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AfDB
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State of Infrastructure in East Africa

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Acknowledgments

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1. Key messages

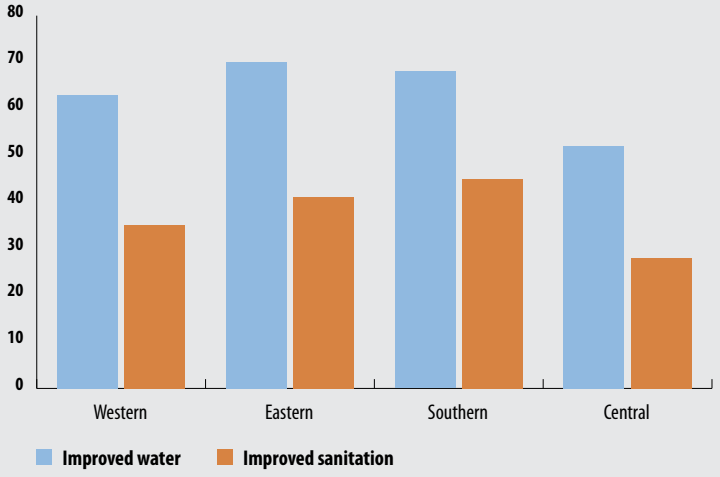
THIS BRIEF OUTLINES some of the principal ongoing infrastructure challenges facing the East African subregion,[1] with a particular focus on water, sanitation, energy, surface transport and ICT. The progress made to date is evaluated in the light of recent studies and new data. The discussion is set against the backdrop of the ongoing Africa Infrastructure Knowledge Program (AIKP); which is a successor program to the African Infrastructure Country Diagnostic (AICD) and is being led by the African Development Bank. The AIKP adopts a longer-term perspective than the AICD and provides a framework for generating infrastructure knowledge on a more sustainable basis. The Bank will take the leading role in the regular collection and assessment of infrastructure indicators, the production of knowledge products and timely policy analysis of emerging infrastructure trends on the continent to guide future policy and funding decisions. Data are currently being collected and validated and country reports will be generated in 2013. A new consolidated East African Community (EAC) report is scheduled for publication at the end of 2013.

At the subregional level, on most measures, East Africa's infrastructure ranks behind that of the Southern African Development Community (SADC) and the Economic Community of West African States (ECOWAS). However, in some areas (e.g. water & sanitation and internet density), East Africa's performance is comparable to that of Southern Africa, the regional leader.

Access to improved water and sanitation: East Africa's overall performance for this indicator is comparable to that of the regional leader, southern Africa (see Figure 1). However, this positive trend has been lagging in recent years, with a significant differential observable between urban and rural areas. On a positive note, internal disparities between lagging and leading areas within a single country are narrowing. Sanitation also shows signs of positive progress.

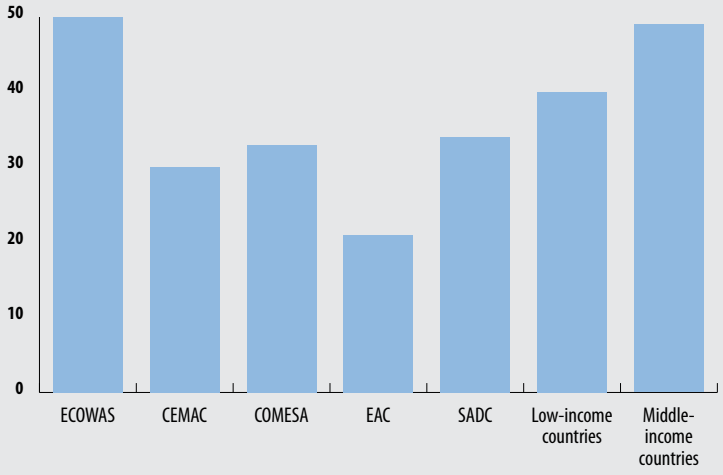
Access to electricity for cooking: This remains a major infrastructure problem in East Africa, which has the lowest access to electrical power of all the African subregions, although performance is improving. However, in most East African countries, firewood and charcoal remain the most commonly used fuel by far.

