for all sectors of the society to address urban economic development and particularly its contribution to addressing housing issues. This work carries many new ideas, solutions and innovative best practices from some of the world's leading urban thinkers and practitioners from international organisations, national governments, local authorities, the private sector, and civil society.

This series also gives us an interesting insight and deeper understanding of the wide range of urban economic development and human settlements development issues. It will serve UN member States well in their quest for better policies and strategies to address increasing global challenges in these areas

Joan Clos
Under-Secretary-General, United Nations
Executive Director, UN-HABITAT

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LIST OF ABBREVIATIONS AND ACRONYMS

AfDB	African Development Bank
AICD	African Infrastructure Country Diagnosis
BOT	Build Operate Transfer
BOOT	Build Own Operate Transfer
CD	Capacity Development
DBFM	Design, Build, Finance & Maintain
DFI	Development Finance Institution
DFID	Department for International Development (UK)
EAIF	Emerging Africa Infrastructure Fund (PIDG)
EU	European Union
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
ICT	Information and Communication Technology
IDA	International Development Agency
IFC	International Finance Corporation (WB)
IPP	Independent Power Producers
MDGs	Millennium Development Goals
MIGA	Multilateral Investment Guarantee Agency (WB)
ODA	Official Development Assistance
OECD	Organisation for Economic Cooperation and Development
OLS	Ordinary Least Squares
PPI	Public-Private Investment
PPIAF	Public-Private Infrastructure Advisory Facility (WB)
PPP	Public-Private Partnership
PSP	Private Sector Participation
SSA	Sub-Saharan Africa
TA	Technical Assistance
UN	United Nations
WB	World Bank
WiMAX	Worldwide Interoperability for Microwave Access
WTO	World Trade Organisation

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CHAPTER 1 **INTRODUCTION**

1.1 Introduction

The adequate supply of infrastructure services has long been viewed as essential for economic development and poverty reduction, both in the policy and academic realms. Over the last two decades, considerable efforts have been devoted to theoretical and empirical evaluation of the contribution of infrastructure to growth and economic development. More recently, increasing attention has also been shifting to the impact of infrastructure on poverty and inequality (Ariyo and Jerome, 2004; Calderon, 2008; Estache and Wodon, 2010; Ogun, 2010). While the extant literature on these two topics is far from unanimous, on the whole, a consensus has emerged that, under the right conditions, infrastructure development can play a major role in promoting growth and equity – and, through both channels, help to reduce poverty.

Paradoxically, in spite of this universally acknowledged attributes and importance, sub Saharan Africa (SSA[1]) trails behind other regions in infrastructure service delivery and quality, with the gap widening over time. This is poignantly demonstrated in the energy sector. With about 800 million citizens, the 48 SSA countries produce collectively about as much power as Spain, which has only a fraction (1/18th) of the population (AICD, 2009). Despite its great potential in clean energy resources, such as hydropower, solar, wind and geothermal, investment in new facilities in SSA has been woefully inadequate, creating a chronic supply imbalance. Investment in maintaining existing infrastructure has also lagged behind, leaving many African countries with degraded and inefficient infrastructure services; poor quality roads, railways, and ports and an inadequate ICT backbone.

The bleak picture of infrastructure deficiencies in SSA is compounded by unprecedented urban growth whose consequences are reflected in the explosion of informal settlements (slums) all over the continent (Binde and Mayor, 2001; Pieterse, 2008). Urbanization in Africa is faster than in any other region of the world. It is estimated that Africa's urban population will more than double the 2007 level of 373.4 million as early as 2025, when 54 percent of the population will be urban. In absolute terms, there will be close to 800 million African urban dwellers then, making it more than today's total number of city dwellers in the entire Western hemisphere (Tibaijuka, 2010). Due to inadequate investment in basic infrastructure, the rapid rate of urbanization in SSA is putting considerable strain on the region's limited infrastructure.

Another key characteristic of urbanization in Africa is that in most countries it is happening without or with limited development, resulting in a rapid increase in urban poverty. Perhaps, the most visible and enduring manifestations of urban poverty is the formation and proliferation of slums (Arimah, 2010).

1 Due to the way data on infrastructure stocks are structured, there is overt reference to Sub Saharan Africa rather than Africa. Many of the indicators for North Africa are lumped with the Middle East.

In the context of economic stagnation, poor governance, and fragile public institutions, it is estimated that almost two-thirds of African urban dwellers are living in slums, characterised by deficient infrastructure, unless current approaches to urban development change radically (Pieterse, 2008). Across Africa, rapid urban growth has been accompanied by a host of problems, such as unemployment and underemployment, a burgeoning informal sector, deteriorating infrastructure and service delivery capacity, overcrowding, environmental degradation, and an acute housing shortage.

The lack of modern infrastructure is an impediment to Africa's economic development and a major constraint on poverty reduction, as well as the attainment of the Millennium Development Goals (MDGs). Available evidence shows that lives and livelihoods are suffering from the fragile state of infrastructure in SSA. The lack of adequate transport, power, communication networks, water, sanitation and other infrastructure puts severe constraints on economic growth and poverty reduction across the region. Taken as a whole, these infrastructure constraints erode Africa's competitiveness and make bringing African goods and services to the world marketplace a challenge. According to the World Bank's 2009 Doing Business, most sub-Saharan African countries, with few exceptions, rank in the bottom 40 percent of all countries in the trading across borders indicator. The needs for infrastructure in SSA are enormous, hence the resurgence of interest in the region's infrastructure. From rural roads, railways and harbours, to irrigation systems, telecommunications, clean water, sanitation, energy and such basic social infrastructure as health, education, banking and commercial services, hundreds of millions of Africans lack even the most fundamental amenities. This is particularly true in rural areas, where the majority of the people live. The burden also falls most heavily on women, who, in the absence of electricity often must spend hours collecting wood for cooking and heating.

Although the damaging economic and social impacts of Africa's infrastructure deficiencies were widely recognized, investment in African infrastructure declined relative to other priorities during the 1990s. In part, there was an incorrect assumption that private investors would step in to finance the much needed infrastructure. However, the private sector has not produced the massive investments and dramatically improved technical performance hoped for (Jerome, 2009). Notable successes notwithstanding, overall outcomes have fallen short of expectations. The results have been disappointing, particularly in relation to water and electricity needs, two areas critical to the rapid economic development of Africa. Available evidence shows that there has been limited mobilization of private financing; a number of concessions have run into problems; in many countries, the cost of infrastructure services has not diminished, and increases in quality and access rates have not occurred as anticipated.

The investment needs in Africa's infrastructure are quite substantial. The Africa Infrastructure Country Diagnostic Study (AICD) estimates the cost of addressing Africa's infrastructure at about USD 93 billion a year, about 15 percent of GDP, one-third of which is for maintenance. The region's track record of investment flows suggests that the private sector by itself is unlikely to provide the kind of near-term funding needed to address these shortcomings.

With Africa's low levels of infrastructure investment in the face of rapidly growing needs, the private sector appears capable of supplying only a fraction of the investment needs. The current global economic and financial crisis poses a new threat to the role of the private sector in financing infrastructure development in Africa.

The effects of the crisis are already apparent in greater delays in financial closures, more cancellations, and higher financing costs for PPI (full) projects, despite the stim¬ulus package in response to the financial crisis in several countries, often targeted at infrastructure.

However, unlike the debates on the reforms of the 1990s which were shaped by ideological orientation and blame game, there is gradually a coalescing of opinions on the reform agenda in addressing Africa's infrastructure despite the wide variation and diversity in countries and regions. A lot of learning has taken place in the past two and a half decades and substantial efforts have been invested in data in recent years[2]. The choice is no longer simply a dichotomy between public and private provision, but how to forge mutual cooperation between these two sectors, defined by areas of competence. There is growing consensus that the public sector must retain a much more important role in financing than previously admitted, while the private sector is expected to help in meeting the significant needs associated with infrastructure construction, operation, and, to some extent, financing in sectors such as telecommunications, energy generation, and transport services in which commercial and political risks are much lower. Small-scale operators are also assuming an increasing, yet generally underestimated role in catering to the needs of the populations not supplied by the actors with higher visibility. Access, affordability and quality of service rendered by small providers are still not clearly understood and deserve more research and analysis.

This report evaluates the role of infrastructure in promoting economic growth and poverty reduction in Africa. It is devoted to the study of the complementary physical infrastructure - telecommunications, power, transport (roads, railways, ports and airports), and water supply. The report is presented in seven chapters. Chapter Two appraises the relationship between infrastructure and development; Chapter Three examines Africa's infrastructure endowment; and Chapter Four evaluates the financing options. The focus of Chapter Five is the record of private sector participation in Africa, while Chapter Six examines the infrastructure/ development and poverty nexus in Africa. Chapter Seven concludes.

2 The most comprehensive effort is the Africa Infrastructure Country Diagnostic (AICD), a project designed to expand the world's knowledge of physical infrastructure in Africa. Financing for AICD is provided by a multi-donor trust fund to which the main contributors are the Department for International Development (United Kingdom), the Public Private Infrastructure Advisory Facility, Agence Française de Développement, and the European Commission.

CHAPTER 2 FRAMEWORK FOR INFRASTRUCTURE, POVERTY REDUCTION AND ECONOMIC DEVELOPMENT

2.1 Definition/ Key Infrastructure Sectors

The last two years have witnessed a heightened interest in infrastructure in both developed and developing countries, with emphasis on the role of infrastructure in mitigating the global financial crisis through stimulus packages in developed countries, and the recurring attention on its impact on growth and poverty reduction in developing countries (Jerome, 2009). There is no iron clad definition of infrastructure. It is most commonly discussed in terms of its characteristics - longevity, scale, inflexibility, and higher investment costs - but that is seldom seen as satisfactory.

Other characteristics describe infrastructure as:

- essentially public goods, providing in principle, non-exclusive goods accessible to all;
- Fixed investments, bulky and lump-sum with long (or no) payback periods;
- having considerable variation in earning power capacity (e.g. telecommunications versus water);
- Output mostly paid for in local currency (less true for ports and airports);
- Until recently, the public sector playing a dominant role (finance, regulation);
- Sensitive to corruption and political shifts.

Increasingly, the meaning of infrastructure has been shifting from one focusing on physical fixed assets such as roads, airports, sea ports, telecommunications systems, water distribution systems and sanitation (what might be called 'public utilities'). It now often embodies notions of softer types of infrastructure such as information systems and knowledge bases (Button, 2002). In general, infrastructure can be categorized into 'hard' infrastructure and 'soft' infrastructure. The former refers to physical structures or facilities that support the society and economy, such as transport (ports, roads and railways); energy (electricity generation, electrical grids, gas and oil pipelines); telecommunications (telephone and internet); and, basic utilities (water supply, hospitals and health clinics, schools, irrigation, etc.). The latter refers to non-tangibles supporting the development and operation of hard infrastructure, such as policy, regulatory, and institutional frameworks; governance mechanisms; systems and procedures; social networks; and transparency and accountability of financing and procurement systems (Bhattacharyay, 2008).

Broadly defined, therefore, infrastructure refers to all basic inputs into and requirements for the proper functioning of the economy. In spite of this, there are two generally accepted categories, namely, economic and social infrastructure.

Economic infrastructure is also, at a given point in time, part of an economy's capital stock used to facilitate economic production, or serve as inputs to production (e.g. electricity, roads, and ports). This helps to produce items that are consumed by households (e.g. water, sanitation and electricity). Economic infrastructure can further be subdivided into three categories: utilities (power, piped gas, telecommunications, water and sanitation, sewerage and solid waste disposal), public works (roads and water catchments in dams, irrigation and drainage) and other transport sub-sectors (railways, waterways and seaports, airports and urban transport systems). In national accounts statistics, these are found in two sub-headings of the gross domestic product (GDP): electricity, gas and water are located in the secondary sector; while transport, storage and communication are found in the tertiary sector.

Social infrastructure, on the other hand, encompasses services such as health, education and recreation. It has both a direct and indirect impact on the quality of life. Directly, it enhances the level of productivity in economic activities, indirectly, it streamlines activities and outcomes such as recreation, education, health and safety. The indirect benefit of improved primary health care, for example, is improved productivity, which in turn leads to higher economic growth and real incomes. Social infrastructure also facilitates investment in human capital that ensures better utilization by some of the economy's physical capital stock and thereby raises the productivity of the workforce. The impact on growth is similar to an increase in the supply of capital – a higher capital to labour ratio which enables a given number of workers to produce more output per capita. It also enhances the quality of life of the populace by empowering them economically, politically and socially, with the attendant positive effects on efficient use of national resources and on poverty alleviation.

2.2. Infrastructure and the Millennium Development Goals

At the United Nations (UN) Millennium Summit of September 2000, 189 nations adopted the 'Millennium Declaration,' out of which grew a set of eight goals, 18 numerical targets and 48 quantifiable indicators to be achieved over the 25-year period from 1990-2015. The Millennium Development Goals (MDGs) commit the international community to an expanded vision of poverty reduction and pro-poor growth and vigorously place human development at the centre of social and economic progress in all countries. They seek to reduce the number of poor people in the world and specifically target the worst aspects of poverty.

Economic infrastructure – essentially, transport, energy, information and communications technology, water, sanitation and irrigation – is specifically identified in the Millennium Development Goals (MDGs), only in respect of *water and sanitation, telephones, personal computers and internet users.* The transport sector has been largely ignored in the MDGs discourse; hence it is widely referred to as the 'omitted MDG'.

In many ways, infrastructure investments underpin virtually all the MDGs, including halving poverty in the world by 2015 as shown in Table 1. It is widely acknowledged that the contribution of infrastructure to halving income poverty or MDG 1 is more significant than the other goals (Willoughby, 2004). Infrastructure also affects non-income aspects of poverty, contributing to improvements in health, nutrition, education and social cohesion. For example, roads contribute significantly to lowering transaction costs (MDG I), raising girls' school attendance (MDG II/III), improving access to hospitals and medication (MDG IV/V/VI), and fostering international connectivity (MDG VIII).

TABLE 1: **Infrastructure's Contribution to the Millennium Development Goals**

MDGs =>	I	II	III	IV	V	VI	VII	VIII
	Poverty	Education	Gender	Mortality.	Mat. Health	HIV	Environment.	Partnership
Infrastructure:								
Transport (local)	+++	++	++	+	+		+	+
Transport (regional)	+++	+	+	++	+	+	--	+++
Modern energy	+++	+	+	++	+	+	++	+
Telecoms	++	+	+	+	+	+	+	++
Water (private use)	++	++	+	+++	+	+	+++	+
Sanitation	+	+	++	+	+	+	++	+
Water management	+++		+	+			++	

Source: Willoughby 2004

Taken in this context, infrastructure makes valuable contributions to all the MDGs (Willoughby, 2004). The many benefits of infrastructure have also been confirmed by the United Nations Millennium Project (2005), which advocates for a major increase in basic infrastructure investments, to assist countries (especially in Africa) escape the poverty trap.

2.3. The Concept of Poverty and the Poor

The MDGs are focusing international attention more sharply on poverty reduction. The international target proposed by the Millennium Development Goal has been widely adopted, namely in 2015 to reduce by half the proportion of people living in extreme poverty. But quite what this target might mean is obscured by the bewildering ambiguity with which the term 'poverty' is used, and by the pecuniary indicators proposed to monitor it like the international poverty line of USD1 per day.

Poverty often appears as an elusive concept, especially from the perspectives of researchers and policy makers in developing countries. The best definition of poverty remains a matter of considerable academic argument. Perhaps the only point of general agreement is that people who live in poverty must be in a state of deprivation; that is, a state in which their standard of living falls below minimum acceptable standards.

The concepts of poverty have developed rapidly over the last four decades. From an analytical perspective, serious concern or thinking about poverty can be traced back to Rowntree's (1901) study. In the 1960s, the main focus was on the level of income, reflected in macro-economic indicators like Gross National Product (GNP) per head. This was associated with an emphasis on growth, for example in the work of the Pearson Commission – *Partners in Development* (1969). In the 1970s, concern about poverty became more prominent, notably as a result of Robert McNamara's celebrated speech to the World Bank Board of Governors in Nairobi in 1973 on basic needs, and the subsequent publication of Redistribution with Growth (Adelman, 1974).

According to the World Bank (2001), "poverty is pronounced deprivation in well-being", where well-being can be measured by an individual's possession of income, health, nutrition, education, assets, housing, and certain rights in a society, such as freedom of speech. Poverty is also viewed as a lack of opportunities, powerlessness, and vulnerability. This broadens the definition of poverty to include hunger, lack of shelter, being sick and not being able to see a doctor, not being able to go to school and not knowing how to read, not having job, fear for the future, living one day at a time and losing a child to illness brought by unclean water. Poverty further entails lack of representation and freedom. Indeed, the poor themselves see powerlessness and voicelessness as key aspects of their poverty (Narayan et al., 2000).

In general, poverty is a condition that is experienced over time and is the outcome of a process. While many are born into poverty and remain in it, others experience the condition at one or more stages of their life and move in and out of it. Fundamentally, poverty is a negative term denoting absence or lack of material wealth. Such absence, however, is seldom absolute and the term is usually employed to describe the much more frequent situation of insufficiency either in the possession of wealth or in the flow of income (Green, 2008).

As Green (2008) suggests, poverty is often embedded in social structures that exclude the poor. Social exclusion can be understood as those processes of discrimination that deprive people of their human rights and result in inequitable and fragmented societies. Gender discrimination is the most common form of discrimination worldwide. The Human Development Report (2001) notes that 70 percent of the world's poor are female on average and that women's share of GDP in developing countries is less than 50 percent of men's. Institutionalised racism, as in South Africa, is also responsible for extreme inequality in income and land ownership (DFID, 2002).

Seen from this perspective, poverty is a multi-dimensional phenomenon and experiences of poverty are conceptually specific to geographical areas and groups. Many factors converge to make poverty an interlocking multi- dimensional phenomenon. These come out clearly in the criteria used to differentiate between categories of rich, average and poor. The 2000/2001 World Development Report (World Bank 2001) identifies three broad dimensions of poverty relating to lack of income, insecurity and lack of political voice.

In defining and measuring poverty, a distinction, thus, needs to be made between the traditional uni-dimensional approach and more recent multidimensional ones. Whereas the traditional approach refers only to one variable such as income or consumption, multidimensional ones, such as Sen's capability theory or studies derived from the concept of fuzzy sets, extend the number of dimensions along which poverty is measured.

The Oxford Poverty and Human Development Initiative recently unveiled an innovative new "multidimensional" measure of people living in poverty, known as the Multidimensional Poverty Index or MPI. The MPI features three deprivation dimensions -- health, education and standard of living. Using the Alkire Foster method, outcomes of individuals or households are measured against multiple criteria (ten in all) from each of the three dimensions, thus providing a detailed picture of not just who is poor, but in what way they are poor. The MPI will be featured in the upcoming 20th-anniversary edition of the UNDP Human Development Report 2010.

2.4. Infrastructure and Economic Development

A recent body of research confirms the importance of infrastructure service provision to sustainable development. The World Bank's (1994) *World Development Report* landmark study on infrastructure highlighted the critical role of infrastructure in the development process.

The evidence in the World Bank report on the vital role of infrastructure services in growth has been reinforced by subsequent research, especially that focusing on Africa's economic performance (Ndulu, 2006). Not only does the development of infrastructure services contribute to growth, but growth also contributes to infrastructure development, in a virtuous circle. Moreover, investments in human capital and in infrastructure interact, each increasing the returns to the other.

DFID (2002) identified the various channels through which investment in infrastructure can contribute to sustainable growth, as follows:

- Reducing transaction costs and facilitating trade flows within and across borders.
- Enabling economic actors – individuals, firms, governments – to respond to new types of demand in different places;
- Lowering the costs of inputs for entrepreneurs, or making existing businesses more profitable;
- Creating employment, including in public works (both as social protection and as a counter-cyclical policy in times of recession);
- Enhancing human capital, for example by improving access to schools and health centres; and,
- Improving environmental conditions, which link to improved livelihoods, better health and reduced vulnerability of the poor

Empirically, research on the impact of infrastructure took off relatively recently, following the seminal work of Aschauer (1989), and has blossomed over the last two decades.

In general, the evidence on the impact of infrastructure on poverty comes from two types of studies. The first focuses on the absolute impact of infrastructure on macroeconomic (production-related) indicators, the second is the microeconomic evidence both at the household and firm levels. A recent development in the microeconomic literature is the increasing use of randomized evaluation to demonstrate impact as well as focus on the dynamic and stochastic nature of poverty. This derives from the realization that that policy analyses based on static poverty can yield substantial inefficiencies in policy interventions (Jalan and Ravallion 1998).

2.4.1 Macroeconomic Evidence

A considerable effort have been devoted at the macroeconomic level to assessing the effects of infrastructure on broad aggregates such as output, growth and productivity, using a variety of data, empirical methodologies and infrastructure measures. Literally hundreds of papers have been written on this subject. The most popular approaches include the estimation of an aggregate production function (or its dual, the cost function), and empirical growth regressions. Infrastructure is variously measured in terms of physical stocks, spending flows, or capital stocks. Estache (2006), Romp and de Haan (2007) and Straub (2007) offer comprehensive surveys of this literature. Admittedly, more of these studies are based on the experience of developed economies.

Aschauer (1989) opened the debate on the macro-economic impact of infrastructure when he found that the elasticity of national GDP to infrastructure is high in the United States, roughly 0.4 for total public capital and 0.24 for core infrastructure. Such large estimates have often been considered unrealistic and

have triggered a large amount of subsequent research, which looks at different samples or refining the techniques used. Subsequent studies by Munnell (1990), and Nadiri and Mamuneas (1994), confirm these results at the national level. However, some researchers, including Garcia Mila and Mcguire (1992) and Morrison and Schwartz (1996), find this elasticity to be lower, and sometimes insignificant at the state or local level (Eberts 1990, Hulten and Schwab 1991), Munnell (1990), for instance, found the elasticity to be around 0.15 at the US metropolitan level.

A majority of this literature observes a positive long-run effect of infrastructure on output, productivity, or their growth rate. More specifically, this is the case with almost all of the studies using physical indicators of infrastructure stocks. But the results are more mixed among the growth studies using measures of public capital stocks or infrastructure spending flows than those that do not (Straub 2007).

Romp and de Haan (2005), while reviewing the literature note that 32 of 39 studies of OECD countries found a positive effect of infrastructure on some combination of output, efficiency, productivity, private investment and employment. (Of the rest, three had inconclusive results and four found a negligible or negative impact of infrastructure). They also review 12 studies that include developing countries. Of these, nine find a significant positive impact. The three that find no impact rely on public spending data which is a notoriously imprecise measure, especially for cross-country analysis. Other meta-analysis also shows a dominance of studies that point to a generally significant impact of infrastructure particularly in developing countries. Calderon and Serven (2004) report that 16 out of 17 studies of developing countries find a positive impact as do 21 of 29 studies of high income countries. Briceño et al (2004) carry out a similar review of about 102 papers and reach similar conclusions.

A strand of the literature has focused on the development impact of infrastructure in Africa. Ayogu (2007) provides a survey of the empirical literature. Most of the studies deal with the growth and productivity effects of infrastructure development. For example, Estache, Speciale and Veredas (2005) present pooled OLS growth regressions based on an augmented Solow model, including a variety of infrastructure indicators. Their main conclusion is that roads, power and telecommunications infrastructure, with the exception of water and sanitation, contribute significantly to long-run growth in Africa. Other studies based on the same production function approach, such as those by Ayogu (1999), Boopen (2006) and Kamara (2006) make similar findings.

In the same vein, Perkins, Fedderke and Luiz (2005) use a detailed database on infrastructure investment and capital stocks, spanning as long as a hundred years, to test for the existence of a long-run relation between different infrastructure measures and GDP. Their results suggest a bi-directional relation in most cases. Kularatne (2005) explores the effects of infrastructure investment (as well as social spending on health and education) on GDP. He also finds bi-directional effects, although the impact of infrastructure investment appears to occur indirectly through private investment.

A more recent study by Calderón (2009) provides a comprehensive assessment of the impact of infrastructure development on economic growth in African countries. Based on econometric estimates for a sample of 136 countries over the period 1960–2005, it evaluates the impact of a faster accumulation of infrastructure stocks and an enhancement in the quality of infrastructure services on economic growth across African countries over the 15-year study period. The study findings indicate that growth is positively affected by the volume of infrastructure stocks and the quality of infrastructure services.

The simulation shows that if all African countries were to catch up with the region's leader, Mauritius, in the infrastructure stock and quality, their rate of economic growth would be enhanced—on average by 2.2 percent per year, and ranging from 0.6 to 3.5 percent.

Several broad generalizations can be deduced from the literature. First, there is increasing consensus on the notion that infrastructure generally matters for growth and production costs, although its impact seems higher at lower levels of income. Nevertheless, the findings remain tremendously varied, particularly in relation to the magnitude of the effect, with studies reporting widely varying returns and elasticity. Overall, the literature supports the view that infrastructure matters but does not unequivocally argue in favour of more or less infrastructure investments.

Second, the literature has been plagued by numerous methodological issues that have often clouded the robustness of the conclusions[3]. Estimating the impact of infrastructure on growth is a complicated endeavour, and papers vary in how carefully they navigate the empirical and econometric pitfalls posed by network effects, endogeneity, heterogeneity and very poor quality data.

In general, most critiques of Aschauer's (1989) pioneering work with its findings of implausibly high rates of return focus on a failure to appropriately correct for the possibility that an omitted variable is driving the results. Indeed, later studies (see Grammlich 1994 for an overview of this literature) attempted to correct this by introducing country (or region) fixed-effects and found much lower rates of return. However, the fixed-effect approach precludes looking at the impact of other slow moving variables, hence a number of authors prefer not to use it (e.g. Estache, Speciale and Veredas 2006). Even when studies have been technically sound, they have suffered from other limitations such as the nature of data. Infrastructure capital stocks are inadequate proxies to the growing private nature of infrastructure services, while physical indicators are still too coarse to really capture the flow of services to households and firms, and optimal stocks are unlikely to be ever identifiable at the aggregation level of regions or countries. This is reflected in the wide variety of findings in the now abundant empirical literature on infrastructure and growth or productivity.

2.4.2 Microeconomic Evidence

Infrastructure, no doubt, has major implications for a variety of development outcomes, both at the household level (health, education and social mobility), at the firm level (productivity, industrial development) and at the global level (climate change). The microeconomic literature on infrastructure is, however, still evolving and far from robust but with divergent results similar to the macroeconomic evidence.

In the micro-economic literature, considerable attention has been devoted to roads because of the perception that they will ineluctably lead to poverty reduction and income generation, especially in rural areas. Gibson and Rozelle (2003), for example, appraise the effect of access to roads in Papua New Guinea on poverty at the household level. They demonstrate that reducing access time to less than three hours where it was above this threshold, leads to a fall of 5.3 percent in the head count poverty index.

3 See for example Estache and Fay (2007), Briceño-Garmendia and Klytchnikova (2006) and Briceño- Garmendia, Estache and Shafik (2004) for more elaboration on the methodological challenges in the study of infrastructure.

Using Tanzanian household survey data, Fan, Nyange and Rao (2005) look at the impact of public investment and roads on household level income and poverty and find very positive effects, with a ratio of 1 to 9 in the case of public capital investment. Bakht, Khandker and Koolwal (2009) estimate the impact of two roads projects in Bangladesh on seven household outcomes by household fixed-effects method. For the two projects under consideration, road development significantly reduced the price of fertilizer. Transport costs also decreased significantly. Going beyond mere access, Gachassin, ET. al (2010) use the second Cameroonian national household survey (Enquête Camerounaise Auprès des Ménages II, 2001) to address the impact of road access on poverty. They report that it is not road availability per se that helps to reduce poverty, but the opportunities opened by roads, more specifically labour opportunities.

Another group of studies examines firm-level data. Reinikka and Svensson (2002) use unique microeconomic evidence to show the effects of poor infrastructure services on private investment in Uganda. They surveyed Ugandan firms to analyze how entrepreneurs cope with deficient public capital. Their study findings show that faced with unavailable and unpredictable services, many firms invest in substitutes such as electricity generators. According to Reinikka and Svensson, poor public capital, proxied by an unreliable and inadequate power supply, significantly reduces productive private investment. As a result, poor public capital crowds out private investment. Their findings are similar to those from investment climate assessments, such as Anas, Lee and Murray (1996) and Lee, Anas and Oh (1996) on Indonesia, Nigeria and Thailand, and Alby and Straub (2007) on eight Latin American countries.

Without any doubt, drawbacks of the microeconomic approach exist, the main one being that since the contributions are by nature focused on specific cases and contexts, they may not always provide lessons that can be generalized.

2.4.3 Micro-Level Studies on Mobile Phones

The rapid adoption of mobile phones has generated a great deal of studies on its effect on economic development and poverty eradication. Although the evidence on Africa is quite recent, an emerging body of literature identifies the effect of mobile phones on development outcomes, using mainly panel data and the quasi-experimental nature of the rollout of mobile phone service. These studies primarily focus on the relationship between mobile phone coverage and specific outcomes, such as price dispersion across markets (Aker and Mbiti, 2010), market agents' behavior (Aker, 2008; Muto and Yamano, 2009) and producer and consumer welfare (Aker, 2008).

Aker (2008) examines the impact of mobile phones on grain markets in Niger. He finds that the introduction of mobile phones is associated with increased consumer welfare through a reduction in the intra-annual coefficient of variation, thereby subjecting consumers to less intra-annual price risk. Mobile phones also increased traders' welfare, primarily by increasing their sales prices, as they were able to take advantage of spatial arbitrage opportunities. The net effect of these changes was an increase in average daily profits, equivalent to a 29 percent increase per year.

Aker and Mbiti (2010) also find that the introduction of mobile phones reduces dispersion of grain prices across markets by 10 percent. The effect is stronger for those market pairs with higher transport costs, namely, those that are farther apart and linked by poor quality roads. The effect is also stronger over time, suggesting that there are networks effects.

The primary mechanism through which mobile phones improve market efficiency is a change in traders' (middlemen) marketing behaviour: grain traders operating in mobile phone markets search over a greater number of markets, sell in more markets and have more market contacts as compared with their non-mobile phone counterparts.

Muto and Yamano (2009) estimate the impact of mobile phones on agricultural markets in Uganda, focusing on farmers' market participation rather than market efficiency. Using a panel dataset on farm households between 2003 and 2005, they find that mobile phone coverage is associated with a 10 percent increase in farmers' probability of market participation for bananas, although not maize, thereby suggesting that mobile phones are more useful for perishable crops. This effect was greater for farmers located in communities farther away from district centres. The authors suggest that improved access to price information reduced marketing costs, increased farm-gate prices and productive efficiency though they did not empirically explore the specific mechanisms driving the results.

2.5 Poverty and Inequality

The studies reviewed in the preceding section all look at infrastructure's contribution to economic growth rather than specifically poverty and inequality. While there is considerable evidence that infrastructure development is correlated with economic growth, there is less evidence to support a positive impact on poverty. Some evidence suggests that certain types of infrastructure service provision, such as roads and transport, have a potential contribution to agricultural output, and that infrastructure improvements (in electricity supply, transport and telecommunications) in small towns contribute significantly to industrial growth and employment. At a community or individual level, benefits can accrue to the poor if labour-intensive methods of construction are used rather than capital-intensive methods (Sida 1996).

Datt and Ravallion (1998) analyze state-level poverty data from India for the period 1957–1991 and conclude that state-level differences in poverty reduction can be attributed to differences in initial conditions, particularly irrigation infrastructure and human resources. Similarly, van de Walle (1996) uses the Vietnam Living Standards Survey of 1992–1993 and estimated the poverty reduction effect of irrigation infrastructure. With regard to the impact of water supply projects on poverty, Jalan and Ravallion (2003) proved that the water supply system had a stronger economic effect among poor households than it did among non-poor households. Lokshin and Yemtsov (2004, 2005) estimate the poverty reduction effect of community-level infrastructure improvement projects on water supply systems that were implemented between 1998 and 2001 in Georgia. Jalan and Ravallion (2003) investigate the role of water supply and public health systems. Moreover, the role of irrigation and water related infrastructure in poverty reduction has been well documented in the literature.

A strand of the empirical literature focuses on the poverty effects of specific infrastructure projects, using matching techniques that combine samples of beneficiaries with samples drawn from regular household surveys. On the whole, the evidence shows that public investment on infrastructure, especially on the rehabilitation of rural roads, improves local community and market development. For example, rehabilitation of rural roads raises male agricultural wages and aggregate crop indices in poor villages of Bangladesh (Khandker et al. 2006). Likewise, in Vietnam public investment in infrastructure has resulted in an increase in the availability of food, the completion rates of primary school and the wages of agricultural workers (Mu and van de Walle, 2007).

In the same vein, other studies elsewhere find that access to new and improved roads in rural areas enhances opportunities in non-agricultural activities in Peru (Escobal and Ponce, 2002) and in non-farm activities among women in Georgia (Lokshin and Yemtsov, 2005).

Given the controversy surrounding both the theoretical and empirical literature on the determinants of poverty, Jalilian and Weiss (2004) explore the nexus between infrastructure, growth and poverty using samples of countries from Africa, Asia and Latin America. Applying different theoretical and empirical techniques, they obtain results from the estimation of the 'ad hoc model' showing that on average, a one per cent increase in infrastructure stock per capita, holding human capital constant, is associated with a 0.35 per cent reduction in the poverty ratio, when poverty is measured by USD 1/day poverty headcount, or 0.52 per cent when it is measured by USD 2/day poverty headcount. This study suggests that, while infrastructure investment in general has a role to play in poverty reduction, physical infrastructure investment needs to be very substantial and must be supported by factors such as improvement in social infrastructure so as to promote rapid reductions in poverty.

However, relatively few empirical studies have tackled directly the inequality impact of infrastructure at the macroeconomic level. López (2004) and Calderón and Servén (2008) are perhaps the two well known studies and they both use cross-country panel data. López uses telephone density to proxy for infrastructure, while Calderón and Servén employ synthetic indices of infrastructure quantity and quality. In both cases, the finding is that, other things being equal, infrastructure development is associated with reduced income inequality. Indeed, for infrastructure development to reduce income inequality, it must help expand access by the poor, as a key ingredient. Combined with another finding that infrastructure appears to raise growth rates, the implication would, therefore, be that with the right conditions, infrastructure development can be a powerful tool for poverty reduction.

The empirical literature suggests that the link between infrastructure and poverty reduction is not linear. While the picture is broadly positive, experience suggests that there is a complex set of variables that need attention if the development of infrastructure services is to contribute to pro-poor growth. 'White elephant' infrastructure projects are well documented, while a variety of barriers may prevent poor people from access to economic opportunities created. In particular, it should be noted that an inadequate focus on governance and institutional frameworks has resulted in outcomes that are often less than anticipated. High levels of personal and political corruption, facilitated by weak systems, have hindered a demand-led approach, distorted public investment choices, diverted benefits from the poor, encouraged neglect of maintenance and hindered the contribution to growth. Too often, there have been negative rather than positive consequences for poor people, including environmental damage to which the poor are most vulnerable.

In general, non-poor households seem to benefit more from public infrastructure investments than non-poor households (World Bank 1994). In Bangladesh, for example, non-poor groups receive over 80 percent of subsidies on infrastructure (Kessides, 1993). Moreover, infrastructure development can have negative impacts on specific social groups due to, among other factors, displacement, environmental pollution and health risks, and loss of livelihoods. Generally, the urban poor are increasingly situated at the periphery of cities where access to city facilities and job opportunities is restricted.

2.6 Randomized Field Experiments and Impact Evaluation

The last decade has witnessed an explosion in the use of randomized field experiments of the Bannerjee-Duflo type (the same approach used by the medical industry to determine if a drug or treatment does what it was designed to do) to poverty interventions to identify whether or not a program is effective. The explosion has resulted from a convergence of several forces- the increasing demand for accountability and results by key stakeholders including bilateral and multilateral donors, availability of high quality data, refinement in the field and interest by academics amid some skeptics.

Experimental designs, also known as randomization, are generally considered the most robust of the evaluation methodologies. By randomly allocating the intervention among eligible beneficiaries, the assignment process itself creates comparable treatment and control groups that are statistically equivalent to one another, given appropriate sample sizes. The outcome is very powerful because, in theory, the control groups generated through random assignment serve as a perfect counterfactual, free from the troublesome selection bias issues that exist in all evaluations. Quasi-experimental (non-random) methods are also used to carry out an evaluation when it is not possible to construct treatment and comparison groups through experimental design. These techniques generate comparison groups that resemble the treatment group, at least in observed characteristics through econometric methodologies, which include matching methods, double difference methods, instrumental variables methods, and reflexive comparisons. The main benefit of quasi-experimental designs is that they can draw on existing data sources and are, thus, often quicker and cheaper to implement, and they can be performed after a program has been implemented, given sufficient existing data. The principal disadvantages of quasi-experimental techniques are that (a) the reliability of the results is often reduced as the methodology is less robust statistically; (b) the methods can be statistically complex; and (c) there is a problem of selection bias.

While there is growing coverage of the sector in evaluation efforts, published evaluations on infrastructure are still few as compared to health or education. Estache (2010) presents an excellent review of the literature on impact evaluations on infrastructure derived mainly from experimental and quasi-experimental techniques and other methodologies when these techniques cannot be used. The review takes stock of the lessons of recent impact evaluations in energy, water and sanitation so far covered by evaluations based on randomized experiments as well as the various transport subsectors (ports, railways, rural roads and highways).

In all, modern evaluation techniques are delivering on their promise to identify poverty related and distributional issues with many of the interventions considered in infrastructure activities, whether projects, programs or policies. Whatever the form of evaluation, the research and practice of the last few years has provided many insights on why not all apparently comparable interventions have sometimes generated dissimilar impacts across locations. Differences in institutions, legal or social incentives and norms, access to and sources of financial resources, technological preferences and choices or in initial conditions can all explain quite convincingly differences in impact.

In what follows, we succinctly appraise developments in three infrastructure sectors where the methodology is reasonably advanced:

2.6.1 Water and Sanitation

There are several recent evaluations conducted in water and sanitation, including the World Bank Dime initiative (Poulos et al. (2006), the World Bank Evaluation Department, (IEG, 2008) and a new think tank (3ie) focusing on impact evaluations (Snilstveit and Waddington, 2009). Snilstveit and Waddington (2009), for example, which is the most recent, is a synthetic review of impact evaluations examining effectiveness of water, sanitation and hygiene (WSH) interventions in reducing childhood diarrhea. The survey was limited to rigorous impact evaluation techniques, using experimental (randomised assignment) and quasi-experimental methods, and which evaluated the impact of water, sanitation and/or hygiene interventions on diarrhoea morbidity among children in low- and middle-income countries. It identified 65 studies for quantitative synthesis, covering 71 distinct interventions assessed across 130,000 children in 35 developing countries during the past three decades.

According to the survey, studies typically vary from 6 to 19 months in duration of collection of water related disease data, with their average sample sizes varying from 327 for point of use treatment to almost 6000 for water supply. All studies found some impact for each intervention type but there was significant diversity of efforts across studies. The results, however, call into question some received wisdom, particularly with regard to the sustainability of water quality interventions and more limited effectiveness of sanitation.

The main consensus in water and sanitation is:

- The questions posed by these studies validate many of the common perceptions regarding the desirability of meeting the Millennium Development Goals (MDGs) soon. Water and sanitation are associated with other desirable MDG goals, namely, health, education, nutritional, employment and income outcomes:
- There is some variance in the effectiveness of the interventions aimed at reaching the MDGs. For instance, unless all connections come from piped water, water supply interventions tend to be less effective in terms of health (although they can help save time) than water treatment at point of use interventions or than many sanitation and hygiene interventions. Assessments thus need to reflect quality of water and quality of service and not just the quantity resulting from the intervention;
- Social norms are quite relevant in maximizing the efforts to improve hygiene and in ensuring the cooperation needed to guarantee the sustainability of interventions in the sector; and,
- The policy and institutional context in which the evaluation is conducted is extremely important. For example, educating water users can have high payoffs as well but that the form of education matters a lot more than many field workers sometimes recognize. For instance, the effects can be very different if the knowledge comes from peers or if it comes from common formal training. There is however no clear ranking of approaches.

2.6.2 Transport

Transport does pose special challenges that limit the possibility to assume randomness. While many small scale or rural transport projects can be evaluated using real or quasi trials, large projects such as highways, ports, airports and railways are not easily amenable to experimental and quasi-experimental techniques. For example, to perform a purely randomized experimental approach, one would need two or more similar areas in terms of their geography and economic situation. Investments are sometimes based on demand forecasts with 20-30 years lead time. The payoffs to many infrastructure interventions tend to be slow to show up.

Estache (2010), thus, recommends the use of other feasible approximations such as general equilibrium and other structural models to obtain an evaluation (propensity scores) but they are not simple either.

van de Walle (2009) offers a very thorough overview of the technical dimensions of impact evaluations of rural road projects. She observes that very few of the many aid-financed rural road projects in developing countries have been subject to evaluations. The reason being that they are simply hard to do using (quasi-) randomized evaluation techniques. The most challenging characteristic of road projects in terms of the techniques approximating random trials is that they have no natural comparison group. It is, indeed, hard to find two similar regions in all the relevant characteristics such as the initial conditions in the composition and level of production activities, composition and levels of skills of workers, the number of users, access to other transport modes, access to schools or any variable that may influence the evolution of the derived demand for the road and hence the comparability of the evolution of regions with and without the road project. In addition, evaluators have a hard time addressing all relevant spillover effects as well as time dimensions associated with many road PPPs. This is why it is still common to see assessments of the impact of rural roads interventions conducted through general equilibrium modeling (Estache, 2010). Despite the challenges, there are a few well known top quality evaluations. Banerjee, Duflo and Qian (2009) for China, Jacoby (2001) on Nepal, van de Walle and Mu (2007) on Vietnam, Gibson and Rozelle (2003) on Papua New-Guinea), Khandaker et al. (2006) on Bangladesh and Dercon et al. (2007) on Ethiopia.

Banerjee, Duflo and Qian (2009), for example, estimate the effect of access to transportation networks on regional demographic and economic outcomes across counties in China during 1986-2003. They go beyond the trade related impacts and assess the effects of greater factor mobility, better access to education, health care and finance, and other effects of diffusion of ideas, technologies, etc. Their results are still preliminary and somewhat surprising. They do not find a significant effect on GDP levels, population, or the composition of population. However, with a few important caveats, they find a distributional impact across space from distance to railways. On average, increasing distance from railroads by one percent decreases annual GDP growth by 0.12-0.28 percent across sectors. In other words, a policy which "randomly" places transportation infrastructure will have a positive economic effect on those areas.

The conclusion and overall policy message of these papers is quite robust. Rural roads provide substantial benefits to households in low-income countries, especially the poorest. But not all roads beneficiaries get the same benefits. There is a wide range of outcomes, including situations in which a specific outcome is present in one project and not in another one within the same country. Moreover, they also show that rural roads are not a panacea for poverty alleviation and the mechanics of poverty alleviation can vary quite a lot across projects.

2.6.3 Irrigation

Very few evaluations have been conducted for irrigation. A recent study by Sawada, et al. (2010) evaluates the role of irrigation infrastructure in mitigating the negative impact of poverty dynamics using household panel data from Sri Lanka.

A unique monthly household panel data set was collected in Sri Lanka through extensive field surveys using standard questionnaires to derive household accessibility to irrigation infrastructure. They then employ propensity score matching to quantify the impacts of irrigation infrastructure access on individual livelihoods and the various channels through which irrigation reduces chronic and transient poverty.

The point estimates derived by the propensity score matching method show that with irrigation accessibility, per capita income and per capita food and non-food consumption expenditures increase by around 17.8, 12.2 and 37.6 percent respectively, when evaluated at the average level among the treated, and that the probability of binding credit constraint is reduced by 5.6 percent during the dry season. The results provide evidence in support of the role of infrastructure in reducing both chronic and transient poverty.

2.6.4 Power

There are very few publications on the impact of electricity interventions as in the case of water and roads, impact evaluations tend to focus a lot more on rural populations. Estache (2010), however, indicates that there are several ongoing evaluations (in Afghanistan, Bangladesh, El Salvador, Ethiopia, Mozambique, Pakistan, Peru, Tanzania, and Vietnam) but it is too early to draw major conclusions from these projects.

Using Chinese data from 1970-97, Fan et al. (2002) show that, for every 10,000 yuan spent on electricity development, 2.3 persons are brought out of poverty. Balisacan et al. (2002) did a similar analysis for Indonesia in 1990 and concluded that a 10 percent improvement in access to a composite technology measure (including electricity in a village) raised the income of the poor by roughly 2 percent. Taylor (2005) and Escobal and Torero (2005) also conducted similar assessments for Guatemala and Peru and drew very similar positive conclusions on the gains from electrification. Balisacan and Pernia (2002) use Filipino data from 1985-1997 to argue that the rich tend to benefit more from increased access to electricity.

However, the above studies suffer from a major econometric deficiency, the inability to fully address the causality between the intervention and the impact. They also do not account for the fact that electricity is often installed first in areas with the greatest potential for economic growth (Estache, 2010).

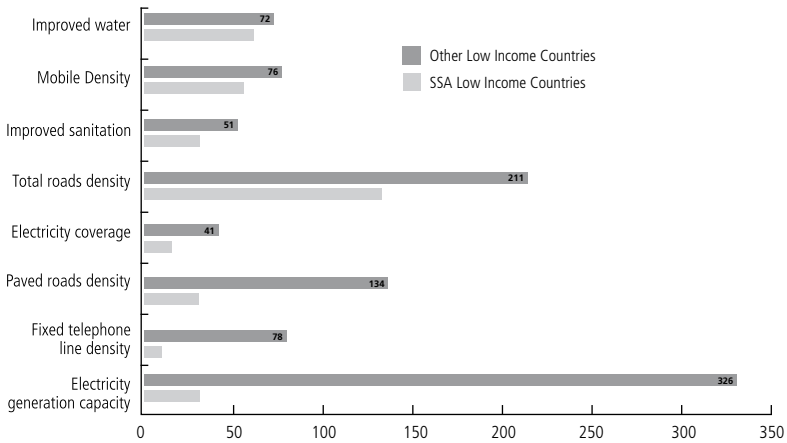
Dinkelman (2008) provides insights into the impact of rural electrification on cooking technologies and employment. These effects are identified by exploiting variation in electricity project placement and timing from South Africa's mass roll-out of rural household electricity. She finds that within five years, treated areas substitute sharply towards electricity in cooking. She also finds a 13.5 per cent increase in women employment but no effect on male employment. This employment effect is driven by the switch to electricity from cooking wood that is usually collected by women.

CHAPTER 3 AFRICA'S INFRASTRUCTURE ENDOWMENT

3.1 Introduction

By any conceivable measure, Africa lags considerably behind other regions of the developing world, both in terms of infrastructure service quality and quantity. This observation holds sway across a wide range of indicators, including the density of road networks and paved roads, per capita capacity to generate electricity, and household access to electricity, water, and sanitation (see Figure 1). Moreover, there is abundant evidence to show that many countries are not keeping up with the rapid demographic growth, including rapid urbanization and if the current trends prevail, the gap is likely to widen even further.

FIGURE 1: **Measures of Basic Infrastructure Provision: Sub-Saharan Africa versus other Low Income Countries**



Source: Adapted from World Bank (2009), Africa's infrastructure: Time for Transformation.

The dismal infrastructure picture in Africa is poignantly painted in Table 1 which presents the continent's endowment relative to other regions of the world. As indicated in the table, the data, though not recent in some sectors, suggests that electricity is accessible to as low as 18 percent of sub-Saharan Africa's population, relative to 44 percent in South Asia, the next-lowest region.

Access to an improved water source is 58 percent in SSA compared to 87 percent for South Asia and East Asia and the Pacific respectively. Access to improved sanitation, at 31 percent, is comparable to that in South Asia at 33 percent, but well below the 66 percent reported for East Asia and the Pacific. Moreover, access to a flush toilet (connecting to a sewer or septic tank) is only 6 percent in SSA.

These aggregate figures, however, mask considerable country variations and the rural /urban dichotomy. Coverage rates in urban areas are much higher than in rural areas. To some extent, Africa's low overall access rates are partly explained by negligible service coverage in rural areas, where the bulk of the population still resides. When broader measures of improved water and sanitation are considered, the discrepancies are still large and stark. About 63 percent of the urban population has access to an improved water source, compared with about 14 percent of the rural population. Similarly, about 42 percent of the urban population has access to improved sanitation versus about 7 percent of the rural population, and only 12 percent of rural households have access to electricity.

TABLE 2: **Africa's Infrastructure Endowment Relative to other Regions**

	Sub-Saharan Africa	South Asia	East Asia and Pacific	Europe and Central Asia	Latin America and Caribbean	Middle East and North Africa
Population (2007)	561	312	800	1,522	1'912	446
Sector and measure						
Transport						
Paved roads (% of Total - 2006)	11.9	56.9	11.4	n.a	22	81
Information and communication technology						
Fixed Line and Mobile Subscribers per 100 people (2007)	25	26	67	121	85	68
PCs per 1000 people (2007)	1.8	3.3	5.6	10.6	11.3	6.3
Energy						
Electrical generating capacity (MW per 1 million people, 2003)	70	154	231	970	464	496
Access to electricity (% of households with access, 2004)	18	44	57	—	79	88
Water and sanitation						
Water (% of population with to improved water source, 2006)	58	87	87	95	91	89
Sanitation (% of population with access to improved sanitation facilities, 2006)	31	33	66	89	78	77

Sources: 2009 World Development Indicators, World Bank, April 20, 2009; except for energy which is sourced from AICDs and Energy Information Agency, US Department of Energy.

Post-conflict countries also suffer disproportionately from lack of basic infrastructure. During war, a country's physical infrastructure is likely to have been significantly damaged or disassembled. Frequently, the neglect of basic maintenance is an even greater problem than destruction and vandalism. During a lengthy conflict, a cumulative lack of maintenance results in infrastructure that must be reconstructed because it is beyond salvaging.

Africa's 15 landlocked countries, home to about 40 of the region's overall population, also face special challenges. Being landlocked adds, on average, four days to land distribution of exports and nine days to imports compared with equivalent distances within the seaport country[4]. The geographic disadvantages results in high transport costs which hamper intra and inter-regional trade, as variously shown by Elbadawi, Mengistae and Zeufack (2006), and Behar and Manners (2008). Reduced openness to trade emerges as the main factor behind the robust empirical finding that – other things equal – landlocked countries tend to grow more slowly than the rest.

Table 2 provides an estimate of trends in access rates to basic infrastructure services in sub-Saharan Africa by households at the national level. It includes piped water, flush toilets, electricity, and landline phones obtained from Demographic and Household Surveys (DHS). A cursory examination of the table indicates that access is generally low for all the countries. Only South Africa (piped water and electricity) and Gabon (electricity) have an access rate that is greater than 50 per cent at any point.

Further, there is clearly a discernable relationship between access rates and economic development. In relatively poor countries such as Burkina Faso, Burundi, Chad, Ethiopia, Kenya, Madagascar, Malawi, Mozambique, Niger, Rwanda, Sierra Leone, Tanzania, and Uganda, less than 20 percent of the population has access to any modern infrastructure service at any time. At the other extreme is middle income Gabon where only 15 percent of the households do not have electricity. The two richest countries (South Africa and Gabon) have the highest access rates to piped water and electricity. South Africa also has the highest coverage rate for flush toilets and landline phones.

The average Africa-wide annual growth rates in coverage for the different services in the countries in the sample is 5.0 percent for electricity, 1.4 percent for piped water, 7.0 percent for flush toilet, and 12 percent for landline telephones during the period 1996-2005. It is striking that for piped water and flush toilets, around a quarter of the countries in the sample actually show evidence of negative growth rates in coverage, while another third report only modest growth rates of 0-4 percent per year. Furthermore, beyond broad averages, a large number of countries are failing to ensure that service expansion keeps pace with population growth. For piped water and flush toilet, close to half of the countries are expanding too slowly to keep pace with demographic growth. In the case of electricity and landline telephones, around 80 percent of the countries are managing to expand coverage faster than they are expanding population. But even for these countries, under a continuation of current trends, it would take perhaps until 2050 to reach universal access for water and beyond 2050 for other services.

4 Goods bound for Uganda, Rwanda, and Burundi spend, on average, five days more (25 versus 20 days) in Tanzania's Dar Es Salaam port than domestically bound goods. The same is true for goods shipped through Mombasa, Kenya. Inefficient port processes in Douala, Cameroon, contribute to the delays and high cost of transporting goods to N'djamena in Chad, 2,000 km from the sea. The five-week journey over rail and road requires seven documents and suffers from poor and fragmented trucking services, widespread "rent-seeking resulting in many checkpoints," security problems, and weak customs administration in Chad.