Figure 1: Access to improved water and sanitation by subregion (% of population)



Source: AICD, 2011: 5.

Figure 2: Access to electricity (urban, % of population)



Source: AICD, 2011: 37.

1 Includes East African Community (EAC) countries of Burundi, Kenya, Rwanda, Tanzania, and Uganda, as well as Sudan and Ethiopia.

Energy production is the most significant problem across all of the infrastructure sectors in East Africa. The subregion has the lowest generation capacity after Central Africa (see Figure 3) and the smallest per capita generation in the whole of the continent. It is clear that East Africa would benefit greatly from intraregional energy trade and integration, which offer significant win–win opportunities, reduce costs, and ensure greater reliability of supply. This would improve the business-enabling environment and stimulate trade and domestic and foreign investment. However, to date scant progress has been made in this direction.

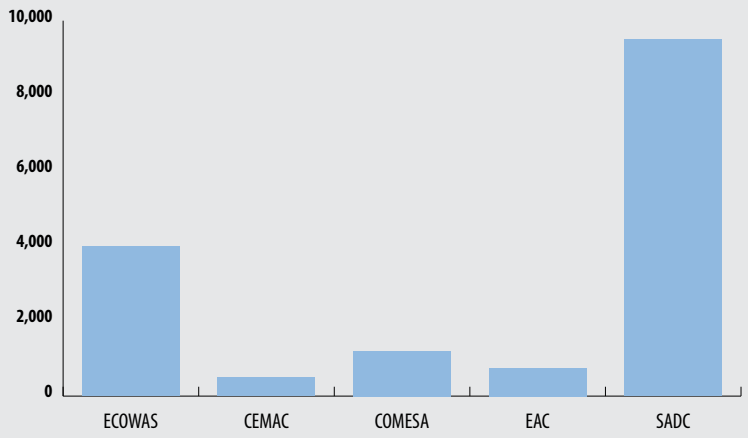
Surface transportation costs associated with logistics in East Africa are higher than in any other region in the world. This is mostly attributable to administrative and customs delays at ports and hold-ups at national borders and checkpoints along the road networks. Capacity constraints faced at the ports, coupled with extremely lengthy import and export procedures, add considerably to the time and cost of transporting goods in East Africa. However, in October 2012, the EAC sectoral council cleared the legal content of two bills for tabling to the East African Legislative Assembly later in the year. The two bills will establish the operation of the planned one-stop border posts and the application of a uniform vehicle weight (axle load) limit for the region (Vehicle Load Control Bill). This should speed up customs procedures and regularize truck loads to reduce deterioration of the road networks.

East African road corridors are in reasonably good condition compared with the other African subregions (Figure 4). Indeed, there has been a marked improvement over the last five years, with an increase in the proportion of paved sections. Strong regional differences are noticeable among the road networks.

East Africa's ICT sector is characterized by high costs and low penetration (see Figure 5). However, a trend of falling prices and higher penetration has been observed in areas that have access to submarine cables. The most pressing issue for the subregion is to complete the fiber-optic backbone, which will provide broader coverage to all of East Africa. Around 3,565 kilometers of fiber-optic cable are needed to complete the network. This represents an investment requirement of US$96 million. Despite the cost, this would give high rates of return, particularly for Sudan (116%) and Uganda (304%).

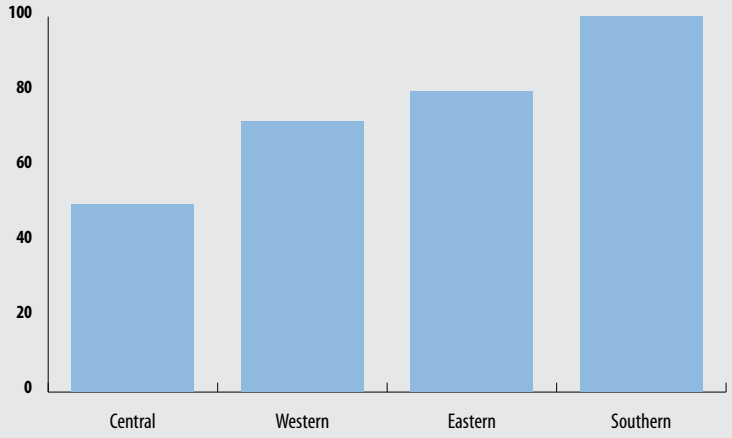
There are significant growth opportunities for East Africa to improve its infrastructure, particularly in productivity-related areas – namely, energy production, logistics and ICT.[2] For instance, the Africa Infrastructure Country Diagnostic (AICD) study (AICD, 2011) estimated that if the subregion´s overall infrastructure were