There is still lack of objective data on the technical quality of Africa's infrastructure such as chemical quality of water delivered. Table 3, thus, presents some rough indicators of the quality of Africa's infrastructure benchmarked against the performance of low, middle and high income countries. Over all, the service quality for Africa is poor across all infrastructure sectors but compares favourably with what is obtainable in low income countries (LICs). While Africa is at par with other LICs in water, it seems to be slightly technically better in electricity and telecommunications. This, however, should be interpreted with caution in view of the limitation of the indicators utilized. For example, in transport and communication, the data covers only six countries. On perceptions, Africa fared relatively worse off in all the indicators except for mobile phones and this should be a concern to policy makers.

Africa's infrastructure networks are not only deficient in coverage and quality, but the price of the services provided are also exceptionally high, by global standards, as revealed by AICD (Table 3). Whether for power, water, road freight, mobile telephones, or Internet services, the tariffs paid in Africa are several multiples of those paid in other parts of the developing world. The explanation for this state is sometimes due to genuine higher costs, and other times due to high profit margins. For example, Nigeria's leading mobile provider, MTN Nigeria, spends in excess of USD 5.55m on diesel to power its 6,000 generator plants across the country monthly. Zain Nigeria also runs back up power generators in the bulk of its 3,600 base stations in the country due to continual national electricity supply problems. The power sector, however, provides the clearest example of infrastructure of genuine higher costs in Africa than elsewhere. Many smaller countries have national power systems below the 500-megawatt threshold and therefore often rely on small diesel generation that can cost up to USD 0.35 per kilowatt-hour to run (AICD, 2008).

Below we highlight some sector specific details.

3.1 Energy

The wide-ranging role of energy in economic development and poverty alleviation is widely acknowledged. Expanded provision and use of energy services is strongly associated with economic development. This makes energy also central to reducing poverty and hunger, increasing literacy and education and reducing infant and maternal mortality.

Africa's largest infrastructure deficiency is more pronounced in the energy sector, whether measured in terms of energy consumption, generation capacity or security of supply. The energy sector in most parts of Africa is characterized by a lack of access (especially in rural areas), low purchasing power, low energy efficiency and over-dependence on traditional biomass for meeting basic energy needs. Biomass accounts for as much as two-thirds of total African final energy consumption. In comparison, biomass accounts for about 3 percent of final energy consumption in OECD countries. Wood, including charcoal, is the most common and the most environmentally detrimental biomass energy source in SSA. Firewood accounts for about 65 percent of biomass use, and charcoal accounts for about 3.0 percent. Health impairment and an unacceptable high rate of mortality in the order of 400,000 deaths from respiratory diseases per year are linked to exposure to indoor pollution from 'dirty fuels' in poorly ventilated dwellings (African Development Bank, 2008). A large segment of the continent's population, thus lives in conditions of acute 'energy poverty'.

TABLE 3: **Evolution of Access to Network Infrastructure, National Level (%)**

Country	1990 – 95	1996 – 00	2001 - 05	1990 – 95	1996 – 00	2001 - 05	1990 – 95	1996 – 00	2001 - 05	1990 – 95	1996 – 00	2001 - 05
Benin		23.15	28.74			2.39		14.39	21.96			4.38
Burkina Faso	5.64	3.62	5.89	0.89	0.58	1.86	6.23	6.06	10.16		1.79	3.72
CAR	2.65			1.11			5.04			1.49		
Cameroon	12.07	11.34	12.95	6.56	6.41	8.07	31.28	41.52	45.76		2.55	2.33
Chad		3.36	4.45		0.24	1.83		2.76	4.33		0.45	0.88
Comoros		22.67			2.93			30.47			3.2	
Congo (Brazzaville)			25.81			5.33			34.86			1.27
Cote d'Ivoire	23.98	27.93			14.03	12.45		38.59	49.74		6.55	
Ethiopia		4.21	5.98		0.34	2.13		11.28	12.04		1.56	4.41
Gabon		43.03			24.5			75.18			15.26	
Ghana	13.65	15.38	15.08	5.94	7.57	10.28	27.85	39.36	44.26		2.4	7.5
Guinea		9.62	9.13	-	2.65	2.62		17.41	20.93		2.42	7.17
Kenya	16.04	19.54	17.94	7.99	9.75	8.97	8.81	11.79	13.1		2.7	12.29
Lesotho		11.03	10.74			1.61			5.7			16.86
Madagascar	5.29	5.9	5.3	2.54	2.26	1.88	9.24	11.13	18.82		0.58	4.9
Malawi	6.11	7.74	6.49	2.62	3.3	3.58	3.69	5.59	7.48			5.99

Country	1990 – 95	1996 – 00	2001 - 05	1990 – 95	1996 – 00	2001 - 05	1990 – 95	1996 – 00	2001 - 05	1990 – 95	1996 – 00	2001 - 05
Mauritania			17.41			1.77			23.36			3.56
Mozambique		6.55	6.86		3.22	2.88		10	11.02		1.35	2.13
Namibia	30.53	37.29		26.65	30.56		20.31	31.68			17.4	
Niger	5.39	6.09		1.25	1.05		5.67	7.9			0.92	
Nigeria	10.58	10.28	6.88	8.46	11.9	13.12	26.08	44.85	51.26		2.32	5.1
Rwanda	1.77	6.28	2.95	1.05	1.47	1.16	2.35	7.35	5.42		1.57	1.08
Senegal	26.6	31.1	43.36	10.62	9.07	36.04	25.29	32.18	46.41		-	19.84
South Africa		59.18			46.37			63.42			27.07	
Tanzania	10.23	13.78	7.36	1.41	1.66	2.75	6.36	7.27	10.57			9.72
Togo		17.75						14.91				
Uganda	1.8		1.99	1.59		1.73	6.95		8.41	0.59		3.14
Zambia	31.41	21.03	18.32	27.13	20.69	18.09	23.25	20.28	20.07			4.34
Zimbabwe	26.68	32.75		26.25	31.45		23.28	33.86			6.91	
DRC	21		15.03	2		1						
Sudan		21.12			6							

Source: Estache and Wodon (2010) using AICD DHS/MICS Survey Database, 2007.

TABLE 4: **Quality Ratings of the Main Infrastructure Services in Africa (2002 Data)**

	Average (sample sizes in parenthesis)			
	Africa	**Low income**	**Lower-middle income**	**Upper-middle income**
Electricity				
Technical				
Transmission and distribution losses (% of total output)[a] Perceived (1 = worst, 7 = best)	22 (17)	24 (33)	15 (31)	14 (23)
Commercial perception of electricity services	4.3 (6)	2.8 (9)	4.2 (25)	5.2 (20)
Commercial perception of public agency electricity provider[(b)]	4.3 (16)	4.0 (27)	5.0 (27)	5.3 (17)
Water and sanitation				
Technical				
Piped to other sources of drinking water ratio[(c)]	0.34 (25)	0.34 (34)	0.71 (21)	0.73 (1)
Perceived (1 = worst, 7 = best)				
Commercial perception of water service[(e)]	4.2 (16)	4.0 (27)	4.8 (24)	5.0 (18)
Telecom				
Technical				
Phone faults (reported faults per 100 mainlines)[(d)] Perceived (1 = worst, 7 = best)	63 (40)	67 (49)	32 (39)	22 (27)
Commercial perception of telephone/fax infrastructure	4.3 (6)	3.4 (9)	4.9 (25)	5.6 (20)
Commercial perception of availability of mobile	5.7 (6)	5.0 (9)	5.8 (25)	6.0 (20)
Commercial perception of internet access in schools	2.8 (6)	2.1 (9)	3.0 (25)	3.8 (20)
Commercial perception of postal efficiency	3.7 (6)	3.1 (9)	3.5 (25)	4.4 (20)
Transport				
Technical				
Paved roads (% of total road network)[(c)] Perceived (1 = worst, 7 = best)	25 (44)	29 (61)	48 (7)	55 (33)
Commercial perception of services delivered by road department[(b)]	3.7 (16)	3.4 (27)	4.2 (24)	4.1 (18)
Commercial perception of port facilities	3.8 (6)	2.6 (9)	3.5 (25)	3.8 (20)
Commercial perception of railway services	3.2 (6)	2.7 (9)	2.6 (25)	2.9 (20)
Commercial perception of air transport services	4.5 (6)	3.6 (9)	4.2 (25)	4.5 (20)

Notes: average figures correspond to unweighted averages of data available. The universes of countries by group are: Africa 48 countries, low income 65, lower-middle income 52, and upper middle income 38.

(a) Africa average include: 1 observation in 2000, and 16 in 2001.

(b) Data available in 2000

(c) Africa average include: 4 observations in 1997, 6 in 1998, 6 in 1999, 4 in 2000 4 in 2001 and 1 in 2002

(d) Africa average include: 5 observations in 1997, 6 in 1998, 5 in 1999, 2 in 2000, 6 in 2001, and 16 in 2002

(e) Africa average include: 1 observation in 1997, 1 in 1998, 32 in 1999, 6 in 2000 and 4 in 2001

Source: Estache and Goicoechea (2005).

TABLE 5: **Africa's High Cost Infrastructure**

	Sub-Saharan Africa	Other developing regions
Power tariffs (USD/kWh)	0.02 – 0.46	0.05 – 0.1
Water tariffs (USD/m3)	0.86 – 6.56	0.03 – 0.6
Road freight tariffs (USD/ton/km)	0.04 – 0.14	0.01 – 0.04
Mobile telephony (USD/basket/mo)	2.6 – 21.0	9.9
International telephony (USD/ 3 min. call to US)	0.44 – 12.5	2.0
Internet dial up service (USD/mo)	6.7 – 148.0	11

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

Source: Africa Infrastructure Country Diagnostics, 2008

As indicated in Table 4, total electricity generation for the whole of Africa stood at only 546.79 billion kilowatt-hours in 2006, which is less than 594.6 for Canada and slightly more than 411.74 for Brazil. Average electricity consumption per capita in Africa is about 480 billion kilowatt-hours in 2006. This is far less than 529.95 billion kilowatt-hours consumed by Canada and slightly higher than Brazil's 382.36 billion kilowatt-hours.

South Africa's utility – Eskom - is the world's fifth largest utility company both in terms of electricity sales and nominal generating capacity. Eskom also operates Africa's only nuclear power generation facility (Koeberg) in Cape Town. However, in mid-January 2008, South Africa experienced nationwide power outages lasting approximately four weeks. The economic costs of the outages were estimated to range from USD 253 to USD 282 million, with approximately half representing mining losses. Although the cost of electricity in South Africa is among the lowest in the world, the country's strong economic growth, rapid industrialization and a mass electrification program has led to demand outstripping supply.

Overall, access to electricity in SSA remains extremely limited. The low level of power generation is accompanied by correspondingly low rates of electrification. Only about 24 percent of Africa's population currently has access to electricity, with supply almost entirely limited to urban areas. This is in marked contrast with other parts of the developing world, where electricity is available to over half the population, with a considerable advancement in rural electrification, despite general levels of poverty comparable to those prevailing in Africa.

TABLE 6: **World Electricity Generation and Consumption, Most Recent Annual Estimates 2006**

(Billion Kilowatt / hour)		
Region	Electricity Generation	Electricity Consumption
North America	4903.27	4543.66
Central and South America	951.01	801.67
Europe	3554.38	3293.57
Eurasia	1330.06	1196.44
Middle East	641.44	558.40
Africa	546.79	480.00
Asia and Oceania	6040.71	5501.88
World	18, 014.67	16,378.62
Selected Countries		
Canada	594.6	529.95
United States of America	4071.26	3816.85
Brazil	411.74	382.36
France	542.4	447.27
India	703.32	517.21
China	2717.50	2527.95
South Africa	227.74	201.88

Source: United States Energy Information Administration.

The gap between rural and urban electrification is larger than in other regions. Even the very limited supply, restricted, as it were, to higher income groups as shown in Table 5 and modern industry and infrastructure in urban areas, is prone to repeated supply failure, as manifested by power rationing, brownouts and blackouts. Moreover, the region's electrification expansion is slower than in other low-income countries.

TABLE 7: **Proportion of African Households Connected to Electricity Supply**

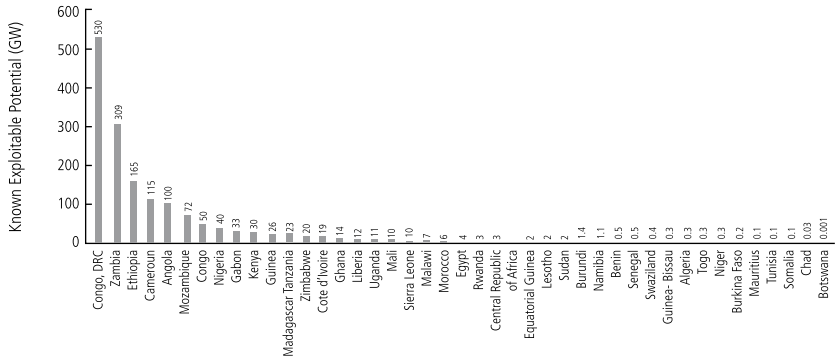
Total		**14.9%**
By Rural/Urban		
	Rural	8.3%
	Urban	54.0%
By Income		
	Poorest 20%	0%
	Next poorest 20%	4%
	Middle 20%	12%
	Next richest 20%	28%
	Richest 20%	71%

Source: Estache 2006A

Africa's energy sector is dominated by South Africa in Southern Africa, Egypt and Morocco in North Africa and Nigeria in West Africa. About 82 percent of Africa's energy comes from the northern and southern regions alone, with three-quarters coming from five countries - Egypt, South Africa, Libya, Morocco and Algeria. Approximately 50 percent of energy in Africa is generated from coal-based facilities, although this figure is projected to decrease to 36 percent by 2020, with many of the new developments running on natural gas. The Democratic Republic of Congo (Central), Kenya (East), and Nigeria (West) are the leaders in energy generating capacity for Africa's other regions. South Africa, Zambia and Ghana are the largest net exporters of electricity in Africa. In 2007, net exports from South Africa were 6.6 terawatt hours (Twh) of power, Zambia 1.2 Twh, and Ghana 0.3 Twh.

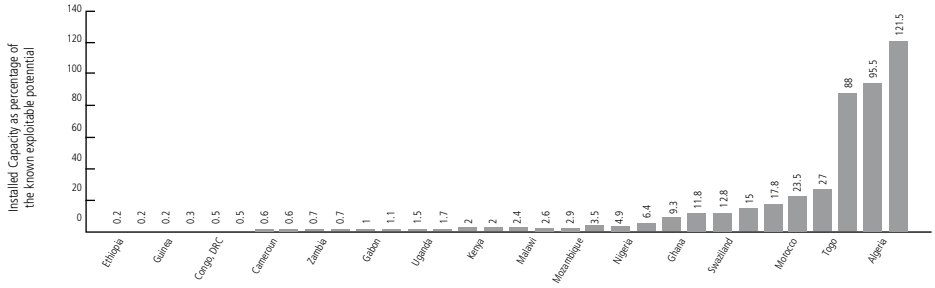
Hydropower currently accounts for 45 per cent of Africa's electric power generation. Africa, no doubt, has massive hydropower capacity as presented in Figure 2. The three leading African countries in hydro power generation are the Democratic Republic of Congo, Zambia and Ethiopia. The hydro potential of the Democratic Republic of Congo alone (530 GW) is reported to be sufficient to provide three times as much power as Africa presently consumes. Less than 5.0 per cent of the commercially exploitable potential is currently exploited as shown in Figure 3.

FIGURE 2: **Africa's Known Exploitable Hydro-Power Potential**



Source: African Development Bank (2008)

FIGURE 3: **Installed Hydropower Capacity as Percentage of Known Exploitable Potential**



Source: African Development Bank (2008).

On average, electricity tariffs across the region are relatively high by international standards—at USD 0.13 per kilowatt-hour. Nevertheless, revenue generated is hardly sufficient to cover operating costs, much less the capital costs. One reason for this is due to the fact that the average operating costs of power systems can be as high as USD 0.30 per kilowatt-hour, in countries relying on small-scale diesel generation. In addition, average revenues fall short of average tariffs due to failure to collect a large portion of utility revenue. The high prices and costs of electricity in SSA pose a serious concern about affordability for the poor, whose vast majority lack access to service.

In 2007 alone, nearly two-thirds of the region's countries experienced an acute energy crisis with frequent and extended electricity outages. Although conflict and drought triggered several of these crises, in most cases electricity supplies failure could not keep pace with growth in demand. Even South Africa, which accounts for more than half the electricity production in the region, faces periodic rounds of rolling power cuts because supply has stagnated in recent years.

3.2 Renewable Energy

Climate change has emerged as an important challenge facing Africa and, indeed, much of the world in the 21st century. In the light of the mounting evidence of its causes and effects, expanding access to reliable energy supplies, particularly for the poor, and promoting investment in clean energy and low-carbon approaches to economic development are urgent imperatives globally. Africa is richly endowed with renewable energy potential, especially hydro-power, geothermal energy, solar and wind power, and more efficient utilisation of biomass - which could easily cover all the continent's current energy needs. Unfortunately, this potential has remained untapped mainly due to the limited policy interest and investment levels. Box 1 outlines the range of available renewable and low-emission energy resources for Africa.

While the adoption of renewable energy in Africa is still in its infancy, there are some promising developments. In April 2008, participants in the International Conference on Renewable Energy in Africa[5] agreed on a vision to scale up renewable energy development in Africa to enhance wider access to modern energy, strengthen the continent's energy security as well as support its industrialization and socio-economic development. In February 2009, the AU Summit also welcomed the Africa-European Union Infrastructure and Energy Partnerships, and committed to undertake to develop renewable energy resources in order to provide clean, reliable, affordable and environmentally friendly energy[6]. In addition, African institutions such as the African Development Bank and NEPAD are actively promoting investment in renewable energy.

The development of renewable energy options could be financed in part by more effective use of the 'cap and trade' mechanisms under the Kyoto Protocol, in particular the Clean Development Mechanism (CDM). So far, only South Africa, Mauritius and the five North African countries have considerable expertise in structuring clean development projects for CDM certification. Most sub Saharan African countries are yet to take advantage of the CDM-facilitated international carbon trade opportunities. Capacity building is needed to enable these countries to prepare CDM-eligible projects and to negotiate carbon emissions credit.

BOX 1: **Africa's Renewable Energy Potential**

Biomass: Africa is the world's largest consumer of biomass energy. Biomass fuels are harvested mostly using unsustainable practices that lead to deforestation and accelerate land degradation processes including desertification. Mauritius, however, demonstrates that more energy can be extracted from biomass fuels using more efficient, state-of-the-art energy conversion technologies: sugar-cane waste (bagasse) used to fire combined-cycle generators now account for close to 40 per cent of the island country's power supply. As regards clean and more efficient stoves, considerable effort has been put into research and development, and limited diffusion on a pilot basis in a number of countries. However, large scale dissemination to the wider population is still a challenge.

Hydropower: So far, less than 4 per cent of commercially exploitable hydro-power has been tapped and there is enormous potential. To-date, hydropower development has concentrated on large-scale plants, generating power for large urban areas and industries. Micro and small-scale hydro-power locations, that can be harnessed to supply the electricity needs of small rural towns and villages, have been almost entirely overlooked in all countries. Countries are showing increasing interest in developing micro and small-scale hydro power sites.

Geothermal: The potential to generate 7,000 MW of geothermal electric power exists in the Great Rift Valley in Eastern Africa. However, to-date, only 130 MW has been exploited in Kenya and less than 8 MW in Ethiopia due to high upfront engineering costs and lack of local expertise.

Solar Energy: Africa is generously endowed with solar energy. Many countries have daily radiation levels in the range of 5-kWh per square metre. Some encouraging results with photovoltaic systems (PV) have been registered in Ghana, Kenya, Namibia, South Africa, Morocco, Tunisia, Senegal and Zimbabwe.

5 The International Conference on Renewable Energy in Africa jointly organised by the Government of Senegal, the African Union, the German Federal Ministry for Economic Cooperation and Development and the United Nations Industrial Development Organisation (UNIDO) was held in Dakar, Senegal, April 2008, to discuss the potential to scale up renewable energy in Africa.

6 6AU Declaration on Development of Transport and Energy Infrastructure in Africa, Doc. Assembly/AU/9 (XII). 2009.

However, due to the high cost of PV panels and energy storage batteries, until now, these initiatives have largely served the electric power needs of some high-income households located beyond the reach of local power distribution networks in cities and rural areas. Some encouraging initiatives to extend access to lower-income households and public institutions are under way in a number of countries, notably Morocco, Tunisia, Mauritius, Seychelles, and South Africa.

Wind Energy: Countries with good potential include Cape Verde, Eritrea, Kenya, Madagascar, Mauritania, Morocco, South Africa, and Tunisia. Even in countries with wind speeds insufficient for electric power generation, there is often sufficient power for less demanding applications such as pumping water for irrigation. Few countries, however, have carried out technical studies to map their wind energy potential and fewer still have developed concrete plans to harness it.

Liquid Biofuels: Biofuels such as ethanol and biodiesel are produced through relatively unsophisticated industrial processes from agricultural crops, both edible and non-edible, that can be grown in most countries with surplus arable land and water resources. To-date, however, few African countries have formulated a serious strategy to promote the production and utilization of liquid biofuels.

Natural Gas: Gas fired combined-cycle power plants produce less GHG emission per kWh of energy generated than oil or coal fired plants. Furthermore, using the gas in power production or in domestic cooking, water boiling and heating applications instead of flaring it in the open air represents a significant reduction of GHGs. Good examples are the West African Gas Pipeline project financed by the World Bank and the Nigeria Liquified Natural Gas (NLNG) project co-financed by the Bank. The latter enables gas produced as a by-product of Nigerian oil production to be exported to Ghana, Togo and Benin.

Clean Coal Power Generation: Integrated gasification combined-cycle is able to attain twice the fuel efficiency of traditional coal-fired steam turbine power plants, reducing by one-half the amount of coal required to generate the same amount of power. In addition, gasification facilitates the sequestration of CO2 and the scrubbing out of nitrogen and sulphur oxides from power plant emissions, greatly reducing GHGs and acid-rain pollution.

Biogas: Biogas Methane Gas from landfills and sewerage systems of large cities can be tapped and used to generate electric power fed into the distribution grid. Even in smaller towns and village communities, waste disposal systems can be designed purposefully to facilitate the collection of biogas, preventing it from leaking into the open air. The gas can be piped to households for domestic cooking and heating purposes, contributing to a reduction in GHGs. A very limited number of landfill sites have been equipped with gas capturing equipment, but the Clean Development Mechanism of the Kyoto protocol (CDM) might be a very effective catalyst in this respect. Domestic biogas development is limited in Africa, but some projects are under way to learn from success stories in South East Asia.

Source: Adapted from African Development Bank (2008).

3.3 TRANSPORT

Transport infrastructure and services are critical to Africa's sustainable development. Effective mobility and timely access to goods and services require well-developed, safe, secure and affordable transport network and services. However, Africa's transport system is still relatively underdeveloped. While most sub-Saharan African countries have the basic building blocks of a transport infrastructure, it is far from efficient.

3.3.1 Roads

Road transport is the dominant mode of motorized transportation in Africa, accounting for 80 per cent of the goods traffic and 90 per cent passenger traffic on the continent. In 2005, only 580,066 km or 22.7 per cent of the total African road network was paved (UNECA, 2009) Most African countries are faced with huge costs associated with transportation.

In accessing foreign markets, on average, Africa's transport and insurance costs represent 30 per cent of the total value of exports, which compares unfavourably with 8.6 per cent for all developing countries. Although most share the problem of high transport costs, landlocked countries face the most excessive transport costs recorded on the continent.

It has been estimated that deaths on African roads Road amounts to 225,000, per annum or 19 per cent of the global total of 1.2 million people. Furthermore, Africa has the highest number of road traffic accidents per capita (UNECA, 2009).

The dysfunctional state of urban transportation all over Africa is a major challenge. A recent study by the Africa Infrastructure Country Diagnostic provides evidence on the characteristics of the road network in 14 African cities (see Table 6).

TABLE 8: **Characteristics of the Road Network in 14 African Cities**

City	Length of road network (kms)	Length of paved road network (kms)	Paved roads as share of all roads (percent)	Paved road density	
				m per 1,000 pop.	kms per km^2
Abidjan	2,042	1,205	59	346	2.1
Accra	1,899	950	50	339	2.8
Addis Ababa	—	400	—	129	0.7
Bamako	836	201	24	167	0.8
Conakry	815	261	32	174	2.3
Dakar	—	—	—	—	—
Dar es Salaam	1,140	445	39	122	0.2
Douala	1,800	450	25	237	2.4
Kampala	610	451	74	225	0.5
Kigali	984	118	12	170	0.2
Kinshasa	5,000	500	10	63	0.1
Lagos	—	6,000	—	400	1.7
Nairobi	—	—	—	—	—
Ouagadougou	1,827	201	11	185	0.4
Average	**—**	**—**	**33**	**318**	**1.7**

Note: — = not available.
Source: Ajay Kumar and Fanny Barrett (2008) Stuck in Traffic: Urban Transport in Africa, Africa Infrastructure Country Diagnostic (AICD), Background Paper 1

In all the cities, in addition to being substandard, the road network is only about one third of that in other developing cities. Capacity is limited; service lanes are absent, including deteriorating pavement, and minimal street lighting. Bad road conditions reduce vehicle speeds, sapping the bus fleet productivity and increasing the cost of maintenance. They also promote the use of minibuses, taxis, and motorcycles that have greater ability to manoeuvre traffic than large buses, but are not as efficient as a means of mass urban transit and are prone to accidents.

Weak, fragmented, and underfunded authorities have been unable to maintain existing services or to plan for expansion. Buses, which are in most cases second hand routinely fall apart after running overloaded for years on rutted roads; replacements are soon left idle for lack of parts. Fares are often too low and subsidies too irregular to permit sustainable operations. Commuters walk or resort to largely unregulated and informal services that are dirty, unsafe, uncomfortable, and unreliable.

Not surprisingly, the use of motorcycles for commercial transport has grown very rapidly in recent years, as a consequence of the poor state of the roads and the inability of bus companies to meet growing demand in some of the cities, especially Douala, Lagos, and Kampala. Motorcycle drivers are often young and inexperienced and accidents are common—and often fatal.

3.3.2. Railways

In 2005, Africa had a total railway network of 90,320 km or 3.1 km for every 1,000 km², most of which is disjointed. With the exception of North Africa, railways in Africa generally have a low level traffic. The railways serve only one per cent of the global railway passenger traffic and carry two per cent of goods. A promising development is the recent launch of Gautrain by South Africa (Box 2). This may inspire other countries to embark on a similar endeavour.