Figure 3: Installed generation capacity by regional economic community (MW)



Source: Eberhard et al., 2009 in AICD, 2011: 37.

Figure 4: Roads in good condition by subregion (%)



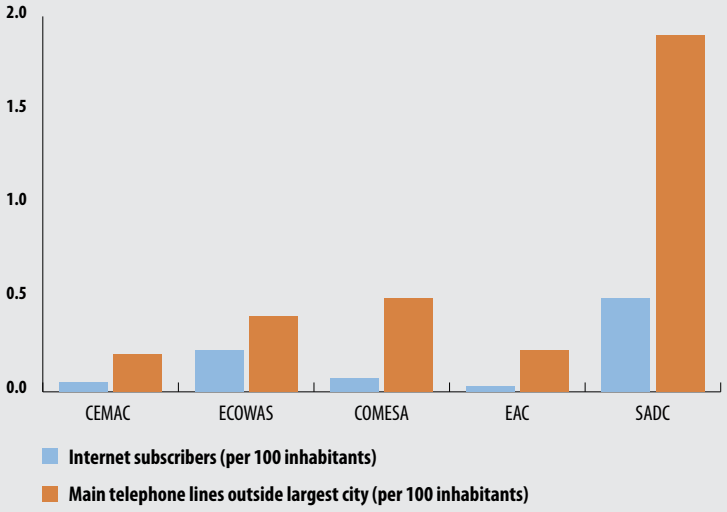
Source: Teravaninthorn and Raballand, 2009 in AICD, 2011: 10.

2 "Productive infrastructure" may be defined as infrastructure that facilitates the production of goods and services, thereby boosting a country's GDP.

raised to the level of the top-performing African country (Mauritius), GDP would grow by 6%. In this respect, increased power generation capacity would make the biggest contribution to growth.

Despite potentially huge gains to be made from boosting productive infrastructure, there remain substantial challenges across all sectors. Principal among these is the lack of a *regional vision for infrastructure provision*, even though it remains one of the critical determinants of success. Recently, some efforts have been made towards a regional vision; however it is still too early to assess their real impact and success. For example, the East African Community developed a Master Plan for the energy sector aiming to achieve a regional vision that goes beyond the power system capacity supporting an institutional arrangement.

Figure 5: Internet subscribers and main telephone lines by regional economic community



Source: AICD, 2011: 48.

2. Social infrastructure: access to water & sanitation (WSS) and electricity

2.1 Water and Sanitation

ALTHOUGH EAST AFRICA'S overall performance in WSS (water and sanitation supplies) has witnessed a positive trend and is comparable with that of the regional leader (Southern Africa), progress has slowed in recent years. A further drag on momentum is the significant access differential between urban and rural areas. On a positive note, disparities between lagging and leading areas within individual East African countries are narrowing. Access to improved sanitation is also showing positive signs.

With respect to access to improved sources of water and sanitation,[3] East Africa's performance is comparable with that of the regional leader—Southern Africa (see Table 1).

Nonetheless, as shown in Table 2, there are significant differences in access rates between the urban and rural areas. Most East African countries have attained relatively high levels of access to improved water and sanitation in urban areas, but in many rural areas households are still without improved access. As a large majority of East Africans reside in rural areas, the national access rates are still low in some countries e.g. Burundi and Rwanda, particularly in the area of improved sanitation.