BOX 2: **Gautrain: Africa's First High-Speed Rail Project Takes off**

Gautrain, the ZAR25 billion (USD3.2-million) state-of-the-art rapid rail project, was launched on 5 July 2010, thus becoming Africa's first high-speed rail project. The service between the Sandton Station and O.R Tambo International Airport started running on 8 July 2010, three days before the opening match of the 2010 FIFA World Cup. It takes approximately 15 minutes and costs ZAR100 (USD13 or EUR10). The train attains speeds of up to 160km an hour, and runs from 5a.m. until around 10 p.m.

In the original contract signed on September 28, 2006, the project was broken into two phases to be constructed concurrently:

- The first phase includes the network between OR Tambo International Airport and Sandton, encompassing the stations at OR Tambo, Rhodesfield, Marlboro and Sandton, together with the depot and operations control centre near Allandale Road in Midrand.
- The second phase, being constructed concurrently, will be completed in 2011. It includes the remainder of the rail network and stations linking Sandton to Park Station in Johannesburg and the route from Midrand to Hatfield.

The Bombela Concession Company was tasked with completing the first phase in June 2010 and the second phase by mid-2011. When completed, the 80-kilometre regional express train will connect the capital Tshane (Pretoria) with the national economic hub Johannesburg and the Johannesburg International Airport.

Source: Author's Compilation

3.3.3 Maritime Transport

Maritime transport is the most dominant mode of transport for moving freight from and to Africa. It accounts for over 92 per cent of Africa's external trade. With a total coastline of 30,725 km, Africa has 90 major ports and a number of other ports providing services for fishing and tourism. However, African ports handle only 6.0 per cent of global traffic, of which about six ports – three each in Egypt and South Africa – handle about 50 per cent of Africa's container traffic (UNECA, 2009).

3.3.4 Airports

In 2007, Africa had over 4,000 airports and airfields, of which only 20 per cent had paved runways. Although the number of airports and airfields in the region seem enormous, a significant number of them do not meet International Civil Aviation Organization (ICAO) standards and recommended practices. Only 117 of Africa's airports are classified as international airports. The share of global air transport remains modest at about 5.2 per cent of the passenger traffic, approximately 3.6 per cent of freight, and roughly 8.5 per cent of the number of departures for 2006.

In all, transit times on African transport corridors are unduly long due to factors such as unclear and sometimes conflicting rules and regulations, inefficient service providers, road blocks, as well as cumbersome administrative and customs procedures. These have created a serious challenge to transport facilitation and trade on the continent. It leads to excessive traffic delays, resulting in substantial increase in transport costs.

3.4 INFORMATION AND COMMUNICATIONS TECHNOLOGY

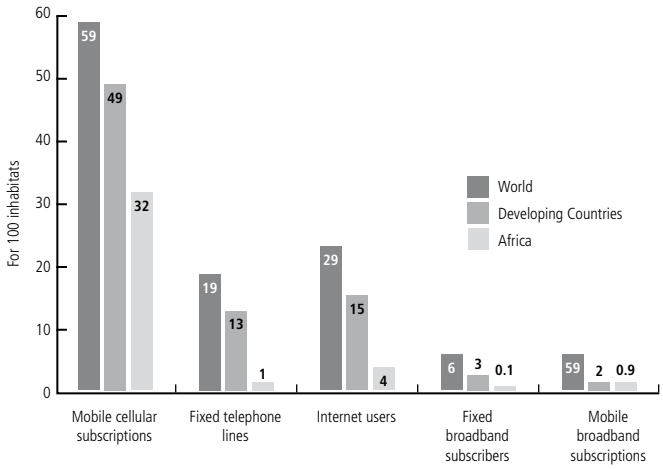
It is now widely accepted that Information and Communication Technologies (ICT) plays a major role in national development. Within a short time, ICT has become one of the major building blocks of a modern society.

3.4.1 Telephones

ICT sector has undergone tremendous transformation in Africa over the past decade characterized by high growth. The number of mobile cellular subscriptions and Internet users are among the fastest growing in the world. However, Africa started out with very low ICT levels and, despite rapid growth, in 2009, the continent's ICT penetration levels are still far behind the rest of the world, as shown in Figure 4. Less than 5.0 percent of Africans use the Internet, and fixed and mobile broadband penetration levels are negligible.

What stands out most is perhaps the strong and continued growth in the number of mobile cellular subscriptions and impressive rise in penetration rate. In 2000, Africa had 11 million mobile cellular subscriptions but this figure rose astronomically to 246 million by the end of 2008, making Africa the region with the highest mobile phone growth in the world. In fact, mobile penetration has risen from just five per cent in 2003 to well over 30 per cent in 2008. As the prices of both handsets and airtime continue to fall, the mobile phone has continued its transformation from an erstwhile elite status symbol to a necessity on the continent.

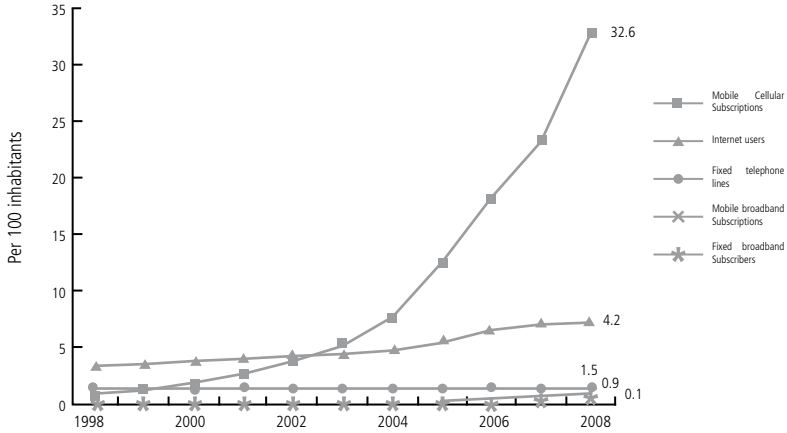
FIGURE 4: **ICT Penetration in Africa in 2009**



Source: International Telecommunication Union (2009)

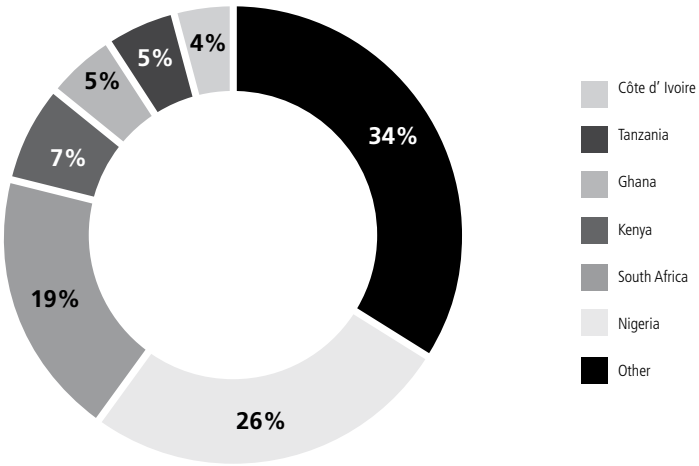
Over the same period, fixed line growth in the region has been much lower compared to that of mobile cellular subscriptions and internet users. In 1998, there were some 8.2 million fixed telephone lines in Africa, which corresponded to a penetration of 1.4 per cent - the lowest of any region (Figure 5). Between 1998 and 2008, the region added only 2.4 million telephone lines, less than 1.0 per cent of the total number of telephone lines that the world added in the same period. As a result, fixed telephone line penetration increased very little in Africa, and the difference with other regions as well.

FIGURE 5: **ICT Development in Africa**



Source: International Telecommunication Union (2009)

FIGURE 6: **Distribution of Mobile Phone Subscription in Africa, 2008**



Source: International Telecommunication Union (2009)

As a result of the strong ICT growth, new promising applications have emerged in the area of m-banking and e-government. Perhaps the most popular is M-PESA which has revolutionised money transfer in Africa (Box 3). Mobile telephony has also brought new possibilities to the continent. All over Africa, teachers, doctors, farmers and fishermen are using communications to find better prices, improve access to markets, and increase their bargaining power.

BOX 3: **M-PESA**

M-money applications have emerged in Asia, Latin America and Africa. Yet the Kenyan mobile money program, M-Pesa, has received the most attention. Introduced in March 2007 by Vodafone, which has a minority interest in Safaricom, M-Pesa ("M" for Mobile, "Pesa" for "Money" in Swahili) is a mobile phone application that facilitates a variety of financial transactions for its users, such as purchasing airtime, transferring money and paying bills. As of September 2009, M-Pesa had 8 million subscribers and a network of 13,000 agents, with almost 40 percent of Kenyans using the service to send and receive money.

Although M-Pesa has been touted as "banking the unbanked", on average, M-Pesa users are wealthier, better educated, urban and "already banked". Moreover, the data suggest that most of the transfers are occurring within urban areas. M-Pesa and other m-money systems have recently transitioned from a pure money transfer system into a payment platform that allows nongovernmental organizations, schools, hospitals and firms to send and receive payments. It is rumoured that even Kenya Police now routinely collect bribes using M-Pesa.

Source: Author's Compilation

In Ghana, farmers in Tamale are able to send a text message to learn corn and tomato prices

in Accra, over 1,000 kilometers away. In Niger, day laborers are able to call acquaintances in Benin to find out about job opportunities without making the USD 40 trip. In Malawi, those affected by HIV and AIDS can receive text messages daily, reminding them to take their medicines on schedule. Citizens in countries as diverse as Kenya, Nigeria and Mozambique are able to report violent confrontations via text message to a centralized server that is viewable, in real time, by the entire world (Aker, 2010).

Operators in Africa have developed different services to address the unique circumstances of the region and boost mobile uptake and usage. The most widespread of these services is prepaid; an estimated 95 per cent of mobile subscribers in the region were using prepaid services in 2008. Providers have searched for ways to enhance the ease of use of prepaid services, and to make it more convenient for low-income users. This includes offering features such as low denomination airtime recharges and per second billing. In Nigeria, recharges are available for as little as NGN 50 (USD 0.40). Similarly, in Zambia recharges are available for about ZMK 1,000 (USD 0.10).

Regional roaming services received a big boost with the launch of Celtel's One Network in 2006, allowing mobile telephone users in the East African countries of Kenya, Tanzania and Uganda to use their mobile phones in any of the countries, at local rates free of roaming charges, subject to taxes. After successive enlargements of the One Network (the latest being the addition of Ghana, in December 2008), 12 African countries and five Arab States currently participate in it.

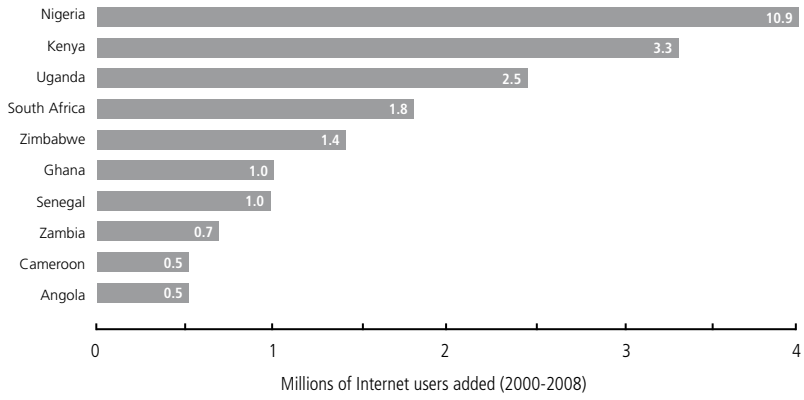
In Eastern Africa, several operators have cooperated to launch a similar service, dubbed "Kama Kawaida". With the latest addition of Vodacom Tanzania to the roaming agreement in April 2009, Kama Kawaida subscribers can enjoy roaming services with MTN Uganda, MTN Rwanda, MTL Uganda, Safaricom Kenya, UCom Burundi and Vodacom Tanzania.

3.4.2 Internet

Over the last decade, the number of internet users has also grown strongly, although penetration rates remain relatively low. From three million internet users in 2000, the number grew tenfold to 32 million internet users in 2008. Compared to other regions, growth in Africa was the third-highest, after the CIS and the Arab States. Nigeria led in contribution to the increase by adding 10.9 million new internet users between 2000 and 2008, 38 per cent of the total increase in that period. Kenya also contributed remarkably, with 3.3 million new internet users (Figure 7).

This progress notwithstanding, almost all countries in Africa have an internet penetration that considerably lags behind the world's 2008 penetration of 23 per cent as shown in Figure 7. This is entirely consistent with the limited availability of fixed telephone networks in the region, which are necessary for Internet dial-up and fixed broadband access. Indeed, in the majority of African countries (27 countries), less than 5.0 per cent of the population uses the internet as shown in Table 8.

FIGURE 7: **Countries with the highest net additions of Internet users in Africa, 2000-2008**



Source: International Telecommunication Union (2009).

Despite the emergence of Africa as one of the most dynamic regions in terms of ICT growth, the region's absolute figures, as well as penetration rates remain low. African countries face a number of challenges in increasing ICT levels. These include the lack of full liberalization of markets and the limited infrastructure, such as a shortage of international Internet bandwidth. In addition, prices for ICT services remain very high compared to income levels, making broadband Internet services out of the reach of most Africans.

3.4.3 Bandwidth

In 2007, Africa had less international Internet bandwidth than the Dominican Republic, despite being more than 70 times its population.

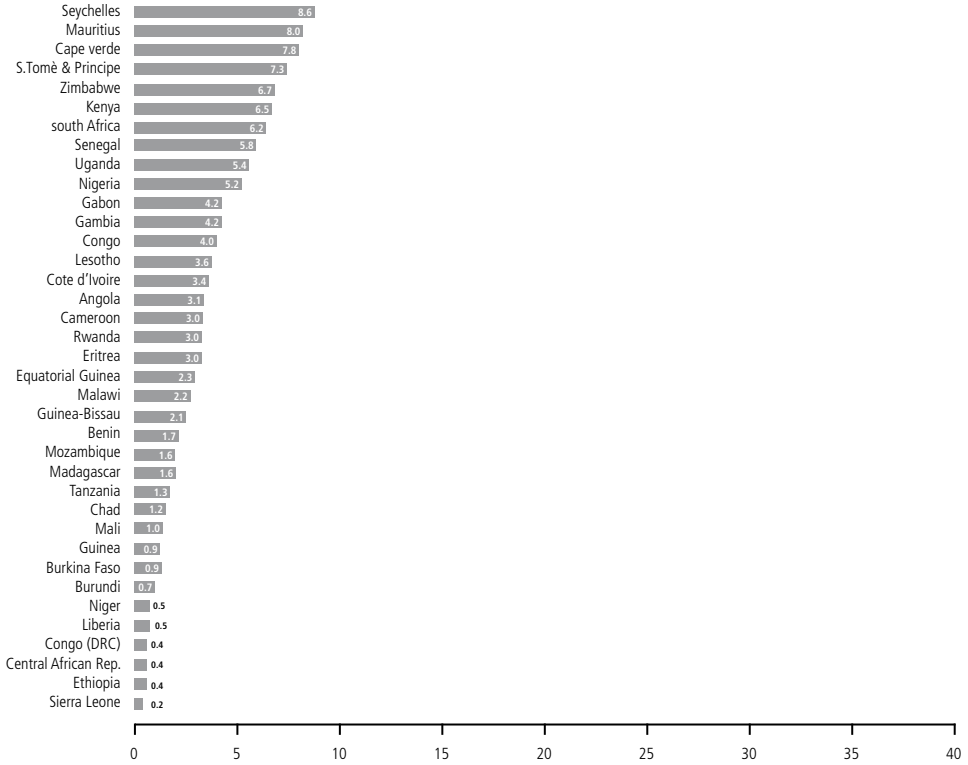
The increase in international Internet bandwidth reflects the efforts made by several African governments to develop continental broadband infrastructure. These efforts are likely to show full results in the coming years, once some of the most ambitious initiatives come into operation.

The Seacom and the TEAMS submarine cables arrived in Kenya by mid-year 2009, and have alleviated the shortage of international Internet bandwidth in East Africa. Other submarine cables that are currently deployed and are scheduled to be launched later include EASSy (2010), also targeting Africa's eastern coast, and WACS (2011), which will link South Africa and Europe through Africa's western coast.

Although progress has been made in the last five years, until these new submarine cable projects are completed, Africa's international connectivity will remain low.

Given the need for investment in ICT infrastructure in the region, it would be logical to minimize duplication and share facilities, where practical. This could reduce costs and prices, making ICTs more affordable for a wider population segment. Regulators could also help by creating an environment of trust among operators and developing policies that promote infrastructure-sharing.

FIGURE 8: **Internet users per 100 inhabitants in Africa, 2008**



Source: International Telecommunication Union (2009).

3.5 WATER AND SANITATION

Water and sanitation are essential for achieving sustainable development, poverty reduction and the MDGs. They contribute to poverty alleviation both directly and indirectly – through improved sanitation services, water supply, affordable food and enhanced resilience of poor communities faced with disease, climate shocks and environmental degradation (United Nations, 2009). Access to water and sanitation is a necessary precursor to other forms of development. Without easy access to these facilities, time spent on water collection, household income spent on medical treatment and water purchase, all contribute to keeping people in the poverty trap.

Water and sanitation interventions themselves significantly impact on poverty by increasing both economic opportunities and household disposable income.

The contribution of sustainable access to safe drinking water and adequate sanitation to achieving the Millennium Development Goals is well established. In fact, halving the estimated 1.1 billion people without access to safe drinking water by 2015 is one of the Millennium Development Goals.

Despite the vital importance of water to all aspects of human life, Africa is falling further behind. The region is facing a water and sanitation crisis that debilitates and kills in large numbers, as well as limiting economic growth, educational access, and life opportunities. Most at risk are the poor, especially women and children in rural areas, and growing informal settlements in cities. The sector has been plagued by a multiplicity of problems, including poor governance, underinvestment and a chronic lack of political support. As a result, millions of people around Africa remain trapped in poverty and ill health and exposed to the risks of water-related disasters, environmental degradation and even political instability and conflict. Population growth, increasing consumption and climate change are threatening to exacerbate these problems, with grave implications for human security and development.

Currently, Africa's seemingly abundant water resources are not being efficiently utilized. With 17 large rivers and more than 160 major lakes, African countries are only able to channel about 4.0 per cent of their annual renewable flows, compared with 70 – 90 percent in many developed countries. Yet water storage is essential to ensure reliable sources of water for irrigation, water supply and hydropower and to provide a buffer for flood management.

3.5.1 Water

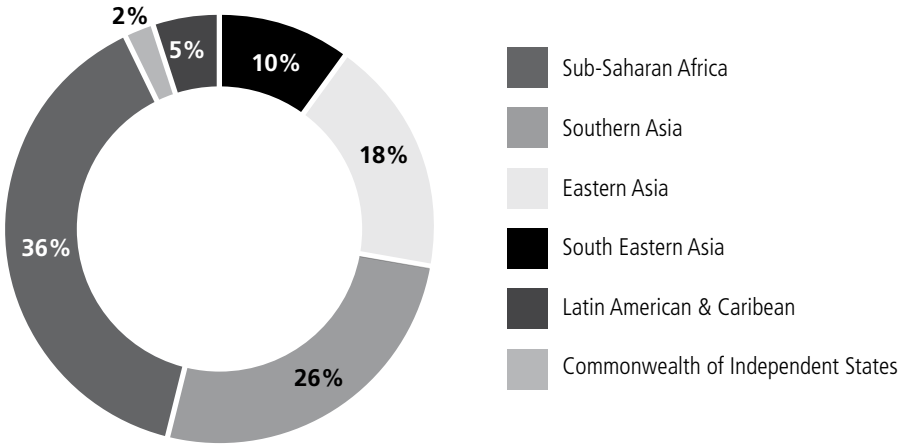
The use of improved sources of drinking-water is high globally, with 87 percent of the world population and 84 percent of the people in developing regions getting their drinking-water from such sources in 2008, as indicated in Table 7. With the exception of Oceania, Africa has the lowest water coverage in the world. In 2008, 60 percent of the African population had access to improved sources of drinking-water, an increase of 11 percentage points since 1990.This compares favourably with Oceania at 50 percent but dismal overall.

TABLE 9: **Drinking Water Sources by MDG Regions (Percentage of Population)**

MDG Region and the World	2000			2008		
	Improved	Piped	Unimproved	Improved	Shared	Unimproved
Sub-Saharan Africa	55	15	58	60	16	40
Northern Africa	89	70	11	92	80	12
Eastern Asia	81	71	19	89	83	11
Southern Asia	81	22	19	87	23	13
South Eastern Asia	80	26	20	86	33	14
Western Asia	88	79	12	90	82	10
Oceania	52	20	48	50	19	50
Latin America & the Caribbean	90	80	10	93	84	7
Commonwealth of Independent States	93	71	7	94	69	6
Developed Regions	100	93	0	100	94	0
Developing Regions	79	45	21	84	49	16
World	83	84	17	87	57	13

Source: Adapted from WHO/UNICEF (2010) Progress on Water and Sanitation: 2010 Update.

FIGURE 9: **Regional Distribution of the 884 Million People Not Using Improved Drinking-Water Sources in 2008, Population (Million)**



Source: Author from WHO/UNICEF (2010) Progress on Water and Sanitation: 2010 Update database.

In absolute terms, 884 million people in the world still do not presently get their drinking-water from improved sources, almost all of them in developing regions as shown in Figure 9. Sub-Saharan Africa accounted for 330 million or 39 percent, followed by Commonwealth of Independent States (26 per cent) and Eastern Asia (18 percent).

There are wide variations in country performance as shown in Figure 9. Mauritius and Egypt led with 99 percent of the population having access to improved water sources. They are closely followed by Botswana (95 Percent) and Gambia and Djibouti at 92 percent. The countries at the bottom are Ethiopia (38 percent), Mozambique (47 percent) and Mauritania (49 Percent). These are also the three countries where access to improved water is still less than 50 percent.

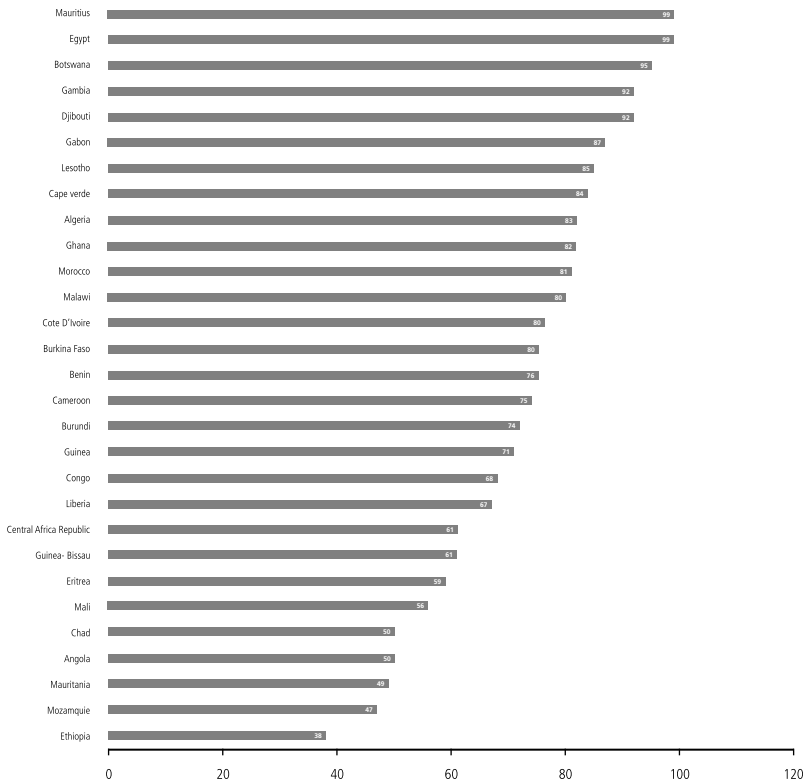
However, there are huge rural-urban disparities as shown in Table 10. Drinking water coverage for rural areas increased marginally from 36 per cent in 2000 to 47 percent in 2008. Paradoxically, the proportion of the population with access to piped water marginally increased from a dismal four percent in 2000 to five percent in 2008. For urban areas, it has declined marginally from 83 to 82 percent between 2000 and 2008 and it is barely keeping pace with population growth. The implication is that most of those accessing improved water sources are in urban areas.

TABLE 10: **Urban/Rural Coverage of Drinking Water in Africa**

	1990	2000	2008
Population ('000)	517681	674693	822436
Percentage Urban Population	28	33	37
Urban			
Improved	82	83	82
Piped	43	38	35
Unimproved	17	18	17
Rural			
Improved	36	42	47
Piped	4	4	5
Unimproved	64	68	63

Source: Author's Compilation from WHO/UNICEF (2010) Progress on Water and Sanitation: 2010 Update database.

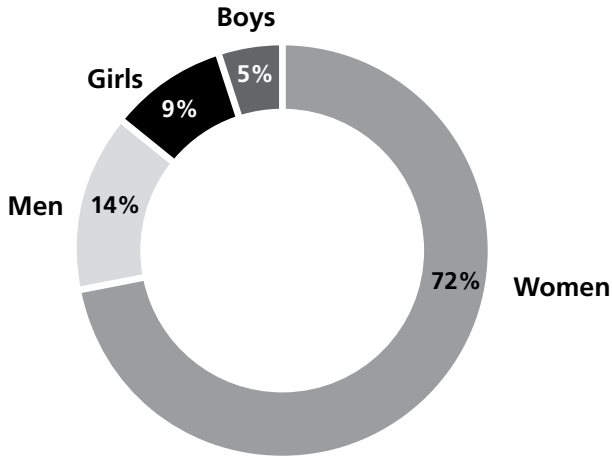
FIGURE 10: **Proportion of the Population with Access to Improved Water Sources in 2008 (Percentage)**



Source: Author from WHO/UNICEF (2010) Progress on Water and Sanitation: 2010 Update Database.

About 18 per cent of sub-Saharan Africa population relies on a source of drinking water that, despite being improved, is still more than a 30 minutes water collection roundtrip away (WHO/UNICEF, 2008). In various countries, most notably in Eastern Africa, more than a quarter of the population spends more than half an hour per round trip to collect water. As indicated in Figure 11, women shoulder the bulk of the water collection responsibility and it often takes considerable time to fetch the water. Women in Africa are more than five times as likely as men to usually go to a source and collect drinking water for the household.