Furthermore access to improved water supplies is losing momentum in most East African countries (see Figure 6.a). Whereas Rwanda, Tanzania, and Uganda recorded substantial increases in access rates during the 1990s, during the subsequent decade the rate declined in Rwanda and Tanzania. Uganda's progress also stalled, registering only a minor increase during the next decade, compared with its achievements in the 1990s. The case of Ethiopia shows a continuing decline throughout both decades.

This deterioration in access to improved water has been affected by excessive expenses arising from operational inefficiencies, which have curbed expansion in services. Such inefficiencies are a more significant problem in rural areas, where scale economies are not easily achievable. Another negative factor is the low access to financing sources, since traditionally

Table 1: Benchmarking the EAC with other regional economic communities (% of population)

	Western	Eastern	Southern	Central
Improved water	63	**71**	68	53
Improved sanitation	35	**42**	46	28

Source: AICD, 2011: 5.

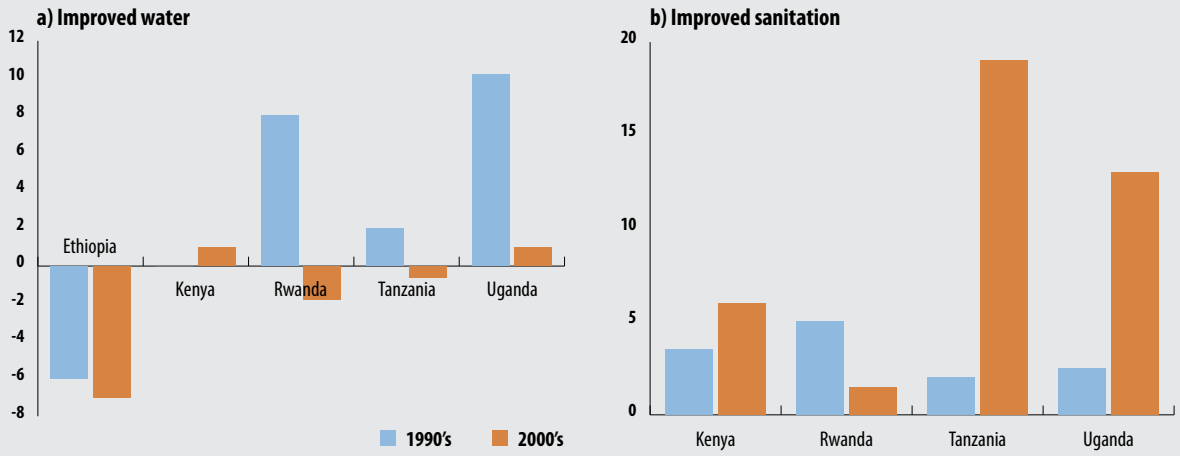
Table 2: Water and sanitation access rates by country and place of residence (%)

Country	Year*	Rural	Urban	Total
Improved Water				
Burundi	2010	27.4	77.2	31.9
Ethiopia	2011	35.0	92.7	48.1
Kenya	2010	53.1	87.5	61.5
Rwanda	2010	31.9	68.8	37.1
Tanzania	2010	65.5	83.8	70.3
Uganda	2011	85.6	96.4	87.6
Improved Sanitation				
Burundi	2010	0.2	26.2	2.6
Ethiopia	2011	1.5	7.5	2.8
Kenya	2010	13.2	55.6	23.5
Rwanda	2010	0.7	5.6	1.4
Tanzania	2010	2.3	33.3	10.4
Uganda	2006	2.6	21.4	6.3

Source: Based on national Demographic and Health Surveys.
* Indicates the most recent year for which data are available.

3 According to the World Bank definition, an improved water source is "a household connection, public standpipe, borehole, protected well or spring, and rainwater collection. Unimproved sources include vendors, tanker trucks, and unprotected wells and springs".

Figure 6: Changes in access rates to improved water and sanitation, 1990s and 2000s



Source: Based on national Demographic and Health Surveys.
Note: Figure 6.b. – Data unavailable for Ethiopia.

these only cover about half of the investment needs. In view of these constraints, countries are forced to consider adopting low-cost technologies. One counterintuitive finding of our research is that, despite a clear financing gap, most countries in Eastern Africa still underprice water provision for connected customers, even though these customers could afford cost-recovery tariffs. Finally, another factor for deteriorating access to an improved water supply could be the rapid population growth and therefore rapidly growing demand, which outstrips supply.

Access to improved sanitation (see Figure 6.b) over the two decades shows a very positive trend in Uganda and Tanzania, a steady improvement in Kenya, but a deterioration in Rwanda.

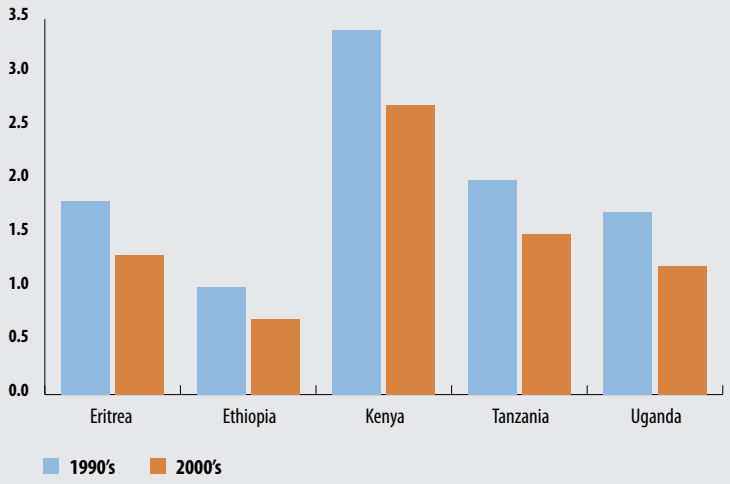
Despite decreasing access to improved water sources, one welcome finding is that disparities between lagging and leading regions within each country are narrowing (see Figure 7). In the 1990s, the leading region in Tanzania recorded twice the level of access compared to the worst-performing region. During the 2000s though, the ratio reduced from 2 to 1.5. The same narrowing of the differentials between leading and lagging areas is true for all other countries in East Africa in respect of improved access to water.

2.2 Access to electricity

Access to electricity is a major problem in East Africa. While it has been improving at a steady rate in most countries, the subregion's performance as a whole falls well below that of the rest of the continent, with firewood and charcoal still the most commonly used fuel for cooking.

Access to electricity and other improved energy sources for cooking is extremely

Figure 7: Differentiated access to improved water for lagging and leading regions within selected countries, 1990s and 2000s



Source: Based on national Demographic and Health Surveys.
Note: The years used for each country vary according to data availability.

Table 3: Benchmarking access to electricity for the urban population (%)

	ECOWAS	CEMAC	COMESA	EAC	SADC	Low-income countries	Middle-income countries
Access (urban, % of population)	50	31	34	23	35	43	50
Growth in access of population to electricity, annual (%)	2	1	1	1	1	3	2

Source: AICD, 2011: 37.

low in East Africa. Indeed, the subregion is the worst performer in the whole continent for this indicator; and this is currently the most significant social infrastructure problem. In terms of access to electricity for its urban population, East Africa records a low rate of 23%, compared to CEMAC (31%), COMESA (34%), SADC (35%), and ECOWAS (50%) (see Table 3).[4]

Demographic and Health Surveys show that electricity access generally has remained low in the EAC in recent years, despite an increase in Kenya, Rwanda, Tanzania, and Ethiopia. Uganda is lagging behind, according to the surveys (see Table 4). The use of firewood and charcoal is almost universal across East Africa. Over the past ten years (2001-2011), available data reveal that the rate of utilization of these fuel sources in Ethiopia, Kenya and Rwanda has changed very little (see Table 5).

Table 4: Rate of electricity access (% of total population)

Country	2000	2001	2003	2005	2006	2009	2010	2011
Burundi	...	...	...	...	...	...	5.3	...
Ethiopia	12.7	...	...	14.0	...	...	...	23.0
Kenya	...	...	16.0	...	...	23.0	...	...
Rwanda	6.2	...	...	4.8	...	...	9.7	...
Tanzania	..	...	...	11.4	...	..	14.8	...
Uganda	...	8.6	...	...	9.0	...	...	...

Source: Based on Demographic and Health Surveys.
Note: ... denotes data unavailable.