FIGURE 11: **Distribution of Who Usually Collects Drinking Water by Percentage**



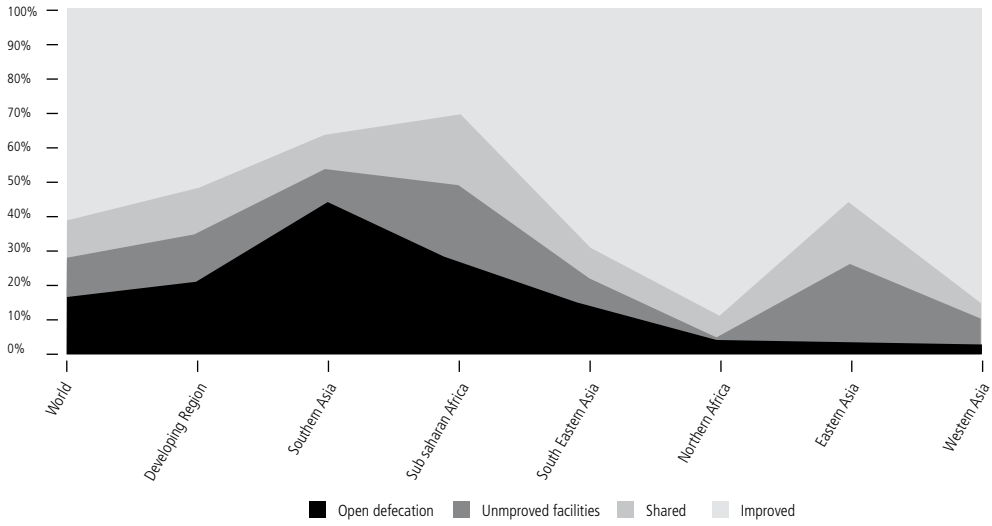
Source: WHO/UNICEF (2008) A Snapshot of Drinking Water and Sanitation in Africa

3.5.2 Sanitation

About 2.6 billion people or two thirds of the world population do not have access to improved sanitation facilities in 2008. The global picture masks great disparities between regions as shown in Figure 11. Virtually the entire population of the developed regions uses improved facilities, but in developing regions only about half the population uses improved sanitation.

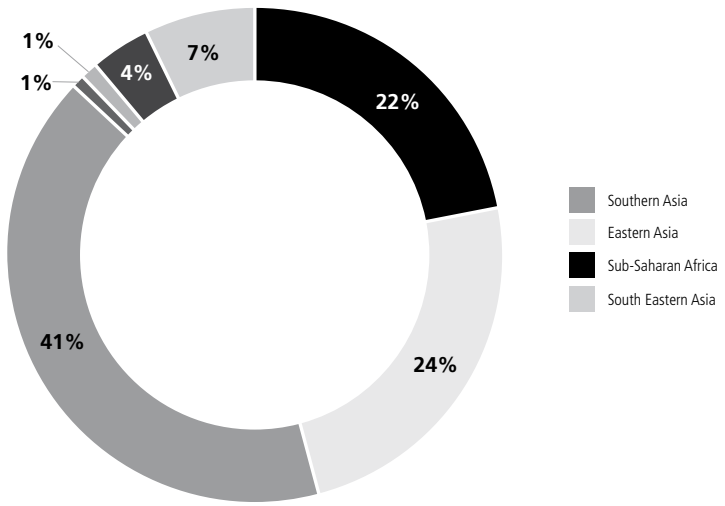
Among the 2.6 billion people in the world who do not use improved sanitation facilities, by far the greatest number are in Southern Asia (1070 million), but there are also large numbers in Eastern Asia (623 Million) and sub-Saharan Africa (565 million). There are also disparities in progress since 1990. Notable increases in the use of improved sanitation have been made in Northern Africa, South-eastern Asia and Eastern Asia, whereas there has been no progress in the Commonwealth of Independent States and a decline in Oceania.

FIGURE 12: **Use of Sanitation facilities by MDG Regions (Percentage)**



Source: Author's Compilation from WHO/UNICEF (2010) Progress on Water and Sanitation: 2010 Update database.

FIGURE 13: **Regional Distribution of the 2.6 Billion People Not Using Improved Sanitation in 2008, Population (Million)**



Source: WHO/UNICEF (2010) Progress on Water and Sanitation: 2010 Update.

As indicated in Table 11, the proportion of the population using an improved sanitation facility throughout Africa was 31 per cent in 2008, - an increase from 29 per cent in 1990. Urban sanitation coverage in Africa improved marginally from 43 percent in 2000 to 44 percent in 2008. Rural sanitation coverage, on the other hand, also increased marginally from 23 to 24 per cent between 2000 and 2008. This implies that less than a quarter of the African rural population, and just 44 percent of the urban population used improved sanitation.

In all, one in four people in Africa still practises open defecation. It is, however, encouraging to note that the proportion of the population practising open defecation has dropped from 32 per cent in 1990 to 27 per cent in 2008.

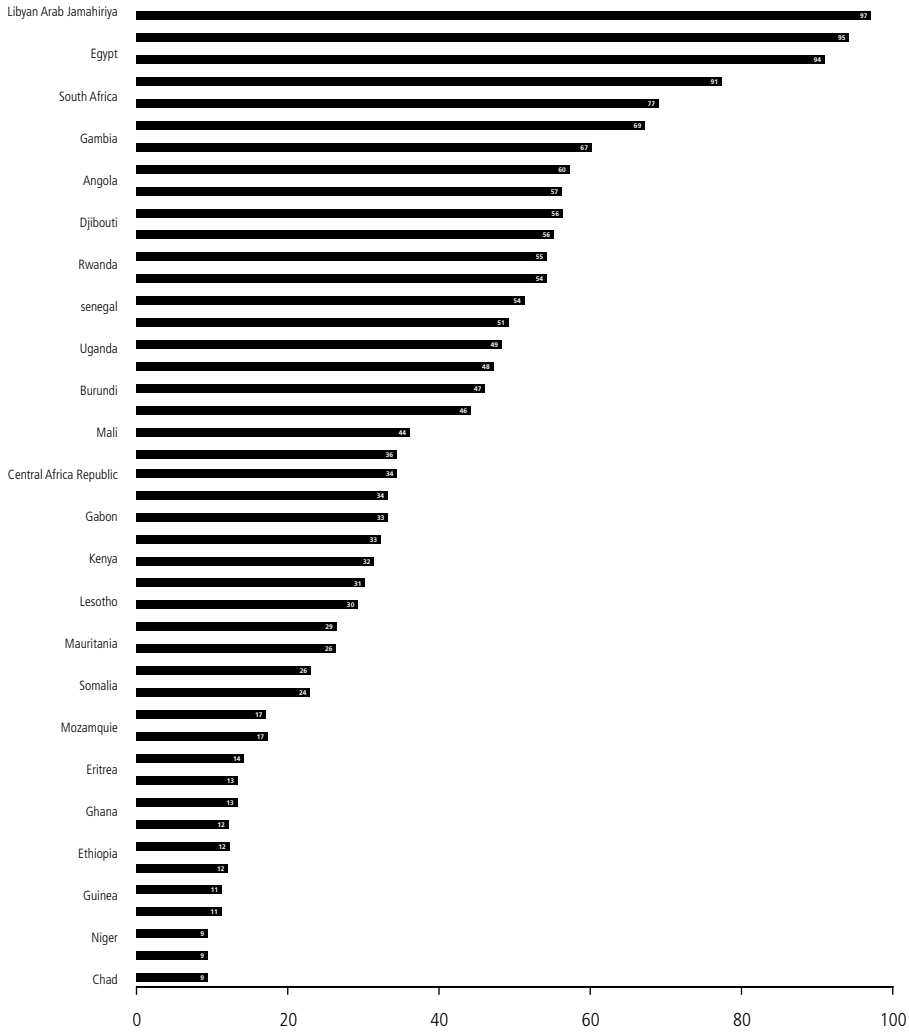
TABLE 11: **Sanitation Coverage in Africa**

	1990	2000	2008
Population ('000)	517681	674693	822436
Percentage Urban Population	28	33	37
Urban			
Improved sanitation	43	43	44
Shared Sanitation	29	30	31
Unimproved facilities	17	17	17
Rural			
Improved sanitation	21	23	24
Shared Sanitation	10	11	13
Unimproved facilities	22	23	25
Open defecation	47	43	38
Total			
Improved sanitation	28	29	31
Shared Sanitation	16	18	20
Unimproved facilities	20	21	22
Open defecation	36	32	27

Source: Author's Compilation from WHO/UNICEF (2010) Progress on Water and Sanitation: 2010 Update database.

Only seven countries in Africa are currently on track to meet the MDG sanitation target. To meet the MDG sanitation target, coverage needs to increase from 31 per cent in 2008 to 67 per cent in 2015. This requires at least a quadrupling in the average number of people served over the past 16 years. On average 45 million Africans need to gain access to sanitation every year until 2015. A cursory examination of Figure 14 indicates that less than 25 per cent of the population in 17 African countries uses an improved sanitation facility.

FIGURE 14: **Sanitation Coverage in Africa in 2008 (Percentage)**



Source: Author's Compilation from WHO/UNICEF (2010) Progress on Water and Sanitation: 2010 Update database.

CHAPTER 4 MODELS OF INFRASTRUCTURE FINANCING

4.1 GOVERNMENT FINANCING

Infrastructure projects typically involve large capital expenditures in order to create physical assets that will subsequently be used for the production of economic and social services in the long term. They are complex activities requiring specific expertise and resources for both the construction and operating phases, significant financial outlays, and the need for some parties to bear the risks associated with the project.

Historically, the tendency has been for infrastructure financing, construction and operation to be primarily within the public sector, although contracting out some specific construction or operational tasks was undertaken by the private sector. Highways, telecommunications, power, railroads, hospitals, prisons and schools are common examples of utilities that were funded by the state. These were viewed as having natural monopoly characteristics, involving externalities, or as not appropriate for a "user-pays" approach, and thus not suitable or feasible for private sector provision.

For much of the 20th century, infrastructure services in most countries were provided by state-owned utility companies that were vertically integrated. Although this model initially produced some desirable results, it ultimately led to serious problems, especially in developing countries. These problems included under-investment caused, to a large extent, by under-pricing, low productivity, poor service delivery, long queues, lack of access to basic services; lack of transparency, and damaging political interference in the operations of these infrastructure entities.

4.2 PRIVATE SECTOR IN INFRASTRUCTURE FINANCING

Since the late 1980s, there has been a profound reassessment of public policy towards the infrastructure sectors as a result of technological change, better appreciation of the linkages between incentive structures and operational efficiency, and greater acceptance of a "user pays" philosophy (Grimsey and Lewis, 2004).

Consequently, there has been a shift towards private management (private sector participation) and private ownership (privatization) of these industries, as well as the competitive provision of services within parts or all of these sectors (liberalization) for two major reasons. First, because of the generally poor performance of state-owned monopolies. Second, because of the rapid globalization of world economies, which has brought into sharp focus the economic costs of inadequate infrastructure, prompting several developing countries to seek new initiatives to promote competition, involving private and foreign interests in the provision of infrastructure.

In the face of extraordinarily weak performance in the provision of infrastructure, the debt and fiscal crises that emerged in the early 1980s in many developing and transition economies, and the recognition that infrastructure is a critical tool in sustainable economic growth and international competitiveness, many African countries began to consider alternative means of infrastructure development.

Subsequent to the endorsement and promotion of infrastructure privatization by international development agencies, many countries in Africa have been implementing far-reaching infrastructure reforms, including restructuring, privatization, and establishing new approaches to regulation over the past decade.

Governments around the world have adopted a wide variety of approaches in engaging the private sector in the delivery of infrastructure services.

Options range from service contracts, in which relatively few responsibilities and risks are passed to the private sector, to concession contracts and divestitures, in which the private sector takes full responsibility for operating and investing in infrastructure services and therefore takes on significant commercial risks. The main distinction among the key PPI approaches is how responsibility is allocated for asset ownership, operations and maintenance, capital investments, and commercial risk, as shown in Table 12.

TABLE 12: **Options for Private Sector Participation in Infrastructure**

Approach	Asset Ownership	Operation & Maintenance	Capital Investment	Commercial Risk	Contract Duration
Service Contract	Public	Public/private	Public	Public	1-2 years
Management Contract	Public	Private	Public	Public	3-5 years
Lease	Public	Private	Public	Shared	8-15 years
Concession	Public	Private	Private	Private	25-30 years
Build-Operate-Transfer (BOT)	Public and Private	Private	Private	Private	2-30 years
Divestiture	Private or public and private	Private	Private	Private	Indefinite or limited by license

Source: Jerome (2009)

The on-going reforms in infrastructure financing are being implemented to promote private investment, provide strong incentives for operating efficiency, restore the financial viability of virtually bankrupt state-owned network utilities, especially through the promotion of more rational pricing policies that would improve service quality and eliminate service backlogs, introduce greater transparency in the operations of these industries, and also insulate the operating infrastructure entities from damaging political interference.

Despite promising signs early in the transition process, the track record of governments in establishing the conditions for attracting private investment in infrastructure has been chequered and uneven across the region. Nearly two decades later, the results have been disappointing, particularly in the areas of greatest need – water and energy. Some notable successes notwithstanding, overall outcomes have fallen short of expectations. Limited private financing has been mobilized and a number of concessions have run into problems. In many countries, the cost of infrastructure services has not decreased, and increases in quality and access rates have not occurred as anticipated.

The development of PPP remains riddled with economic, political and institutional challenges. While the principle of economic pricing and cost recovery is generally well understood, political resistance and social considerations demonstrates that it has not been universally adopted. Similarly, the establishment of an appropriate and comprehensive legal and regulatory environment has been only gradual, with considerable variations between sectors. With the benefit of hindsight, not all infrastructure assets or services are amenable to PFI; indeed, experience in other jurisdictions has suggested that in some circumstances infrastructure provided via PFI can lead to poor public accountability, a reduction in competition, as well as the development of monopolies.

Optimal contract design and pricing for PPPs is an emerging art, with many lessons learnt from both successes and failures. But some lessons have not been learnt as rapidly as might have been hoped, such as the appropriate methods for pricing and comparing risks of alternative approaches. In addition, many of the lessons, such as the costs of real options implicit in PPPs, and the consequences of incomplete contracts, may take many years to be fully recognized. Moreover, the complexity of, and secrecy demanded by, commercial contracting means that public analysis and discussion, which would facilitate continuous improvement in PPP design, is less than optimal (Tangri, 1999). There are signs, however, that originally widespread political scepticism about private sector involvement in transport and, especially, water is diminishing. Selected municipalities are attempting to attract private operators - both to raise finance and productivity.

4.3 GOVERNMENT FINANCING OF INFRASTRUCTURE IN AFRICA

By and large, governments are still the most prominent financiers of infrastructure investment in Sub-Saharan Africa. Currently, Governments in SSA spend on average between 6–12 percent of their GDP on infrastructure each year, understood as comprising ICT, power, roads, water, and sanitation. As indicated in Figure 15, about half of the countries spend more than 8.0 percent of GDP, while only a quarter spends less than 5.0 percent, the level commonly encountered in the OECD Countries. Cape Verde, Ethiopia, and Namibia spend well above 10 percent of their GDP on infrastructure annually.

A majority of the public spending on infrastructure in sub-Saharan Africa is channelled through State Owned Enterprises (SOEs). These SOEs have played a particularly large role in the middle-income countries, where they account for over 70 percent of all public infrastructure spending. In Namibia, for example, 90 percent of expenditures on infrastructure are made by SOEs. In non-oil-exporting low-income countries, the share of expenditures realized by SOEs is close to 60 percent, or just below two-thirds of total infrastructure spending. The bulk of the resources that pass through SOEs, however, go to current spending. Most of the recorded current spending relates to so-called non productive expenses, namely wages and salaries while very little goes to financing operations and maintenance.

Too often, infrastructure financing is biased toward the realization of new investments at the detriment of existing stock maintenance. This is rather unsurprising considering that maintenance is tax-financed, while new investments rely on soft international loans, which are more palatable to politicians, as long as they do not have too many strings attached.

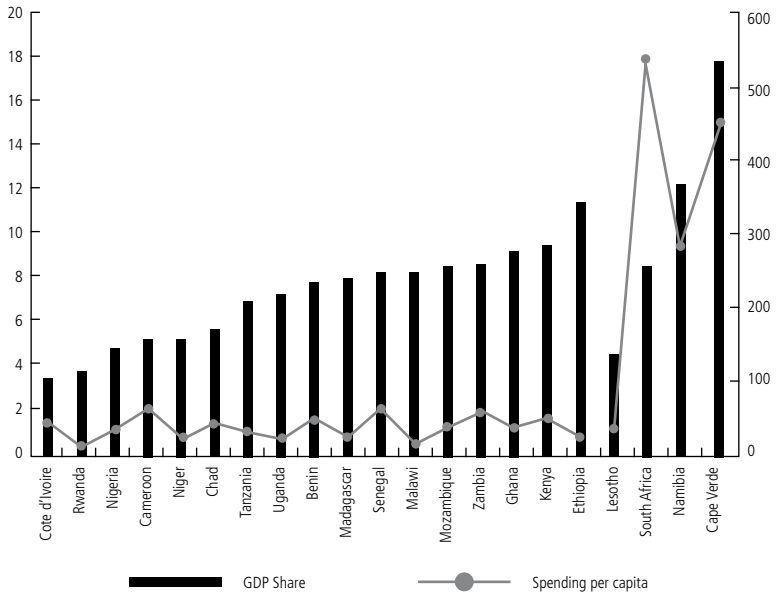
New investments also have higher "political visibility" and shorter "horizon" than maintenance, which only has gradual effects on the quality of the infrastructure stock. This lower-than-optimal level of maintenance has two main consequences. First, it reduces the life-span of the existing stock of infrastructure itself. Second, it relates to higher operation costs and reduced duration of private capital, such as trucks operating on low-quality roads or machines connected to unstable voltage lines.

4.4 CURRENT INVESTMENT NEEDS

Much of the current international debate on ways to spur growth, reduce poverty and improve the quality of human life in African countries has been centered on the need to promote a large increase in infrastructure. Recent Reports on Africa by the United Nations Millennium Project (2005), the Blair Commission (2005) and the AIDGs (2009) have dwelt on the importance of a "Big Push" in public investment in core infrastructure, financed by generous debt relief and a substantial increase in aid. The chances of Africa attaining the MDGs, in the most part, will be determined by the region's ability to tackle critical infrastructure challenges. Basic infrastructure, whether transport, energy, or water and sanitation, is amongst the most fundamental conditions required to support social development and sustained economic growth.

So far, SSA's track record of investment suggests that the private sector by itself is unlikely to provide the kind of near-term funding needed to address these shortcomings. With Africa's low levels of infrastructure investment in the face of rapidly growing needs, the private sector appears capable of supplying only a fraction of the additional infrastructure finance that Africa needs to meet the Millennium Development Goals.

FIGURE 15 : **Fiscal flows devoted to infrastructure**



Source: AICD 2009

There have been various estimates of the investment gap and the cost of redressing Africa's infrastructure deficit. Perhaps the most comprehensive and current is that by AIDG (2009) which tabulated the funding requirements as USD 93 billion a year, translating into about 15 percent of Africa's GDP (see Table 13). Setting these requirements against the USD 45 billion of existing spending directly traced to these needs and the USD 17 billion of potential efficiency gains still leaves an annual infrastructure funding gap of USD 31 billion. Over 70 percent of the infrastructure funding gap is for energy, reflecting the particularly large deficits that Africa has in this regard, and about two-thirds of this is associated with needed expansions in generation capacity to keep pace with escalating demand. Transport is a distant second in terms of spending requirements, and more than half of the total amount for this sector is associated with improvements and extensions to the rural network to reduce isolation. However, the magnitude of the burden varies greatly according to the type of country. While middle-income countries and oil exporting countries could meet their infrastructure needs with an attainable commitment of less than 10 percent of GDP, low-income countries would need to devote an implausible 20 percent of GDP—and fragile states an impossible 40 percent of GDP (Briceño-Garmendia, 2008).

Given that prospects for public-private partnerships (PPPs) in infrastructure investment for the region, and low-income countries in general, are limited (if not inexistent, in some sectors), the financial resources required for closing the infrastructure gap must come from governments, other official sources, and, increasingly, from private capital markets. The two approaches on which reform hopes have been based have both proven deficient, though in different ways. The revised tactics require further revision. The search for mechanisms that combine private capital and expertise with socially acceptable management and delivery must be renewed.

TABLE 13: **Africa's Annual Expenditure Needs to Meet the MDGs**

	Investment	Operation and maintenance	Total	
Power	26.7	14.1	40.8	6.6%
Water and sanitation	14.9	7.0	21.9	3.6%
Transport	8.8	9.4	18.2	3.0%
ICT	7.0	2.0	9.0	1.4%
Irrigation	2.7	0.6	3.3	0.5%
TOTAL	**60.4**	**33.0**	**93.3**	**15.0%**

Source: Foster and Briceno-Garmendia (2010)

CHAPTER 5 PRIVATE PARTICIPATION IN INFRASTRUCTURE IN AFRICA

5.1 THE RECORD OF PRIVATE SECTOR PARTICIPATION IN AFRICA'S INFRASTRUCTURE

Drawing from the World Bank's Private Participation in Infrastructure (PPI) database, we evaluate the extent of private sector participation in infrastructure in Africa[7]. According to this database, 150 low- and middle-income countries transferred to the private sector the operating risk for 4,078 infrastructure projects between 1990 and 2007, attracting investment commitments of USD 1.243 billion as indicated in Table 14; though, actual investment may have been somewhat lower due to some cancelled projects.

TABLE 14: **Private Sector in Infrastructure Projects by Region (1990-2007)**

Region	Total Number of projects	Percentage of Total	Total Investment Commitments USDMillion	Percentage of Total
Latin America and the Caribbean	1,243	30.53	474,525	38.17
East Asia and Pacific	1,224	30.01	275,552	22.17
Europe and Central Asia	714	17.51	230,393	18.53
South Asia	414	10.15	127,577	10.26
Sub Saharan Africa	357	8.75	68,716	5.53
Middle East and North Africa	124	3.04	66,295	5.33
Total	**4,078**	**100**	**1,243,058**	**100**

Source: Adapted from World Bank's Private Participation in Infrastructure (PPI) database.

According to the World Bank data base, sub-Saharan Africa attracted USD 68.716 billion in investment commitments between 1990 and 2007, as indicated in Table 11[8]. But this figure represents a mere 5.5 per cent of the cumulative investment in developing countries. In spite of this dismal performance, South Africa (32 projects accounting for USD 25.341 billion) and Nigeria (32 projects at USD 17.133) accounted for over 62 per cent of these flows (about USD 19 billion from 1990–2004), respectively.

Nigeria has also claimed a rapidly growing share of investment commitments, about 2.6 percent over the 15-year period, with much of that investment coming since 2001. Apart from South Africa and Nigeria, which have emerged as the top ten countries globally by investment flows since 2001, the region's share of the total for low- and middle-income countries is less than 2.0 percent.

7 This section draws substantially from Jerome (2009). Due to the way data from the PPIAF data is structured, much of the discussion in this section is limited to Sub-Saharan Africa

8 This may have been underestimated since the data on private activity exclude small-scale private service providers, which play important role in Africa.

By 2007, 46 of the 48 sub-Saharan countries had awarded 357 infrastructure projects (Table 15) with private participation over the 17-year period, though this is likely to have been underestimated. But only four countries had projects in all four infrastructure sectors, namely, energy, telecommunications, transport and water and sewerage. The average size of the projects was only about a quarter of what obtains in the rest of the developing world. Indeed, Africa has had relatively widespread private activity, but fewer and smaller projects per country than in more affluent regions.

After a slow start in the early 1990s, private involvement in infrastructure in SSA grew significantly from the mid 1990s. Annual investment in infrastructure projects increased from USD 1.43 billion in 1986 to USD 4.6 billion in 1999, then declined to USD 3.5 billion in 2000, oscillating in subsequent years before peaking at USD 11.89 billion in 2006 (Table 16). It, however, declined marginally to USD 10.98 billion in 2007, the latest year for which data is available

TABLE 15: **Number of Private Sector Participation in Infrastructure Projects by Primary Sector in Sub-Saharan Africa (1990-2007)**

Financial Closure Year	Energy	Telecom	Transport	Water and Sewerage	Total
1990	1	0	1	0	2
1991	1	0	1	1	3
1992	0	3	0	1	4
1993	3	3	3	1	10
1994	4	3	1	0	8
1995	3	10	2	1	16
1996	5	9	4	1	19
1997	6	17	5	0	28
1998	5	15	7	1	28
1999	7	13	6	5	31
2000	5	19	6	1	31
2001	7	16	2	4	29
2002	3	3	1	2	9
2003	7	9	9	1	26
2004	4	10	5	0	19
2005	12	6	21	1	40
2006	11	10	8	2	31
2007	6	14	2	2	24
Grand Total	**89**	**160**	**84**	**24**	**357**

Source: World Bank's Private Participation in Infrastructure (PPI) database.

TABLE 16: **Private Sector Investment in Infrastructure Projects by Primary Sector in Sub-Saharan Africa (Total Investment Commitments in USD million)**

Investment Year	Energy	Telecom	Transport	Water and Sewerage	Total Investment
1990	40	0	0	0	40
1991	0	0	0	0	0
1992	0	20	0	0	20
1993	0	1	31	0	31
1994	76	553	18	0	647
1995	77	677	63	0	817
1996	428	961	28	20	1,437
1997	754	1,755	469	0	2,978
1998	715	1,467	336	0	2,517
1999	585	2,846	1,087	82	4,601
2000	451	2,787	204	31	3,473
2001	713	4,050	484	3	5,251
2002	484	3,635	78	0	4,196
2003	1,297	4,715	280	9	6,301
2004	56	4,512	223	0	4,792
2005	1,359	4,918	2,460	0	8,737
2006	616	7,028	4,251	0	11,895
2007	1,192	9,484	187	121	10,984
Grand Total	**8,841**	**49,410**	**10,199**	**266**	**68,716**

Source: World Bank's Private Participation in Infrastructure (PPI) database.

Sub-Saharan Africa's share of private sector investment in infrastructure has been heavily tilted toward telecommunications. As indicated in both Tables 13 and 14, telecommunications is the leading sector with private sector participation in SSA, both in terms of capital invested (USD 49.410 billion or 72 percent) and the number of projects (160 or 44.8 percent), a far larger share than the 47 percent in the rest of the developing world. Transport ranked a distant second with (USD10.199 billion or 14.8 percent) though third in the number of projects (84 or 23.5 percent).

According to the World Bank data base, nearly 60 percent of all investment went to toll roads, mostly for long-term concessions. Perhaps, the largest recent project is the USD 450 million Bakwena Platinum Toll Highway, linking Pretoria to South Africa's border with Botswana.

Energy had the next largest share of activity, with USD 8.841 billion on 89 projects. Among recent energy projects, the largest is the 865-kilometer pipeline to transport natural gas from fields in Mozambique to South Africa, a USD 1.2 billion project.

Investment in water and sewerage projects lagged far behind other sectors, at USD 266 million (less than 1.0 percent of the total) for 24 projects between 1990 and 2007. However, many African governments bundle energy and water into one large utility company that they then turn over to private operators. Africa had 12 such projects between 1990 and 2007, more than any other developing region. These projects accounted for about 5.0 percent of total investment, though anecdotal evidence suggests that most investment went into electricity rather than water. Regional investors, mainly from South Africa, have played a key role in all infrastructure sectors, accounting for more investment (about 38 percent) in Africa than any other category of investors during the period between 1998 and 2005 (Schur, von Klaudy and Dellacha 2006). The breakdown by sub-sector is presented in Table 17.

About 31 projects or 8.9 percent of the total infrastructure projects with private participation implemented in sub-Saharan Africa between 1990 and 2007 period have been cancelled or classified as "distressed", representing USD 1.9 billion or 2.8 percent of investment commitments in the period. Ten of the cancelled or distressed projects in Africa were small Greenfield mobile operations that failed to build a sizable customer base. Management and lease contracts are lower risk, and are popular in the region, but these characteristics do not guarantee their sustainability.

TABLE 17: **Total Projects by Primary Sector and Subsector (USD million)**

Primary Sector	Subsector	Project Count	Total Investment
Energy	Electricity	83	6,908
	Natural Gas	7	2,249
Total Energy		90	9,157
Telecom	Telecom	160	49,410
Total Telecom		160	49,410
Transport	Airports	11	495
	Railroads	20	4,769
	Roads	10	1,856
	Seaports	44	3,096
Total Transport		85	10,217
Water and sewerage	Treatment plant	3	133
	Utility	21	134
Total Water and sewerage		24	266
Grand Total	..	**359**	**69,050**

Source: World Bank's Private Participation in Infrastructure (PPI) database

An emerging trend is the increasing importance of China, India, and a few Middle Eastern Gulf nations in African infrastructure development. A recent study indicates that investment commitments in Africa by these emerging financiers jumped from less than USD 1 billion per year before 2004 to USD 8 billion in 2006 and USD 5 billion in 2007. By far, the largest contributor was China whose contribution started from a low base (less than USD 1 billion per year before 2004) but rose to over USD 7 billion in 2006 but dipped to USD4.5 billion in 2007 (Foster, et. al 2008). Noteworthy, however, is that nearly 70 percent of Chinese investments are concentrated in resource rich Angola, Nigeria, Ethiopia, and Sudan, a reciprocity demonstrating the huge appetite of China for Africa's oil.

As indicated in Table 18, sub-Saharan African countries have tended to rely mainly on Greenfield projects to increase capacity. This type of project, used mainly for mobile telecommunications, led in private activity in investment and number of projects (197 projects or 55 percent). Concessions followed, accounting for 71 projects of total investment. This has been closely followed by management and lease contracts with 53 projects. Divestiture accounted for only 36 projects. These transactions usually involved the sale of controlling stakes, through international tenders, to strategic investors committed to managing the companies and complying with a predefined investment programme. Most divestitures took place in telecommunications and involved incumbent national operators.

TABLE 18: **Number of Projects by Type**

Financial Closure Year	Concession	Divestiture	Greenfield	Management and lease contract	Total
1990	1	0	0	1	2
1991	1	0	0	2	3
1992	0	1	2	1	4
1993	1	0	3	6	10
1994	0	0	6	2	8
1995	3	3	8	2	16
1996	1	1	11	5	18
1997	2	5	18	3	28
1998	3	2	22	1	28
1999	5	2	19	5	31
2000	4	4	21	2	31
2001	1	7	16	5	29
2002	1	0	4	4	9
2003	11	0	10	5	26
2004	5	1	11	2	19
2005	23	1	14	2	40
2006	6	4	17	4	31
2007	3	5	15	1	24
Grand Total	**71**	**36**	**197**	**53**	**357**

Note: Most infrastructure projects with private participation fit in one of these four categories. But the boundaries between these categories are not always clear, and some projects have features of more than one category. In these cases projects have been classified in the category that better reflects the risk borne by the private sector.

Source: World Bank's Private Participation in Infrastructure (PPI) database

In what follows, we briefly appraise the main developments in each sector.

5.2 WATER AND SANITATION

In the 1990s private sector participation was broadly hailed as the solution to developing countries' problems in the water sector. Private investors were expected to provide not only much-needed expertise but also the sizable funding required to rehabili¬tate infrastructure and expand coverage. The private sector investment boom of the late 1990s has, however, been followed by declining investment flows and the cancellation or distress of several high-profile projects. Enthusiasm has been replaced by doubts. Contracts often reflected excessive optimism, by both private investors and governments, and the socio-political difficulties of raising tariffs to levels covering costs were often underestimated. Finan¬cial markets were hesitant to provide non-recourse financing for water projects (unlike projects in other infrastructure sectors), often requiring that financing be backed by the sponsors' balance sheets. Finally, some of the largest water projects were in East Asia and Argentina, and when financial crisis broke out, the contracts proved insufficiently robust to weather the storm. Several international water operators lost much of their appetite for further investment in developing countries.

In the period 1990–2007, private investors committed USD 56.471 billion to 584 water projects in develop¬ing countries. During this 17-year period, 60 developing countries brought private participation to their water sector. By 2005, 54 of those countries still had operational water projects. In the past three years, coun¬tries such as Albania, Algeria, Ghana, Peru, and Russia have opened their water utilities to private participation. However, sub-Saharan Africa was able to attract only 24 projects and 12 other projects combining water and electricity services. In all, South Africa accounted for seven of these projects.

However, recent data paint a more nuanced picture. Activity in 2005 suggests that private participation in the water sector is entering a new phase. New private activity is focusing on smaller projects, a few countries, and bulk facilities. Contractual arrangements involving utilities are combining private operation with public financing and new players are entering the market. Indeed, 2005 was a record year in which 41 projects reached financial closure, the most since 1990.

But due to the high political risk in sub-Saharan Africa, private operators were reluctant to invest even during the "concession boom," leading to a predominance of management and lease contracts. As these schemes have proved to be more sustainable, countries such as Côte d'Ivoire and Senegal have become international success stories for private participation. In 2005, Vittens of the Netherlands won the management contract for Ghana's national water utility in a consor¬tium with Rand Water of South Africa.

Nowhere has privatization met more intense resistance in Africa, than in water supply. There have been a number of effective campaigns against the privatization of water services in sub-Saharan Africa, notably in Ghana , Kenya and South Africa.

5.3 ENERGY

On attaining political independence in the 1960s, African countries saw energy infrastructure as an essential lever for economic take-off and social advancement of the citizenry. At the time, the dominant view was that the state would manage the operation, planning, and financing of this sector. The organisation of the sector was, thus, based on state-owned monopolistic operators and managed as government departments or a separate public company. Over the years, the public monopoly

approach facilitated the expansion of power suppliers and captured technical economies of scale. However, it failed to ensure high quality service, wide access to the service, and reliable supply, resulting in poor investment decisions and precarious financial viability.

Since the 1990s, new ways of organizing the industry are being explored. In an effort to improve the technical, commercial, and financial performance of utilities; boost sector cash flow; facilitate mobilization of resources for capital investment on a commercial basis, thereby releasing public funds for other investments; and extend access to electricity to poor and rural communities, many countries have adopted plans to reform the structure, operation, and financing of their state-owned electricity utilities. A number of African countries have also adopted policies and plans to unbundle and privatize their power sectors and introduce competition.

While the depth and pace of reforms in Africa have not been as extensive or as rapid as in many industrialized countries, a sizeable group of countries have taken several steps in the reform process, with considerable private sector involvement, both in IPPs and in divested assets. Private participation has mainly been through management contracts, concessions, and new investments in independent power producers. Most countries are also establishing independent electricity regulators. In addition, many power sector reform initiatives have involved the establishment of electrification funds and agencies. It is noteworthy that most African governments have initiated institutional reform of their power sectors, under pressure from the International Finance Institutions, which unanimously bundled institutional reforms with lending for investment to expand and renew power facilities.

Energy sector reform has conventionally begun with an initial stage of commercialization and corporatization of state-owned utilities, followed by unbundling and the introduction of competition. Although many countries have begun this reform process, no African country has completed the transition to a fully unbundled, competitive, and private electricity sector. So far, only Uganda has successfully unbundled its utility. Some have introduced limited competition for the market by allowing bids by independent power producers (Ghana, South Africa, Tanzania and Nigeria) or concession agreements (Mali, Uganda), but none has succeeded in developing competition in the market through a competitive power market or at the distribution level.

While past and ongoing reforms in the power sector in Africa have registered some encouraging results, especially improved generation capacity, as well as financial performance in certain utilities, there are still a number of important challenges that are yet to be addressed. First, there is a need for sustained improvement in technical and financial performance in the electricity industry. In a number of African countries, the advent of PPIs has certainly improved the availability of power by boosting national installed capacity. In addition, in certain countries, changes ushered in by new management teams, usually under some form of contract management arrangement have resulted in attitudinal changes, especially in respect of debt collection rates. The long-standing problem of poor performance at the transmission and distribution end, however, remains intractable.

Other challenges include increased electrification of the poor and increased local participation in the power sector. The energy sector in Africa has largely failed to provide adequate electricity services in support of economic growth and improved social welfare.

With the exception of South Africa, Ghana and, to a lesser extent, Zimbabwe, the majority of sub-Saharan African countries continue to register woefully low levels of national electrification. In most countries, rural electrification is at single digit levels and urban electrification still well below 50 per cent. For lower income groups, access to electricity is still a dream. The emphasis on profitability appears to have relegated expanded electrification for the poor to the bottom of the priority list.

5.4 TELECOMMUNICATIONS

The record made by private participation in infrastructure in SSA has largely been in telecommunications. Many countries are undergoing sector reforms and foreign investment is now actively encouraged across the continent, as privatisation and liberalisation are progressively being introduced. More than one-third of all state telecommunications companies have already been privatised and several more are set to undergo privatisation in the near future.

There are currently more than 120 mobile networks in operation in Africa, compared with 33 in 1995. Regional and international players have continued to jostle for positions in Africa's lucrative mobile market, and consolidation is beginning to take hold. Particularly remarkable is the influx of Middle Eastern firms.

The most competitive markets are Algeria, the Democratic Republic of Congo, Nigeria and South Africa with three or more operators. South Africa is Africa's most developed market with a market penetration rate of 67 % in 2006, followed by Tunisia. Despite falling tariffs, competition is still needed in some markets retaining monopolies, such as Ethiopia and Rwanda, coincidentally still with the lowest penetration rates.

Table 19 presents Africa's top 15 Mobile phone companies. Considering Africa's top 500 companies, South African phone companies maintain their position of supremacy in the new economy in Africa. MTN, Telkom and Vodacom, as the Fifth, Seventh and Ninth largest firms on the continent, respectively, have the home market stitched up and are continuing to expand abroad.

Due to technological innovation in the sector, there is need to enhance further liberalization of the sector in Africa. Given the need for more investment in ICT infrastructure and lower prices, infrastructure sharing is a good way of minimizing duplication and sharing facilities. Regulators need to create a trusting environment among operators and develop policies that promote infrastructure sharing and allow operators to compete on service, rather than at the infrastructure level.

Efforts should be made to reduce prices for telecommunications services, especially broadband Internet. The third-generation mobile networks and WiMAX offer promising solutions for increasing broadband access in Africa. These technologies are beginning to take root in some countries. Governments should promote wireless broadband through efficient spectrum allocation and liberal licensing. On the other hand, operators should be encouraged to roll out coverage of advanced wireless technologies beyond urban areas through tax incentives, license conditions and initiatives to promote infrastructure-sharing. Wireless broadband deployment could be included in universal access policies.

TABLE 19: **Africa's Top 15 Telecommunications Firms in 2008**

Rank in 500	Company	Country	Turnover (USD Billion)
5	MTN Group	South Africa	$10.3
7	TELKOM	South Africa	$8.33
9	Vodacom	South Africa	$7.13
15	Vodacom South Africa	South Africa	$6.39
20	ORASCOM	Egypt	$4.91
25	MTN South Africa	South Africa	$4.18
31	MAROC Telecom	Morocco	$3.60
41	MTN Nigeria	Nigeria	$3.00
64	Telcom Egypt	Egypt	$1.82
65	ORASCOM Tel. Algerie	Algeria	$1.76
87	Algerie Telecom	Algeria	$1.31
101	Zain Nigeria	Nigeria	$1.17
104	Soc Nat. De Telecom	Senegal	$1.13
111	Vodafone Egypt	Egypt	$1.05
129	Tunisie Telecom	Tunisia	$0.88

Source: Jerome (2009). Adapted from Africa's Top 500 Companies, The Africa Report, February to March 2009

5.5. TRANSPORT

Since the 1990s, the transport sector has undergone a major transformation. The transport business has mostly been deregulated, and transport policies have been modified to permit market-determined decisions, enterprise autonomy, and private participation in the ownership and management of the transport business. Most bus and truck companies have been privatized, and governments are making concessions on the railways, ports and harbours, and airports, especially since 2000. Various forms of public-private partnerships have been tried in airports, seaports and railways, more rarely for roads. However, investors' perception of high risk renders full privatisation impractical, so most private participation in transport infrastructure has taken the form of leases or concessions.

Private contractors are playing an increasing role in the rehabilitation and maintenance of roads and transport infrastructure. In addition, public enterprises have been given considerable autonomy, and arbitrary regulation has been replaced by regulation through consensual performance contracts. In the highway sector, setting up of more sustainable institutions – autonomous road agencies and dedicated road funds — has become the norm, and in some countries has started to show positive results.

Nonetheless, Africa is still considerably disadvantaged in all respects in the transport sector. Under a fifth of the road network in SSA is paved, compared to over a quarter in Latin America and over two fifths in South Asia. Even paved roads are severely affected by systematic axle overloading of trucks and poor drainage, with dramatic consequences on safety.

High transport costs are a handicap to Africa's ability to compete within a global market, inland transport costs are twice as high in sub-Saharan Africa compared to Asia; international maritime costs are three times higher. These higher costs are due to a combination of factors, such as lower road quality, outdated port facilities, time-consuming administrative procedures and in some countries, insufficient competition between service providers.

Despite the importance of airports and seaports for long distance freight, only a few airports (in Egypt, Cape Verde, Ethiopia, Morocco, Ghana and South Africa) have attained FAA Category I status, required for international flights. Only one African seaport is owned by one of the five largest global port operators known worldwide for their efficiency and most container terminals are reaching or have reached capacity limits, and are under-equipped. This suggests that more still needs to be done to develop Africa's ports infrastructure to international standards.

CHAPTER 6 IMPACT OF INFRASTRUCTURE ON ECONOMIC GROWTH AND POVERTY REDUCTION IN AFRICA

6.1 AFRICA'S GROWTH PERFORMANCE

After what has been tagged as the "lost decade" for Africa in the 1980s, the continent's political and economic landscape has recorded notable progress in recent years. Economic growth in several African countries improved significantly in the last decade. While performance varied across countries, the region as a whole saw average annual real GDP growth rates of around 5.0 percent between 1995 and 2007, or annual increases in per capita GDP of over 2.0 percent as a result of improved macroeconomic policies, favorable commodity prices, and significant increases in aid, capital flows and remittances. These growth rates brought Africa in line with the trends for other developing countries (World Bank, 2009).

As can be gleaned from Table 20, this improved performance cut across patterns of resource endowments and geography. For instance, while oil exporters such as Equatorial Guinea, Angola, Chad and Sudan had spectacular growth, other countries less well endowed with mineral wealth, such as Mozambique, Cape Verde and Rwanda also sustained high growth rates over the period. The list of high-growth countries included both coastal countries, such as Ghana, as well as landlocked ones, like Burkina Faso.

However, the decade-long, sustained and accelerating growth came to a grinding halt as a result of the global economic crisis of 2008-2009 (Figure 16). Improved policies in the face of the crisis have helped the continent get through the storm better than expected. GDP is projected to expand by around 4.2 percent in 2010 and 4.9 in 2011 - a faster turnaround than in previous crises. Per capita income, which fell by nearly 1.0 percent in 2009 – the first such contraction in a decade – will also post an upward trend (World Bank, 2010).

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TABLE 20: **Africa GDP Growth Rates, 1997 – 2007 (Cumulative annual average)**

Slow Growing Countries 36% of Population		**Moderate to Fast Growth 34% of Population**		**Oil Exporting Countries 30% of Population**	
Zambia	3.9	Mozambique	10.3	Equatorial Guinea	26.4
Madagascar	3.7	Cape Verde*	9	Guinea*	10.3
Niger	3.7	Rwanda	6.9	Angola*	8.1
Mauritania	3.6	Sao Tome and Principe	6.9	Chad	7.4
South Africa*	3.6	Rwanda	6.8	Sudan	4.7
Kenya	3.4	Botswana*	6.5	Nigeria	4
Guinea	3.3	Burkina Faso	5.9	Cameroon	3.1
Lesotho*	3	Uganda	5.8	Congo, Rep	1.3
Malawi	2.9	Mali	5.7	Gabon*	
Togo	2.8	Tanzania	5.6		
Swaziland	2.6	Ethiopia	5.5		
Seychelles*	2.6	Sierra Leone	5.5		
Comoros	2	Ghana	5		
Burundi	1.9	The Gambia	4.7		
Central African Republic	1.8	Mauritius*	4.6		
Eritrea	1.4	Senegal	4.5		
Congo, Dem.Rep.	1.2	Benin	4.4		
Cote d'Ivoire	1	Namibia	4.1		
Guinea-Bissau	0				
Zimbabwe	-3.9				
Simple Average	**2.2**		**5.9**		**8.1**

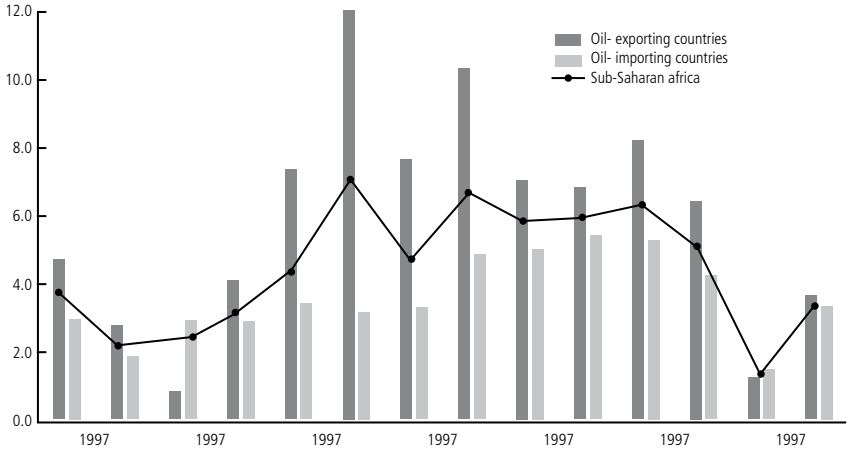
**Middle income country*
Source: World Bank (2010).

6.2 POVERTY IN AFRICA

Economic growth is a key driver in reducing poverty and achieving other desired development outcomes. Africa's recent economic growth has been accompanied by a reduction in the proportion of Africans living on less than USD 1.25 a day from 58 percent in 1995 to 51 percent in 2005 (Figure 17). Over the past decade, the region's poverty rate has been declining at about one percentage point a year. Nevertheless, the USD 1.25-a-day poverty rate is at about 50 percent, the same rate as in 1980. Moreover, although the population share in extreme poverty is falling, as a result of population growth, the actual number of poor people—nearly 380 million—has been increasing.

Despite the recent claim by some analysts, such as Sala-i-Martin and Pinkovskiy (2010), that African poverty is declining and rapidly, Sub-Saharan Africa is perhaps the only region, in the past 20 years, where the proportion of the poor has been rising and is relatively worse off than their counterparts in other parts of the world. Meanwhile, while some regions, notably Asia, have made significant progress in terms of poverty reduction over the last two decades, Africa has made less progress over this period. In some of the relatively few countries where evidence exists, poverty levels appear to have increased in the 1990s.

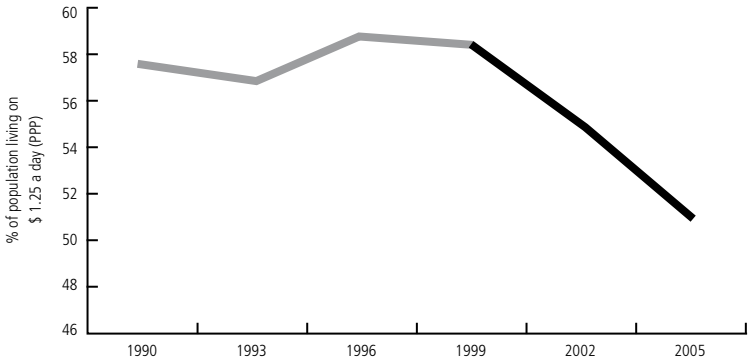
FIGURE 16: **Economic Growth in Africa (1997 to 2009)**



Note: *Oil exporting countries are Angola, Cameroon, Chad, Republic of Congo, Equatorial Guinea, Gabon, and Nigeria. All other African countries are net oil importers.*
Source: Arieff, Weiss and Jones (2010) using IMF Sub-Saharan Africa Regional Economic Outlook Database.

Five years from the deadline set by the international community for achieving the MDGs, none of the Sub-Saharan African countries is currently on track to attain all of the goals by 2015. In fact, several countries are "off-track" as a result of the global financial crisis which has prompted an economic slowdown in Africa, a continent where most countries are already hit by the rise in the prices of food and energy. The ever-present risk of conflict and long-term climate change are also undermining the conditions for growth and attaining the MDGs.

FIGURE 17: **Evolution of Poverty in Africa (1990 to 2005)**

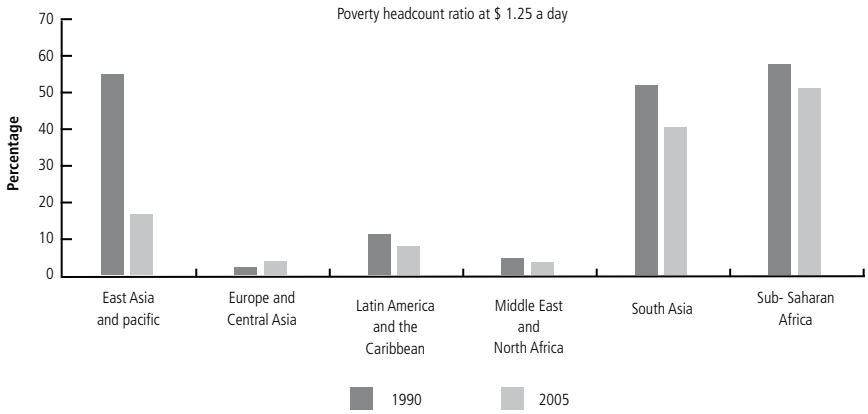


Source: World Bank (2010) The MDGs after the Crisis

Although some countries, such as Ghana, are close to halving absolute poverty by 2015, it is unlikely that Africa as a whole will achieve the first MDG – to reduce the 1990 poverty rate by half by 2015—whereas every other region will.

The poverty rate on current trends is now expected to fall to 38 percent by 2015, as opposed to the pre-crisis projected rate of 36 percent. This will leave an additional 20 million people in extreme poverty by 2015.

FIGURE 18: **Poverty Headcount by Region**



Source: World Bank (2010) The MDGs after the Crisis

6.3 INFRASTRUCTURE AND GROWTH IN AFRICA

Infrastructure in Africa is very central to the various efforts to support growth, reduce poverty and improve the overall quality of life of Africans. A common argument for the push for a large increase in public spending on infrastructure in Africa is that infrastructure services may have a strong growth-promoting effect, through their impact on the productivity of private inputs and the rate of return on capital – particularly when, to begin with, stocks of infrastructure assets are relatively low.

The role of infrastructure development in economic growth in Africa has been well documented in the literature. The unequivocal finding from this research is that there will be no growth and no significant poverty alleviation in Africa without a major improvement in the level and state of its infrastructure supporting the widely held consensus that the MDGs will not be achieved without at least a seven percent annual growth rate for the region, and that this target will not be achieved without a significant increase in infrastructure investment.

Estache et al (2005) demonstrate that over the last 30 years, infrastructure investments accelerated the annual growth convergence rate by over 13 percent in Africa. The strongest impact comes from telecommunications, followed by roads and electricity. However, the evidence on the link of access to water or sanitation is more tenuous. This is probably because this sector has the highest correlation with health or education as well as with the other subsectors.

The importance of the water and sanitation sector is particularly strong in Africa when it is considered in isolation from the effects of other sectors (Estache, 2010).

Calderon (2008) recently estimated that across Africa, infrastructure contributed 99 basis points to per capita economic growth over the period 1990 - 2005, compared with only 68 basis points for other structural policies. That contribution is almost entirely attributable to advances in the penetration of telecommunication services. The deterioration in the quantity and quality of power infrastructure over the same period has had a significant retarding effect on economic growth. If these deficiencies could be eliminated, the effect would be remarkable. Calderon's simulations suggest that if all African countries were to catch up with Mauritius in infrastructure, per capita economic growth in the region could increase by 2.2 percentage points.

Relying on an analytical approach proposed by Calderon and Serven (2004), Estache and Woodon (2010) calculated the increase in the average growth of GDP per capita that 21 African countries would have had if they had been able to rely on the infrastructure stocks and quality of South Korea during the 1996-2000 period. Catching up with Korea's level would bring about economic growth per capita up to 1.1 percent per year as shown in Table 21. In a number of countries, including Ethiopia, Mali and Mauritania, the impact would be even larger. For instance, if Burkina Faso had enjoyed Korea's infrastructure quantity and quality, its per capita GDP growth rate would have been 2.18 percent (0.59 Actual+1.59 potential point increase) instead of 0.59 percent.