Table 5: Rate of utilization of firewood or charcoal for cooking, 2001–2011

Country	2001	2005	2006	2008	2009	2010	2011
Ethiopia	95.5	...	...	...	...	...	94.7
Kenya	...	80.5	...	...	84.0	...	...
Rwanda	98.8	...	...	98.9	...	...	...
Tanzania	...	...	...	...	...	94.9	...
Uganda	...	...	95.7	...	...	...	...

Source: Based on Demographic and Health Surveys.
Note: ... denotes data unavailable.

4 CEMAC = Economic and Monetary Community of Central Africa
COMESA = Common Market for Eastern and Southern Africa
SADC = Southern African Development Community
ECOWAS = Economic Community of West African States

3. Infrastructure to serve productive needs

3.1 Energy production

ENERGY DEFICIENCY IS the most notable problem across all infrastructure sectors in East Africa, negatively impacting households, industries, and businesses alike. Improving access to a reliable and affordable source of energy would do much to improve the business-enabling environment for the subregion, stimulating trade and encouraging both domestic and foreign investment. Regional integration offers a win–win solution, however as yet there is little sign that East African countries have begun to work effectively together toward this end.

Just as access to power is a major infrastructure problem in East Africa, so too is energy production. East Africa's electricity generation capacity is very low – only Central Africa performs worse – while its per capita generation is the lowest in the African continent. Generation capacity in the SADC region is 13 times greater than in the EAC region, while in ECOWAS it is 5 times greater. Although annual power outages in the region are lower than in ECOWAS and CEMAC, they cause greater economic losses to firms, possibly because of the nature of industry in East Africa (see Table 6) (AICD, 2011: 36).

Table 6: Benchmarking power infrastructure, capacity and utility performance

	ECOWAS	CEMAC	COMESA	EAC	SADC	Low-income countries	Middle-income countries
Installed generation capacity (MW)	3,912	583	1,085	**774**	9,855	2,110	36,971
Net generation per capita, annual (kWh/capita/year)	171	147	114	**82**	1214	165	4,479
Outages, number, annually (number/year)	165	152	119	**132**	91	134	71
Outages, value lost, annually (% of sales)	7	5	7	**8**	2	5	2
Firms with own generator (% of firms)	54	51	43	**56**	19	33	18
System losses (% of generation)	29	31	32	**23**	12	…	10
Cost recovery ratio, historical (%)	79	45	73	**69**	68	100	87
Total hidden costs (% of revenue)	159	107	102	**65**	4	544	0
Collection rate, reported by utility, electricity (% of billing)	71	93	93	**94**	89	…	91
	WAPP	**CAPP**	**SAPP**	**EAPP**			
Average historic cost (US$/kWh)	0.21	0.49	0.14	**0.19**		—	—
Long-run marginal cost (US$/kWh)	0.18	0.09	0.07	**0.12**		—	—

Source: Excerpt from Eberhard et al., 2009 in AICD, 2011: 37.
Notes: EAPP = East African Power Pool; CAPP = Central Africa Power Pool; SAPP = Southern African Power Pool; WAPP = West African Power Pool.

On the other hand, East Africa's utility performance is better than some of the other subregions. Its systems losses and hidden costs are less serious, while it enjoys the highest cost-recovery record in Africa. In terms of pricing, the average historic costs of power in the subregion are high – almost US$0.20 per kilowatt-hour (kWh). With demand for power expected to increase by 70%, the expansion of power infrastructure will be critical to the subregion's economic development (AICD, 2011: vii).

Bujagali hydro power station and transmission line, Uganda.

3.2 Energy trade and regional integration

Almost all of the effective power demand for the East African Power Pool/Nile Basin (EAPP/NB)[5] is currently being met. The baseline total net demand for power was 100.6 terawatt-hours (TWh) in 2005, making it the second-largest power market in Sub-Saharan Africa, behind the Southern African Power Pool (SAPP). But power demand in the EAPP area is expected to increase by 69% over the next decade. It is estimated that power demand could reach 169 TWh by 2015, taking account of the anticipated expansion in market demand. This will be driven by economic growth in commerce and industry, and by the planned expansion in electrification coverage from 35% to 60% of households in the subregion.