6.4 INFRASTRUCTURE AND POVERTY REDUCTION IN AFRICA

There is very little strong cross-country analytical evidence for Africa on the impact of infrastructure on poverty. Anecdotal evidence on the importance of the sector for the poor is large and so is the evidence generated by donor agencies based on their project work. In a recent overview of the drivers of rural development in Africa, Mwabu and Thorbeke (2004) cover a wide range of country specific studies which add up to very convincing evidence on the relevance of access to infrastructure for the African rural poor. In the range of impacts covered, they include linkages through gender or human development concern, e.g. the significant positive impact of rural transport and water access on women's life and the evidence on the improved access to improved education or health. They also point to the impact of infrastructure on the poor through its increased access on self and wage-based employment opportunities.

The microeconomic evidence is much more robust. Wooden (2006) and Estache and Wooden (2010) employ household survey data to assess the impact of policies promoting access to basic infrastructure services for the poor on poverty in some African countries. The poverty reduction impact of basic services is measured by estimating the gain in the implicit rental value of owner-occupied houses when access to a basic infrastructure service is provided. This gain is then added to the consumption of the household in order to have a rough measure of the impact on poverty of access. The gain in rental value due to access to basic services is then estimated from a model in which the rent paid is explained by the characteristics of the house and its location using hedonic semi-log rental regression.

TABLE 21: **How much faster Africa would have grown if it had enjoyed South Korea's infrastructure stock and quality?**

Country	Actual growth per capita (1996 – 2000)	% point increase in potential growth rate per capita assuming country enjoys South Korea's infrastructure quantity and quality	Potential growth rate per capita assuming country enjoys South Korea's infrastructure quantity and quality (1996 – 2000)
Botswana	5.32%	0.6	5.92%
Burkina Faso	0.59%	1.59	2.18%
Cote d'Ivoire	0.35%	0.64	0.99%
Ethiopia	0.47%	1.47	1.94%
Ghana	1.11%	0.65	1.76%
Guinea	0.07%	1.03	1.10%
Guinea-Bissau	1.19%	0.98	2.17%
Kenya	1.12%	0.91	2.03%
Madagascar	-0.99%	1.21	0.22%
Mali	-0.03%	1.79	1.76%
Mauritania	0.60%	1.57	2.17%
Mauritius	3.71%	0.34	4.05%
Niger	-1.55%	1.87	0.32%
Nigeria	-0.95%	1.01	0.06%
Rwanda	-0.12%	1.23	1.11%
Senegal	-0.28%	0.9	0.62%
Sierra Leone	0.08%	0.92	1.00%
Tanzania	0.58%	1.31	1.89%
Uganda	1.29%	1.16	2.45%
Zambia	-0.76	0.51	-0.25%
Zimbabwe	1.76%	0.18	1.94%
Sample average	0.07%	1.04	1.11%

Source: Estache and Woodon (2010).

Table 22 presents the coefficient estimates in the rental regressions for the access to electricity and water for a sample of African countries. The percentage increase in rent obtained with access to basic services varies between 20 and 70 percent of the rent paid by the tenant. If we consider those households in the bottom three quintiles, the value of access to electricity and water varies typically from 1 to 6 percent of per capita consumption, which is not negligible.

The poverty reduction brought about through the provision of these services ranges from one to two percentage points. While such estimates are limited in magnitude in comparison to the high levels of poverty in African countries, they, nonetheless, do not take into account the dynamic effects for growth of infrastructure provision.

TABLE 22: **Impact of Access to Water and Electricity on Poverty, Selected African Countries**

	Electricity			Water		
	Mauritania	**Rwanda**	**Sao Tome**	**Mauritania**	**Rwanda**	**Sao Tome**
Percentage increase in rent	39.8%	56.26%	21.36%	31.1%	67.96%	21.40%
Percentage increase in consumption per capita						
Quintile 1	3.8%	5.16%	1.61%	2.3%	6.09%	1.17%
Quintile 2	2.2%	3.37%	0.70%	1.4%	3.97%	0.72%
Quintile 3	1.8%	2.80%	0.52%	1.3%	3.40%	0.74%
Quintile 4	1.5%	2.51%	0.30%	1.3%	3.09%	0.72%
Quintile 5	1.2%	1.83%	0.19%	1.4%	2.99%	0.52%
Change in extreme poverty (percentage points)						
All sample	NA	-1.56	-0.29	NA	-2.01	-0.11
Household without access	-1.2	-1.65	-0.62	-0.5	-0.27	-0.16
Change in poverty (percentage points)						
All sample	NA	-1.40	-0.49	NA	-1.63	-0.56
Household without access	-1.3	-1.48	-1.05	-0.7	-1.68	-0.78

Source: Wodon (2006) and Estache and Wodon (2010)

Analyses of the interface between poverty and infrastructure services in African countries indicate that the poor's access to basic infrastructure is extremely limited. Country level estimates provided in Table 23 are given by quintile of wealth of the household. Clearly, and as was to be expected, coverage is virtually nonexistent among the very poor in most countries, and in quite a few countries, coverage is also low even in the top quintile.

Table 24 presents the evolution to access to water and electricity by income groups. The data imply that the main beneficiaries of efforts to increase access tend to remain in the richest and second richest quintiles. The reforms implemented so far, especially in the 1990s, have failed to address the needs of the poor and in some cases even the middle class.

Experience to date has demonstrated that private service companies have not shown eagerness to extend infrastructure to poor informal neighborhoods. While there may be successful examples, the majority of privatized water and sanitation companies tend to avoid the poor neighborhoods.

There are a host of factors explaining why existing infrastructure interventions fail to serve the poor. Box 4 presents an appraisal of the case of the urban poor. The two most obvious are: non availability of service and affordability problems. Perhaps the one that gets the most attention is the non availability of infrastructure. Poor households may not have access to the infrastructure services simply because they are too far from the services. This is especially the case for network utility services such as water and electricity. For many among the poor, even if the services were affordable, they would not be able to benefit because the services are not provided in the areas where the households are located. But there are also problems on the demand side, as the cost of being connected to the network, when the network is available, is often too high for the poor. The affordability problem is particularly acute for the poorest.

TABLE 23: **Access to infrastructure services by quintile of wealth, National level (%)**

	Year	Quintile 1	Quintile 5	Quintile 1	Quintile 5	Quintile 1	Quintile 5	Quintile 1	Quintile 5
Benin	2001	0	89	0	11	0	82	0	18
Burkina Faso	2003	0	34	0	9	0	57	0	21
CAR	1995	0	13	0	5	0	25	0	7
Cameroon	2004	0	49	0	38	1	98	0	10
Chad	2004	0	22	0	8	0	21	0	4
Comoros	1996	0	46	0	14	4	84	0	15
DRC	2005	0	90	0	24	5	88	0	4
Cote d'Ivoire	1999	0	98	0	60	4	100	0	32
Ethiopia	2005	0	30	0	6	0	56	0	22
Gabon	2000	0	100	0	95	17	99	0	48
Ghana	2003	1	60	0	43	8	90	0	31
Guinea	2005	0	44	0	12	0	83	0	32
Kenya	2003	0	62	0	43	0	57	0	49
Lesotho	2005	0	50	0	8	0	27	0	57
Madagascar	2004	0	24	0	8	0	82	0	23
Malawi	2004	0	30	0	16	0	34	0	27
Mauritania	2001	0	57	0	8	0	81	0	16
Mozambique	2003	0	34	0	14	0	51	0	11
Namibia	2000	0	100	0	99	1	100	0	70
Niger	1998	0	26	0	3	0	36	0	4
Nigeria	2003	0	18	0	54	10	91	0	21
Rwanda	2005	0	13	0	5	0	25	0	5
Senegal	2005	1	96	1	78	4	94	0	51
Tanzania	2004	0	30	0	13	0	50	0	42
Togo	1998	1	100	0	0	0	62		
Uganda	2001	0	10	0	7	0	38	0	15
Zambia	2002	0	77	0	76	0	84	0	17
Zimbabwe	1999	0	100	0	99	0	97	0	23
DRC	2001	0	59	0	6				
Sudan	2000	0	77	0	31				

Source: Banerjee et al (2009).

TABLE 24:**Evolution of Access Rates to Networked Water and Electricity across Income Classes**

		Average access rates per Quintiles				
		First	**Second**	**Third**	**Fourth**	**Fifth**
Piped water	Early 1990s	0%	0%	0%	13%	53%
	Late 90s – early 00's	0%	0%	3%	10%	43%
Improved water	Early 1990s	35%	41%	51%	70%	88%
	Late 90s – early 00's	39%	53%	57%	70%	85%
Electricity	Early 1990s	0%	1%	4%	22%	68%
	Late 90s – early 00's	0%	4%	12%	32%	75%

Source: Echaste and Wodon (2010)

Subsidized provision of infrastructure is often proposed as a means of redistributing resources from higher income households to the poor. Yet its effectiveness depends on whether subsidies actually reach the poor. Arguments for the removal of subsidies typically draw on surveys illustrating the ways in which the poor are currently paying several times more for services than those connected to the formal system.

Despite their unpopularity especially among Economists, the anecdotal and econometric evidence confirms that subsidies are hard to avoid. Estache and Wooden (2010) presents a feasible menu of action that can mitigate both the accessibility and affordability problems of the poor. For access, there are three basic types of instruments: (a) instruments requiring operators to provide access (a service obligation to avoid unilateral exclusion by the provider); (b) instruments reducing connection costs (through cross-subsidies or direct subsidies built into the tariff design or through credit or discriminatory payment plans in favour of the poor); and (c) instruments increasing the range of suppliers (to give users choice, including the option of reducing costs by choosing lower-quality service providers).

BOX 4: **THE INFRASTRUCTURE CHALLENGE OF THE URBAN POOR**

For the scale and speed of urbanization that has been taking place in Africa, most municipal governments are ill-equipped both financially and administratively to tackle the problems of providing the basic infrastructure services for the urban poor. Biases in investment standards, pricing policy, and administrative procedures, more often than not, skew services in favour of the rich, denying the poor good shelter, safe water, acceptable sanitation, good roads and electricity. They thus resort to unorthodox means of meeting their infrastructure needs such as pirating electricity from the nearest cables, buying unsafe water from unregulated vendors, walking long distances and outright open defecation.

For affordability, broadly speaking, all instruments work in at least one of three ways (Estache, Foster, and Wodon 2002): (a) by reducing bills for poor households (through lifelines or means-tested subsidies based on socioeconomic characteristics or the characteristics of the connection, financed through cross-subsidies or direct subsidies built into the tariff design); (b) by reducing the cost of services (by avoiding granting a monopoly when it is not necessary or by providing an incentive for operators to reduce costs and pass on the cost reductions to users); and (c) by facilitating the payment of bills (by allowing discriminatory administrative arrangements in favor of the permanently or temporarily poor).

While these recipes may seem obvious, they are not without controversy. Subsidies, particularly cross-subsidies, continue to be seen as undesirable policy instruments in many circles, and that bad reputation has tended to spill over in infrastructure for the last 20 years or so. Yet, in spite of their bad reputation, most practitioners will argue that subsidies (direct or not) are needed in most countries, and they are not always as ineffective or distortionary as has been argued (Foster and Yepes, 2006; Estache and Wooden, 2010).

It does appear that majority of the poor in Africa would not be able to afford services if infrastructure costs are set at cost recovery. Banerjee et al. (2009) present empirical evidence that shows that most African households live on tight budgets, with more than half of total expenditures allocated to food. An average African household lives on USD 180 per month or less, with spending ranging from around USD 50 per month in the lowest consumption quintile to USD 400 per month in the top quintile. The average household monthly budget ranges from USD 57 in Ethiopia to USD 539 in South Africa (in 2002 USD). Given that on average, more than half of a household's budget is allocated to food, what is left for other goods, including basic infrastructure services, is limited. It also turns out that infrastructure spending absorbs, on average, 7.0 percent of the household budget, and it falls within the 5-15 percent range for most countries, although in rare cases spending on infrastructure exceeds 25 percent of the total budget.

CHAPTER 7 LESSONS, CONCLUSIONS AND RECOMMENDATIONS

7.1 KEY LESSONS

The heterogeneity of the infrastructure sectors makes it difficult to draw specific conclusions for any given subsector or country from an overview such as this one. However, some general conclusions can be drawn. In what follows, we chart the road for the major actors if Africa's huge infrastructure needs are to be met.

Over the last few years, Africa has witnessed some modest improvements in infrastructure development, especially in telecommunications. But, as indicated in several parts of the preceding chapters, Africa ranks at the bottom of all developing regions in most dimensions of infrastructure performance indicators. Not only does sub-Saharan Africa's existing infrastructure fall short of its needs, it lags well behind infrastructure development in other poor regions. Poor maintenance has left much of the existing infrastructure in a decrepit state, further hindering economic growth and discouraging new investment.

Poor infrastructure is stunting economic growth and efforts to reduce poverty. In addition to overt neglect by African governments, there has been a "policy mistake" founded on the dogma of the 1980s/90s that infrastructure would be financed by the private sector. For various reasons, mainly involving investment climates and rates of return, private investment has been limited in terms of volume, sectors and countries. The result has been dashed hopes, insufficient improvement in public services, and a widespread backlash against privatization. Limited improvements on infrastructure have also meant less progress on reducing poverty and improving the living standards and economic opportunities of the poorest.

Clearly, the optimism of the early 1990s, which saw private finance entirely replacing public finance, was unfounded. Roughly only one third of the developing countries can count on private sector operators for the delivery of electricity, water, or railways services. The largest presence is in the fixed line telecoms business where about 60 percent of the countries rely on private operators. Overall, the private sector has roughly contributed to 20-25 percent of the investment realized in developing countries on average over the last 15 years or so. In Africa, it has probably contributed less than 10 percent of the needs. This is not to deny the presence of the private sector. In fact, where the state and the large private sector have failed to deliver the services, the small scale, generally local, private sector has filled the gap.

Regulatory weaknesses underscore most failed attempts at infrastructure reform and privatization. It has often been neglected outright or treated as an add-on after the reform process has been initiated. Even where regulation exists, it is fraught with weaknesses and uncertainties that hamper investor decision making. Governments across Africa, often at the prodding of investment bankers and financial advisers and multilateral institutions, have established or are establishing regulatory agencies for utilities. Under pressure from multilateral institutions, many of these countries hastily adopted regulatory templates from developed countries.

Many of them have had little or no precedence to guide the design of regulatory mechanisms. The models are rarely adapted to the political and institutional features prevalent in these economies, including lack of checks and balances, limited technical expertise, weak auditing, accounting and tax systems, and widespread corruption and regulatory capture. As a result, such efforts have had limited successes or failed woefully.

7.2 RECOMMENDATIONS

As identified in Chapter 4 of this report, the funding requirements of USD 93 billion a year, translating into about 15 percent of Africa's GDP is quite substantial. This will require reforming the way in which business is conducted in Africa's infrastructure. In forging ahead, there is a need for significant improvements in the management and operation of Africa's infrastructure, but the choice is no longer simply a dichotomous relationship between the public and private sectors but mutual collaboration. The public sector is expected to retain a much more important role in financing than admitted during much of the last two and a half decades, while the private sector will help in meeting the significant needs associated with infrastructure construction, operation, and to some extent financing. The role of the private sector in financing will most likely be limited to sectors such as telecommunications, energy generation, and transport services in which commercial and political risks are lower. In what follows, we chart the road for the major actors.

7.2.1 Governments

Governments remain at the heart of infrastructure service delivery. With or without private participation, governments remain responsible for infrastructure reform, for setting and enforcing the basic rules of the game, and for regulation. This includes managing the political economy of reform as infrastructure reforms are political processes, prone to backlash. Governments also remain responsible for much of infrastructure finance as well as social goals.

Better expenditure allocation is also needed. In particular, not enough is being spent on maintenance. Many countries lack a reliable source of funding to ensure the regular maintenance needed, notably in roads which are mostly publicly funded and hence subject to the vagaries of the fiscal situation. New investments should aim to focus on strategic goals, such as completing networks. But tackling bottlenecks should not come at the expense of providing service to the poor, can be done at a relatively low cost.

7.2.2 Role of the Private Sector

Nevertheless, private investment is likely to remain an important component of infrastructure development in the years ahead, particularly as the available fiscal space in many countries remains limited. The important thing will be to channel private initiative where it has the greatest likelihood of being successful and to have realistic expectations as to what it can achieve.

Some of the problems experienced with private participation reflect basic errors in the design and implementation of such contracts. Private participation should be focused on those aspects of infrastructure that present the most appropriate risk-reward characteristics, accepting that public finance will remain necessary in other areas. Guarantees for infrastructure projects can be more carefully designed to avoid some of the large payouts experienced in the past.

Private participation in infrastructure is not only about financing, it is also more importantly about capacity building, transferring better technologies, innovations and removing capacity constraints to implementation.

It requires fiscal reform and improvements in public sector management. It also requires careful attention to the basics of project design, including identifying and allocating risk and ensuring sound procurement practices. Developing successful projects requires some things in short supply in the developing world—time, money, and sophisticated skills. Moreover, private participation does not always work well in every infrastructure sector or every developing country. Concretely, a better PPI framework entails improving award processes to ensure transparency and competitiveness. It also requires better concession design to clearly state events that would trigger renegotiations, as well as guidelines for the process. Contracts also need to specify information to be disclosed. This, combined with an adequate regulatory accounting framework, is critical for regulators to cope with the asymmetry of information inherent in any concession.

Some of the problems experienced in the last decade could be avoided through greater reliance on the local private sector. In the early days, PPI was synonymous with large multinational corporations. In many countries, however, the local private sector may have significant resources to invest and may be better equipped to deal with currency devaluation and political interference.

7.2.3 Alternative Sources of Finance

Improving the capacity of the local financial markets to mobilise resources would be an important part of a sustainable financing strategy. As in other regions, project sponsors in Africa have in recent years sought to increase local financial markets' contributions to the debt funding of infrastructure projects that generate mostly local currency revenues. These efforts have led to some local currency loans and bonds, mainly for tele¬communications projects. But a larger share of local currency financing would be desirable. Progress in financial sector reform could make this feasible, as local banks build capacity for project finance and capital markets become more liquid.

7.3.4 Appropriate Regulation

Lessons from the past decade indicate the importance of planning for credible and efficient regulation, including its economic content and institutional architecture prior to reform. There is growing consensus around the key design features for a modern regulatory agency. The main features of effective regulation of privatized utilities are coherence, independence, accountability, predictability, transparency and capacity (Noll, 2000 and Stern and Holder, 1999). Regulatory agencies should be strengthened and allowed to operate independently. Moreover, they need to be adapted to fit the country peculiarities.

7.3.5 Meeting the Rural Challenge

As indicated in several parts of this Report, rural areas have persistent low access to electricity, water, telecoms or transport in SSA countries, and corresponding low consumption levels. In several cases, access rates to networks are still in single-digit figures. Clearly, their exclusion from the service obligations imposed on utilities have stimulated the creativity of suppliers and governments alike in Africa. The solutions adopted across the continent have varied. These include a significant effort to promote the role of alternative small-scale producers, particularly in East Africa, and the establishment of a regulatory framework encouraging private entry into the sectors and based on competitive tendering for rural licenses by independent suppliers. In other cases, explicit supply (least cost) subsidies for non-profitable extensions have also sometimes been agreed on between operators and the government, when these governments were viewed as credible debtors in the sector.

All of these solutions have had minimal effect in increasing access rates and often the quality of service. However, they have led to several new issues. Indeed, the fiscal costs of these solutions are often substantial. Rural infrastructure development often requires expensive investment in network extension, especially when locations are scattered. Indeed, the financial viability of infrastructure supply in rural areas is hard to guarantee, at least in the short to medium term, and some way to subsidize the new customers, at least for the initial connection cost is necessary. These assessments are necessary if a major scaling up of efforts is to be realized.

7.3.6 Meeting the needs of the Urban Poor

In the face of the rapid urbanization in Africa, the issue of an exploding number of urban poor with no or very limited access to essential infrastructure services are some of the pressing challenges confronting policy makers. The problem of increased access rates for the urban poor appears smaller than the rural poverty issue, because possible solutions include the possibility of relying on the existing infrastructure and thus expanding at lower costs. In most cases, the main concern of the reforms is not the cost but how to generate the resources necessary to subsidize poor urban dwellers due to their inability to pay. The scale of the subsidy is, however, arguably less per new connection than in the rural case. A more serious problem to tackle may be the semi-legal or illegal condition of many dwellings in urban and peri-urban areas, which often precludes dwellers from getting connected to utility networks. Unfortunately, very few concrete assessments of current experiences in peri-urban interventions exist.

7.3.7 Regional Integration

Regional approaches to infrastructure development are probably more important than previously recognized. Regional integration holds the key to reducing infrastructure costs. Africa is highly fragmented with a large number of small economies, many of which are landlocked. Regional infrastructure offers the opportunity for cost reductions through economies of scale, making infrastructure more affordable. For example, about USD 2 billion could be saved each year by trading power across national borders. However, regional infrastructure projects are proving difficult to realize in part due to the size of financing requirements and the complexity of multi-country transactions. In many cases, an active catalyst will be required to move a regional project forward. Careful co-ordination with regional and continental authorities (such as the NEPAD) rationalises state action on cross border projects, while offering the country benefits from larger markets.

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DATA APENDICES

TABLE A1: **Africa's Electricity Installed Capacity by Type, January 1, 2006**

Country	Thermal	Hydroelectric	Nuclear	Solar, Wind Wood and Waste	Total
Algeria	6.190	0.280	0	0	6.470
Angola	0.333	0.498	0	0	0.830
Benin	0.058	0.001	0	0	0.059
Botswana	0.132	0	0	0	0.132
Burkina Faso	0.204	0.032	0	0	0.236
Burundi	0.001	0.032	0	0	0.033
Cameroon	0.070	0.805	0	0	0.875
Cape Verde	0.077	0	0	0	0.077
Central African Rep.	0.021	0.019	0	0	0.040
Chad	0.029	0	0	0	0.029
Comoros	0.004	0.001	0	0	0.005
Congo (Brazzaville)	0.029	0.092	0	0	0.121
Congo (Kinshasa)	0.033	2.410	0	0	2.443
Cote d'Ivoire (Ivory Coast)	0.480	0.606	0	0	1.086
Djibouti	0.118	0	0	0	0.118
Egypt	17.529	2.793	0	0.145	20.467
Equatorial Guinea	0.010	0.003	0	0	0.013
Eritrea	0.150	0	0	0	0.150
Ethiopia	0.138	0.669	0	0.007	0.814
Gabon	0.245	0.170	0	0	0.415
Gambia, The	0.030	0	0	0	0.030
Ghana	0.292	1.198	0	0	1.490
Guinea	0.145	0.129	0	0	0.274
Guinea-Bissau	0.021	0	0	0	0.021
Kenya	0.409	0.677	0	0.129	1.215
Lesotho	0.000	0.076	0	0	0.076
Liberia	0.188	0	0	0	0.188
Libya	5.438	0	0	0	5.438
Madagascar	0.122	0.105	0	0	0.227
Malawi	0.025	0.285	0	0	0.310
Mali	0.125	0.155	0	0	0.280
Mauritania	0.075	0.097	0	0	0.172
Mauritius	0.629	0.059	0	0	0.688

Morocco	3.469	1.500	0	0.064	5.033
Mozambique	0.204	2.179	0	0	2.383
Namibia	0.015	0.249	0	0	0.264
Niger	0.105	0	0	0	0.105
Nigeria	3.960	2.000	0	0	5.960
Reunion	0.315	0.125	0	0	0.440
Rwanda	0.004	0.035	0	0	0.039
Saint Helena	0.004	0	0	0	0.004
Sao Tome and Principe	0.003	0.006	0	0	0.009
Senegal	0.507	0	0	0	0.507
Seychelles	0.095	0	0	0	0.095
Sierra Leone	0.053	0.004	0	0	0.057
Somalia		0.060	0	0	0
South Africa	38.020	0.661	1.800	0.017	40.498
Sudan	0.777	0.337	0	0	1.114
Swaziland	0.087	0.041	0	0	0.128
Tanzania	0.340	0.579	0	0	0.919
Togo	0.018	0.067	0	0	0.085
Tunisia	3.235	0.066	0	0.019	3.320
Uganda	0.003	0.310	0	0	0.313
Western Sahara	0.058	0	0	0	0.058
Zambia	0.008	1.692	0	0	1.700
Zimbabwe	1.345	1.000	0	0	2.345
Africa	86.034	22.043	1.800	0.381	110.258

Source: Energy Information Administration

TABLE A2: **Africa's Total Net Electricity Generation 2003 to 2006 (Billion Kilowatt-hours)**

	2003	**2004**	**2005**	**2006**
Algeria	27.81	29.39	31.91	33.12
Angola	1.94	2.44	3.05	3.51
Benin	0.08	0.08	0.10	0.12
Botswana	1.05	0.93	0.91	0.98
Burkina Faso	0.44	0.47	0.52	0.55
Burundi	0.13	0.13	0.10	0.09
Cameroon	3.64	4.06	4.00	3.90
Cape Verde	0.04	0.04	0.05	0.05
Central African Republic	0.11	0.11	0.11	0.11

Chad	0.09	0.09	0.09	0.10
Comoros	0.02	0.02	0.02	0.02
Congo (Brazzaville)	0.40	0.46	0.43	0.44
Congo (Kinshasa)	6.38	6.78	7.34	7.24
Cote d'Ivoire (Ivory Coast)	4.87	5.17	5.31	5.27
Djibouti	0.19	0.20	0.24	0.25
Egypt	90.13	95.86	102.81	109.14
Equatorial Guinea	0.03	0.03	0.03	0.03
Eritrea	0.26	0.27	0.27	0.25
Ethiopia	2.30	2.53	2.85	3.27
Gabon	1.46	1.49	1.56	1.67
Gambia, The	0.14	0.14	0.15	0.15
Ghana	5.74	5.94	6.66	8.20
Guinea	0.78	0.78	0.78	0.80
Guinea-Bissau	0.06	0.06	0.06	0.06
Kenya	5.05	5.39	5.81	6.26
Lesotho	0.33	0.30	0.35	0.20
Liberia	0.30	0.31	0.32	0.32
Libya	17.81	18.99	21.10	22.55
Madagascar	0.88	0.96	1.01	0.98
Malawi	1.18	1.29	1.40	1.13
Mali	0.43	0.44	0.44	0.51
Mauritania	0.33	0.37	0.39	0.41
Mauritius	1.96	2.04	2.14	2.21
Morocco	17.10	18.24	21.17	21.88
Mozambique	10.79	11.58	13.17	14.62
Namibia	1.54	1.63	1.69	1.64
Niger	0.23	0.23	0.24	0.24
Nigeria	19.35	23.17	22.52	22.11
Reunion	1.55	1.55	1.56	1.48
Rwanda	0.12	0.13	0.13	0.13
Saint Helena	0.01	0.01	0.01	0.01
Sao Tome and Principe	0.02	0.02	0.02	0.02
Senegal	1.90	1.99	2.27	2.28
Seychelles	0.21	0.21	0.21	0.21
Sierra Leone	0.24	0.24	0.25	0.25
Somalia	0.26	0.26	0.27	0.28
South Africa	215.98	227.29	228.33	227.74
Sudan	3.21	3.70	3.94	4.04
Swaziland	0.38	0.40	0.42	0.42
Tanzania	2.63	2.45	2.94	2.68
Togo	0.20	0.18	0.18	0.20

Tunisia	11.67	12.29	12.65	12.65
Uganda	1.76	1.89	1.84	1.16
Western Sahara	0.09	0.09	0.09	0.09
Zambia	8.22	8.42	8.85	9.29
Zimbabwe	8.54	9.41	9.95	9.47
Africa	**482.33**	**512.94**	**534.96**	**546.79**

Source: Energy Information Administration, International Energy Annual 2006, Updated 2009

TABLE A3: **Progress on Sanitation in Africa (Percentage of Population)**

Year	**1990**	**2000**	**2008**	**2008**
Algeria	88	92	95	4
Angola	25	40	57	23
Benin	5	9	12	60
Botswana	36	50	60	16
Burkina Faso	6	8	11	64
Burundi	44	45	46	1
Cameroon	47	47	47	5
Cape Verde	-	45	54	42
Central Africa Republic	11	22	34	20
Chad	6	7	9	65
Congo	-	30	30	-
Cote d'Ivoire	20	22	23	27
Djibouti	66	63	56	8
Egypt	72	86	94	0
Equatorial Guinea	-	51	-	-
Eritrea	9	11	14	85
Ethiopia	4	8	12	60
Gabon	-	36	33	1
Gambia	-	63	67	4
Ghana	7	9	13	20
Guinea	6	9	11	22
Guinea-Bissau	-	7	9	31
Kenya	26	29	31	15
Lesotho	32	29	29	40
Liberia	11	14	17	49
Libyan Arab Jamahiriya	97	97	97	-
Malawi	42	50	56	9
Mali	26	32	36	16
Mauritania	16	21	26	53
Mauritius	91	91	91	0

Morocco	53	64	69	17
Mozambique	11	14	17	42
Namibia	25	29	33	53
Niger	5	7	9	79
Nigeria	37	34	32	22
Rwanda	23	40	54	3
Sao Tome And Principe	-	21	26	55
Senegal	38	45	51	19
Sierra Leone	-	11	13	24
Somalia	-	22	23	54
South Africa	69	73	77	8
Sudan	34	34	34	41
Swaziland	-	49	55	16
Togo	13	12	12	55
Uganda	39	44	48	10
Tanzania	24	24	24	13
Zambia	46	47	49	18
Zimbabwe	43	44	44	25

Source: Author's Compilation from WHO/UNICEF (2010) Progress on Water and Sanitation: 2010 Update database.