5 The East African Power Pool is expanded to include key Nile Basin trading partners Egypt, Ethiopia, and Sudan.

Meeting this demand would require 26,000 MW of new generation capacity, which means more than doubling the existing capacity (see Table 7). This could be achieved either by scaling up national production or by expanding cross-border power trade within EAPP (AICD, 2011: 38). There is great potential for integration in the electricity sector in East Africa.

In 2005, power trade flows in the EAPP comprised just 0.28 TWh of imports and 0.18 TWh of exports, or about 2.1% of the electricity generated. Although EAPP is the third most active regional power pool in Africa after SAPP and WAPP, these power volumes are very small. Under a trade expansion scenario, the volume traded has the potential to increase from 12 to 162 TWh per year. Regional power demand would be met by the most cost-effective energy resources available to the subregion as a whole, and additional cross-border transmission capacity would be added where required, to allow power to flow from production to consumption locations.

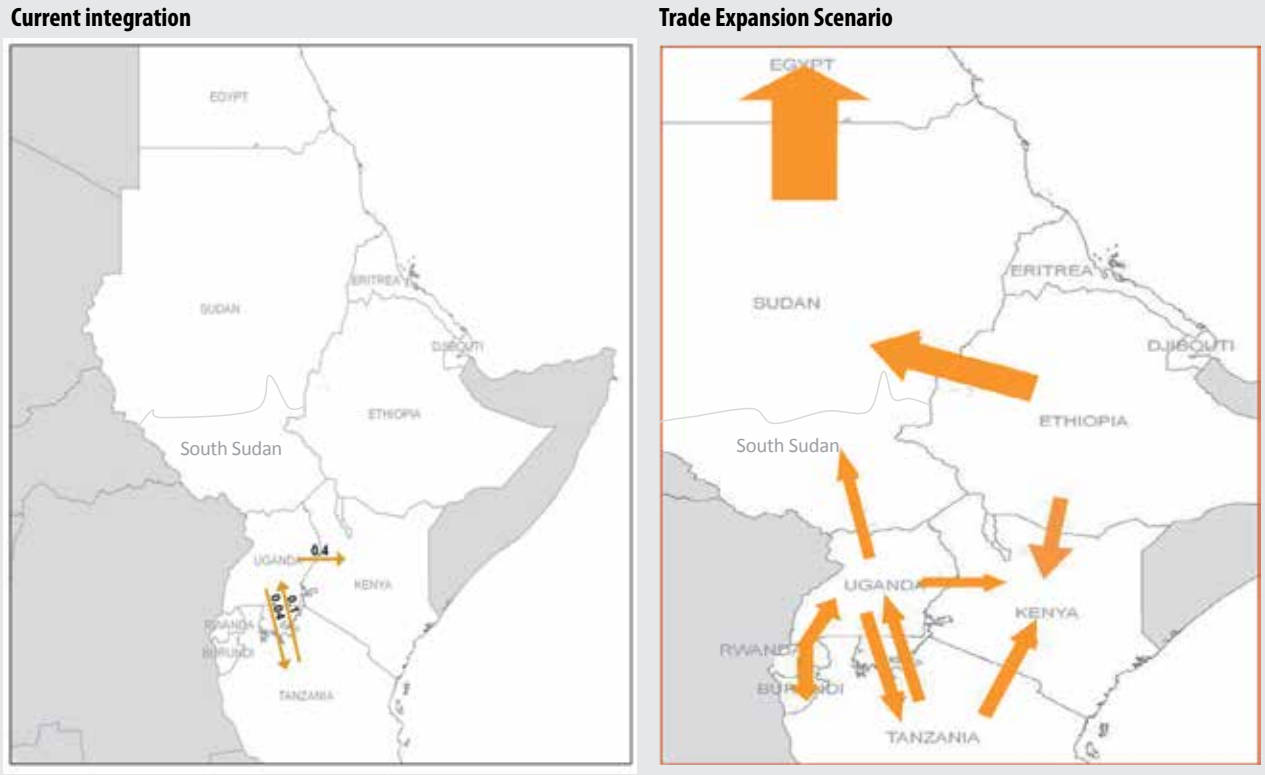
Expanding electricity trade in the East African Power Pool/Nile Basin (EAPP/NB) would position Ethiopia, Rwanda, South Sudan, Sudan, Uganda, and Tanzania as net exporters, while Kenya, Egypt and Burundi would be net importers (see Figure 8). As an example, if Ethiopia and Sudan were to fully develop their hydropower potential and become the major