TABLE A4: **Improved Water Source in Africa (Percentage of Population)**

Year	1990	2000	2008
Algeria	94	89	83
Angola	36	41	50
Benin	56	66	75
Botswana	93	94	95
Burkina Faso	41	60	76
Burundi	70	72	72
Cameroon	50	64	74
Cape Verde	-	83	84
Central Africa Republic	58	63	67
Chad	38	45	50
Congo	-	70	71
Cote D'Ivoire	76	78	80
Djibouti	77	84	92
Egypt	90	96	99
Equatorial Guinea	-	43	-
Eritrea	43	54	61
Ethiopia	17	28	38
Gabon	-	85	87

Gambia	74	84	92
Ghana	54	71	82
Guinea	52	62	71
Guinea-Bissau	-	55	61
Kenya	43	52	59
Lesotho	61	74	85
Liberia	58	65	68
Libyan Arab Jamahiriya	54	54	-
Malawi	40	63	80
Mali	29	44	56
Mauritania	30	40	49
Mauritius	99	99	99
Morocco	74	78	81
Mozambique	36	42	47
Namibia	64	81	92
Niger	35	42	48
Nigeria	47	53	58
Rwanda	68	67	65
Sao Tome and Principe	-	79	89
Senegal	61	65	69
Sierra Leone	-	55	49
Somalia	-	23	30
South Africa	83	86	91
Sudan	65	61	57
Swaziland	-	55	69
Togo	49	55	60
Uganda	43	57	67
Tanzania	55	54	54
Zambia	49	54	60
Zimbabwe	78	80	82

Source: Author's Compilation from WHO/UNICEF (2010) Progress on Water and Sanitation: 2010 Update database.

TABLE A5 : **ICT Development Index (IDI), 2002 and 2007, Africa**

Country	Rank 2007	IDI 2007	Rank 2002	IDI 2002	Rank change 2002 – 2007	IDI change 2002 – 2007
Seychelles	1	3.60	1	2.59	0	1.01
Mauritius	2	3.45	2	2.45	0	1.00
South Africa	3	2.70	3	2.11	0	0.60
Cape Verde	4	2.18	5	1.67	1	0.51
Gabon	5	2.14	7	1.48	2	0.66
Botswana	6	2.10	4	1.70	-2	0.40
Namibia	7	1.92	6	1.58	-1	0.34
Swaziland	8	1.73	8	1.32	0	0.41
Ghana	9	1.63	14	1.10	5	0.53
Kenya	10	1.62	10	1.21	0	0.41
Gambia	11	1.49	22	0.96	11	0.53
Lesotho	12	1.48	11	1.15	-1	0.32
Cameroon	13	1.46	12	1.12	-1	0.34
Zimbabwe	14	1.46	9	1.29	-5	0.16
Cote d'Ivoire	15	1.41	18	1.01	3	0.40
Zambia	16	1.39	16	1.08	0	0.31
Nigeria	17	1.39	15	1.09	-2	0.30
Senegal	18	1.38	25	0.95	7	0.42
Congo	19	1.37	13	1.10	-6	0.26
Madagascar	20	1.36	23	0.96	3	0.40
Benin	21	1.28	30	0.76	9	0.52
Togo	22	1.26	17	1.03	-5	0.23
Uganda	23	1.21	26	0.92	3	0.29
Malawi	24	1.17	24	0.95	0	0.22
Rwanda	25	1.17	19	0.99	-6	0.18
Tanzania	26	1.13	21	0.96	-5	0.17
Mali	27	1.12	31	0.75	4	0.37
Ethiopia	28	1.03	28	0.78	0	0.25
Mozambique	29	1.02	29	0.77	0	0.26
Eritrea	30	1.00	20	0.96	-10	0.04
Burkina Faso	31	0.97	32	0.68	1	0.29
D.R. Congo	32	0.95	27	0.92	-5	0.04
Guinea-Bissau	33	0.90	34	0.56	1	0.35
Chad	34	0.83	33	0.65	-1	0.17
Niger	35	0.82	35	0.51	0	0.31

Source: ITU (2010)

TABLE A6: **Main (fixed) telephone lines**

		Main (fixed) telephone lines (000s)		Main (fixed) telephone lines CAGR (%)	Main (fixed) telephone lines per 100 inhabitants	
		2003	2008	2003 – 2008	2003	2008
1	Angola	85	114.3	6.1	0.6	0.7
2	Benin	66.5	110.8↓	13.6↓	0.8	1.2↓
3	Botswana	131.4	142.3	1	7.4	7.5
4	Burkina Faso	66.6	121.8↓	16.3↓	0.5	0.8↓
5	Burundi	23.9	30.4	4.9	0.3	0.3
6	Cameroon	97.4	198.3	15.3	0.6	1
7	Cape Verde	71.7	72	0.1	14.8	13.3
8	Central African Republic	9.5	-	-	0.2	-
9	Chad	12.5	-	-	0.1	-
10	Congo	7	-	-	0.2	-
11	Congo (Democratic Republic)	9.7	37.3	30.8	0	0.1
12	Cote d'Ivoire	238	356.5	8.4	1.4	1.8
13	Equatorial Guinea	9.6	-	-	2	-
14	Eritrea	38.1	40.4	1.2	0.9	0.8
15	Ethiopia	404.8	908.9	17.6	0.5	1.1
16	Gabon	38.4	26.5↓	-8.9↓	2.9	2.0↓
17	Gambia	42	48.9	3.1	2.9	2.8
18	Ghana	291	143.9	-13.1	1.4	0.6
19	Guinea	26.2	50.0↓	17.6↓	0.3	0.5↓
20	Guinea-Bissau	10.6	4.6	-15.1	0.7	0.3
21	Kenya	328.4	252.3	-5.1	1	0.7
22	Lesotho	35.1	-	-	2	-
23	Liberia	6.9	2.0↓	-21.6	0.2	0.1↓
24	Madagascar	59.6	164.9	22.6	0.3	0.8
25	Malawi	85	175.2↓	19.8↓	0.7	1.3↓
26	Mali	60.9	82.8	6.3	0.5	0.7
27	Mauritius	348.2	364.5	0.9	28.5	28.7
28	Mozambique	77.6	78.3	0.2	0.4	0.4
29	Namibia	127.4	138.1↓	2.0↓	6.4	6.7↓
30	Niger	23	-	-	0.2	-
31	Nigeria	888.5	1307.6	8	0.7	0.9
32	Rwanda	25.6	16.8	-8.1	0.3	0.2
33	Sao Tomé & Principe	7	7.7↓	2.4↓	4.7	4.9↓
34	Senegal	228.8	237.8	0.8	2.1	1.9
35	Seychelles	21.2	23.2	1.8	26.8	27.4
36	Sierra Leone	24	-	-	0.5↓	-

37	South Africa	4821	4532.0↓	-1.5↓	10.3	9.3↓
38	Swaziland	46.2	-	-	4.5	-
39	Tanzania	147	123.8	-3.4	0.4	0.3
40	Togo	61.1	99.5↓	13.0↓	1	1.5↓
41	Uganda	61	168.5	22.5	0.2	0.5
42	Zambia	88.4	90.6	0.5	0.8	0.7
43	Zimbabwe	300.9	344.5↓	3.4↓	2.3	2.6↓
Africa		**9552.7**	**10617**	**2.5**	**1.4**	**1.5**

↓ Figures are estimates or refer to years other than those specified
Source: ITU World Telecommunication/ICT indicators database

TABLE A7: **Mobile Cellular Subscriptions in Africa**

		Mobile cellular subscriptions			**Mobile cellular subscriptions per 100 inhabitants**		
		(000s)		**CAGR (%)**			**CAGR (%)**
		2003	**2008**	**2003 – 2008**	**2003**	**2008**	**2003 - 2008**
1	Angola	350	6773.4	80.9	2.3	38.7	75.5
2	Benin	236.2	3435.0↓	70.8↓	3	36.9↓	65.4↓
3	Botswana	445	1485.8	27.3	25.1	78	25.4
4	Burkina Faso	238.1	2553.0↓	60.7↓	1.9	16.8↓	54.3↓
5	Burundi	64	480.6	49.7	0.9	5.4	42.9
6	Cameroon	1077	6160.9	41.7	6.8	32.6	36.6
7	Cape Verde	53.3	277.7	39.1	11	51.2	35.9
8	Central African Republic	40	154.0↓	30.9↓	1	3.5↓	27.9↓
9	Chad	65	1809.0↓	94.5	0.7	16.3↓	87.1↓
10	Congo	330	1807.0↓	40.5↓	8.8	47.0↓	39.9↓
11	Congo (Democratic Republic)	1246.2	9262.9	49.9	2.3	14.3	44.2
12	Cote d'Ivoire	1280.7	10449	52.2	7.3	53.2	48.9
13	Equatorial Guinea	41.5	346.0↓	52.8↓	8.6	66.6↓	50.5↓
14	Eritrea	-	108.6	-	-	2.2	-
15	Ethiopia	51.3	3168.3	128.1	0.1	3.7	121.6
16	Gabon	300	1300.0↓	34.1↓	22.4	96.3↓	33.9↓
17	Gambia	149.3	1166.1	50.8	10.4	66.5	45
18	Ghana	795.5	11570.4	70.8	3.8	48.3	66.7
19	Guinea	111.5	2600.0↓	87.7↓	1.2	27.2↓	85.4↓
20	Guinea-Bissau	1.3	500.2	230.2	0.1	28.6	220
21	Kenya	1590.8	16233.8	59.1	4.9	42.1	54
22	Lesotho	126	581.0↓	35.8↓	7	28.8↓	32.7↓
23	Liberia	47.3	732.0↓	73.0↓	1.5	18.6↓	66.2↓
24	Madagascar	283.7	4835.2	76.3	1.6	23.9	71.6
25	Malawi	135.1	1781.0↓	67.5↓	1.1	12.5↓	62.6↓

26	Mali	247.2	3267.2	67.6	1.9	25.7	67.6
27	Mauritius	462.4	1033.3	17.4	37.9	81.3	16.5
28	Mozambique	435.8	4405	58.8	2.3	20.2	54.6
29	Namibia	223.7	1052.0↓	36.3↓	11.3	50.0↓	34.8↓
30	Niger	82.4	1677.0↓	82.7↓	0.6	11.4↓	78.3↓
31	Nigeria	3149.5	62988.5	82.1	2.5	41.6	75.4
32	Rwanda	130.7	1322.6	58.9	1.5	13.2	54.7
33	Sao Tomé & Principe	4.8	49.0↓	59.0↓	3.2	30.6↓	56.8
34	Senegal	782.4	5389.1	47.1	7	42.5	43.3
35	Seychelles	49.2	85.3	11.6	62.2	100.9	10.2
36	Sierra Leone	113.2	1008.8↓	54.9↓	2.2	16.9↓	50.2↓
37	South Africa	16860	45000	21.7	35.9	92.2	20.7
38	Swaziland	85	457.0↓	40.0↓	8.2	39.8↓	37.1↓
39	Tanzania	1942	13006.8	46.3	2.4	31.4	67.9
40	Togo	243.6	1547.0↓	44.7↓	4.2	22.9↓	40.5↓
41	Uganda	776.2	8554.9	61.6	2.9	26.8	56.1
42	Zambia	241	3539	71.1	2.1	29.1	68.6
43	Zimbabwe	363.7	1654.7	35.4	2.8	13.1	35.9
Africa		**35251.4**	**245608.1**	**47.4**	**5.3**	**32.5**	**44**

↓ Figures are estimates or refer to years other than those specified
Source: ITU World Telecommunication/ICT indicators database

TABLE A8: **Mobile cellular subscriptions (continuation)**

		Mobile cellular subscriptions			Mobile cellular subscriptions per 100 inhabitants		
		Prepaid subscription (%)	Population coverage (%)	As % of total telephone subscribers	(000s)		Per 100 inhabitants
		2008	2007	2008	2003	2008	2008
1	Angola	70.4↓	40	98.3	-	139.3	0.8
2	Benin	99.5↓	80	96.9↓	-	-	-
3	Botswana	97.9	99	91.3	-	-	-
4	Burkina Faso	99.2↓	61.1	95.4	-	-	-
5	Burundi	99.6	82	94	-	-	-
6	Cameroon	99	58	96.9	-	34.4	0.2
7	Cape Verde	99.5	87	79.4	-	4.9	0.9
8	Central African Republic	-	19.3	90.2↓	-	-	-
9	Chad	100.0↓	24	97.3↓	-	-	-
10	Congo	99	53	97.2↓	-	-	-
11	Congo (Democratic Republic)	99.6	50	99.6↓	-	-	-
12	Cote d'Ivoire	98.9	59	96.7	-	-	-
13	Equatorial Guinea	97.5↓	-	90.6↓	-	-	-

14	Eritrea	100	1.7	72.9	-	-	-
15	Ethiopia	87.2↓	10	77.7	-	-	-
16	Gabon	99.2	79	98.0↓	-	-	-
17	Gambia	100	85	96	-	-	-
18	Ghana	94.1	68	98.8	-	-	-
19	Guinea	95.0↓	80	98.1	-	-	-
20	Guinea-Bissau	100	65	99.1	-	-	-
21	Kenya	98.7	77	98.5	-	20.6	0.1
22	Lesotho	85.6↓	55	87.1↓	-	-	-
23	Liberia	-	-	99.7	-	-	-
24	Madagascar	98.2	23	96.7	-	4.3	-
25	Malawi	99.1↓	93	91.0↓	-	-	-
26	Mali	99.7	21.5	97.5	-	-	-
27	Mauritius	93.9	99	73.9	-	90	7.1
28	Mozambique	80.0↓	44	98.3	-	-	-
29	Namibia	87.6↓	95	88.4	-	-	-
30	Niger	92.4↓	45	93.1↓	-	-	-
31	Nigeria	99	60	98	-	3671.5	2.4
32	Rwanda	99	90	98.7	-	0.7	-
33	Sao Tomé & Principe	98.9↓	19.5	86.5	-	-	-
34	Senegal	99.3	85	95.8	-	-	-
35	Seychelles	76.9	98	78.6	-	0.1	0.1
36	Sierra Leone	-	70	-	-	-	-
37	South Africa	81.9↓	99.8	90.9↓	-	2471.3	5.1
38	Swaziland	95.0↓	90	85	-	-	-
39	Tanzania	96.7↓	65	99.1	-	175.6	0.4
40	Togo	99.8↓	85	94	-	-	-
41	Uganda	95	80	98.1	-	214.3	0.7
42	Zambia	99.6	50	97.5	-	-	-
43	Zimbabwe	79.1↓	75	83.7↓	-	-	-
Africa		**94.8**	**58.5**	**95.6**	**-**	**6827**	**0.9**

Note: for data compatibility and coverage, see the technical notes
↓ Figures are estimates or refer to years other than those specified
Source: ITU World Telecommunication/ICT indicators database

TABLE A9: **Internet Users**

		Internet users			Internet users per 100 inhabitants		
		(000s)		CAGR (%)			CAGR (%)
		2003	2008	2003 – 2008	2003	2008	2003 - 2008
1	Angola	58	550	56.8	0.4	3.1	52.1
2	Benin	70	160↓	18	0.9	1.7↓	14.2
3	Botswana	60	118↓	14.6	3.4	6.2↓	12.9
4	Burkina Faso	48	140↓	23.9	0.4	0.9↓	18.9
5	Burundi	14	65↓	35.9	0.2	0.7↓	29.8
6	Cameroon	100	548↓	53	0.6	3.0↓	47.4
7	Cape Verde	20	103	38.7	4.1	19	35.6
8	Central African Republic	6	19↓	25.9	0.2	0.4↓	23
9	Chad	30	130↓	34.1	0.3	1.2↓	29
10	Congo	15	155↓	59.5	0.4	4.0↓	58.9
11	Congo (Democratic Republic)	75	290↓	31.1	0.1	0.4↓	26.5
12	Cote d'Ivoire	140	660↓	36.4	0.8	3.4↓	33.4
13	Equatorial Guinea	3	12↓	32	0.6	2.3↓	29.9
14	Eritrea	30	150	38	0.7	3	32.3
15	Ethiopia	75	360	36.9	0.1	0.4	33
16	Gabon	35	90↓	20.8	2.6	6.7↓	20.6
17	Gambia	35	114↓	26.7	2.4	6.5↓	21.7
18	Ghana	250	997	31.9	1.2	4.2	28.7
19	Guinea	40	90↓	17.6	0.4	0.9↓	16.2
20	Guinea-Bissau	19	37	14.3	1.3	2.1	10.8
21	Kenya	1000	3360	27.4	3.1	8.7	23.3
22	Lesotho	30	73↓	19.6	1.7	3.6↓	16.8
23	Liberia	1	20↓	111.5	-	0.5↓	-
24	Madagascar	71	316↓	35	0.4	1.6↓	31.3
25	Malawi	36	316	54.4	0.3	2.2↓	50
26	Mali	35	125	29	0.3	1	29
27	Mauritius	150	380	20.4	12.3	29.9	19.5
28	Mozambique	83	350	33.4	0.4	1.6	29.8
29	Namibia	65	114↓	11.8	3.3	5.4↓	10.5
30	Niger	19	80↓	33.3	0.1	0.5↓	30.1
31	Nigeria	750	11000	71.1	0.6	7.3	64.9
32	Rwanda	31	300	57.5	0.4	3	53.3
33	Sao Tomé & Principe	15	25↓	10.6	10	15.5↓	9.1
34	Senegal	225	1020↓	35.3	2	8.0↓	31.8
35	Seychelles	12	32↓	21.7	15.2	37.8↓	20.1

36	Sierra Leone	9	14↓	9.1	0.2	0.2↓	5.8
37	South Africa	3283	4187	5	7	8.6↓	4.1
38	Swaziland	27	48↓	12.3	2.6	4.2↓	10
39	Tanzania	250	520↓	15.8	0.7	1.3↓	13.1
40	Togo	210	350↓	10.8	3.6	5.2↓	7.5
41	Uganda	125	2500	82.1	0.5	7.8	75.9
42	Zambia	110	700	44.8	1	5.8	42.7
43	Zimbabwe	800	1481↓	13.1	6.2	11.0↓	12
Africa		8460	32098	30.6	1.3	4.2	27

↓ Figures are estimates or refer to years other than those specified

Source: ITU World Telecommunication/ICT indicators database

TABLE A10: **International Internet Bandwidth**

		International internet bandwidth					
		Mbps		CAGR (%)	Bits/s per internet user		CAGR (%)
		2003	2008	2003 – 2008	2003	2008	2003 - 2008
1	Angola	7	290.0↓	153.7↓	121	582↓	48.2↓
2	Benin	47	155.0↓	34.8↓	671	1033↓	11.4↓
3	Botswana	23	81.0↓	37.0↓	383	810↓	20.6↓
4	Burkina Faso	12	215.0↓	78.1↓	250	1955↓	67.2↓
5	Burundi	4	15.5	31.1	286	238	-3.6
6	Cameroon	45	155	28.1	450	283	-8.9
7	Cape Verde	8	155	80.9	400	1508	30.4
8	Central African Republic	1	1.5↓	11.4↓	167	96↓	-12.9↓
9	Chad	0.5	6.0↓	85.0↓	17	67↓	40.6↓
10	Congo	0.6	1.0↓	15.4↓	38	10↓	-27.8↓
11	Congo (Democratic Republic)	5	10	14.9	67	34	-12.4
12	Cote d'Ivoire	40.5	310.0↓	66.4↓	289	689↓	24.2↓
13	Equatorial Guinea	1	16.8↓	102.5↓	333	1680↓	49.8↓
14	Eritrea	2	24	64.4	67	160	19.1
15	Ethiopia	10	245.0↓	122.5↓	133	842↓	58.5↓
16	Gabon	45	200	45.2	1286	2439↓	17.4↓
17	Gambia	2.1	62.0↓	134.5↓	59	618↓	80.3↓
18	Ghana	28.9	497.0↓	103.6↓	116	565↓	48.7↓
19	Guinea	2	2.0↓	-	50	27↓	-14.5↓
20	Guinea-Bissau	0.1	2.0↓	136.4↓	3	59↓	104.4↓
21	Kenya	26	1421.2	171.9↓	26	423	100.8↓
22	Lesotho	1	4.3↓	43.9↓	33	61↓	16.4↓
23	Liberia	0.3↓	-	-	-	-	-

24	Madagascar	20	162	51.9	284	512	12.6
25	Malawi	3.5	67.0↓	109.5↓	97	480↓	49.3↓
26	Mali	6	213	144.1	171	1704	58.3
27	Mauritius	63	400	58.7	420	1053	20.2
28	Mozambique	18.5	72.0↓	40.5↓	223	360↓	12.7↓
29	Namibia	8.8	56.0↓	58.8↓	135	554↓	42.3↓
30	Niger	2	30.0↓	96.8↓	105	543↓	50.7↓
31	Nigeria	92	693.0↓	65.7↓	123	69↓	-13.3↓
32	Rwanda	10	267	127.3↓	323	890	28.9↓
33	Sao Tomé & Principe	2	8.0↓	41.4↓	133	348↓	27.1↓
34	Senegal	310	2900	56.4	1378	2843	15.6
35	Seychelles	6	74	65.3	500	2313	35.8
36	Sierra Leone	-	-	-	-	-	-
37	South Africa	625.5	3380.0↓	52.5↓	191	852↓	45.4↓
38	Swaziland	1	1.0↓	-	37	21↓	-13.0↓
39	Tanzania	16	100.0↓	58.1↓	64	250↓	40.6↓
40	Togo	14.3	28.5↓	18.9↓	68	84↓	5.3↓
41	Uganda	10	369	146.5	80	148	13
42	Zambia	12	100	69.9	109	143	5.5
43	Zimbabwe	-	57.0↓	-	-	42↓	-
Africa		**1532.4**	**12846.8**	**52.9**	**203**	**433**	**16.3**

↓ Figures are estimates or refer to years other than those specified

Source: ITU World Telecommunication/ICT indicators database

Despite the perceived role of efficient infrastructure as a critical element for economic growth, poverty reduction and the attainment of the Millennium Development Goals (MDGs), there is abundant evidence that Africa's infrastructure is much below international standards in terms of quantity and quality. This paper is an appraisal of the role of infrastructure in economic development and poverty eradication in Africa. The relevance of infrastructure to growth and poverty alleviation in Africa is empirically robust. In addition to overt neglect of the sector by African governments since attaining independence, there has been a "policy mistake" founded on the dogma of the 1980s/90s that infrastructure would be financed by the private sector. This has not materialized and the results have been rather disappointing, especially in water and transport, two extremely important sectors. Poverty was not carefully addressed as part of the regulatory and other reform packages implemented during the 1990s. Not surprisingly, the infrastructure needs of the poor, the majority of who reside in rural and peri-urban areas have not been met. They continue to rely on unsafe, unreliable and often overpriced alternatives to compensate for the policy failures.

Access, affordability and quality of service continue to be key issues in all infrastructure sectors. There is now a significant base of experience during much of the last 25 years from which useful lessons can be learned. The choice is no longer simply a dichotomy between public and private provision but mutual collaboration and pragmatism between the two sectors. The public sector is now expected to retain a much more important role in financing infrastructure development than previously admitted, while the private sector would assist in meeting the significant needs associated with infrastructure construction, operation, and, to some extent, financing in sectors such as telecommunications, energy generation, and transport services in which commercial and political risks are much lower. Small-scale operators, who have played an increasing yet generally underestimated role in catering to the needs of the populations not supplied by the actors with higher visibility, must also be brought on board.

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