Table 7: Demand and suppressed demand in EAPP (TWh)

	Total Net Demand in 2005	% suppressed demand as a share of net demand (2005)	Market demand 2015	Social demand with national targets 2015	Total net demand 2015
EAPP	100.6	1	144.8	24.2	169

Source: Rosnes and Vennemo, 2009 in AICD, 2011: 38.

Figure 8: Trade flows in EAPP / Nile Basin under the trade expansion scenario



Source: Rosnes and Vennemo, 2009 in AICD, 2011: 42.

power exporters in the region, Ethiopia could export as much as 200% and Sudan more than 100% of domestic consumption (AICD, 2011: 40).

As a whole, expanding trade in the Nile basin could generate US$1 billion a year. But many countries such as Ethiopia and Sudan – and to a lesser extent Rwanda, Tanzania, and Uganda – would need to develop their hydropower potential. Further, all EAPP countries would need to invest significantly in cross-border interconnectors to allow power to flow more readily around the subregion. To finance this, investment needs would be greater for some of the countries under the trade expansion scenario. Ethiopia, for example, would need to develop more than 6,700 MW of additional hydropower capacity to supply export markets in neighboring countries. For its part, Sudan would have to develop 3,100 MW of additional hydropower capacity (AICD, 2011: 39).

For the EAPP, regional power trade could result in gains of more than 20% annually accruing to the power pool members. However, individual countries stand to earn higher returns: in some cases such as Kenya, as high as 400% (see Table 8). These economic gains would arise not through cost reductions but rather through increases in power production.

Furthermore, in addition to economic gains, improving regional power trade would increase reliance on hydropower and result in significant CO_2 emission reductions, in the order of 20 million tonnes (see Table 9).

3.3 Developing a regional approach to hydropower investment

The possibility of accelerating regional power trade in EAPP depends critically on the ability of the countries involved to deliver the necessary massive investments in hydropower. A host of technical, financial, and political challenges are making this difficult.

The recent report, *Regional Power System Master Plan and Grid Code Study for the Eastern Africa Power Pool* (EAPP and EAC, 2011) shows that countries in the subregion have been planning and implementing their power systems in an isolated manner focused on the national demand for growth. While bilateral power exchange agreements between some countries in the subregion exist, the volume exchanged is

Table 8: Benefits from trade expansion in the power sector

	Unit benefit (US$/kWh)	Net power trade (TWh)	Annual benefits (US$ mn p.a.)	One-time investment (US$ mn)	Rate of Return (%)
EXPORTERS					
Ethiopia	0.19	26.2	5,974	1,001	60
Rwanda	0.12	1.0	144	59	24
Sudan	0.13	13.0	2,044	1,032	20
Tanzania	0.1	2.4	288	44	66
Uganda	0.12	2.8	403	145	28
IMPORTERS					
Burundi	0.03	1.0	210	10	210
Djibouti	<.01	<1	...	0	...
Kenya	0.01	12.0	1,200	30	400
Egypt	<.01	123	6,165	...	...

Source: AICD, 2011: 46.
Note: ... denotes data unavailable.

Table 9: Emissions savings from turning to hydropower

	WAPP	SAPP	EAPP	CAPP	Total	WAPP	SAPP	EAPP	CAPP	Total
	Production difference (TWh)					**Emissions savings (mn tonnes)**				
Coal	...	-41.5	0.7	...	-40.8	...	-37.8	0.6	...	-37.2
Diesel	-0.8	-0.3	0.3	...	-0.8	-0.6	-0.2	0.2	...	-0.6
Gas	-9.2	-5.3	-42.4	...	-56.8	-4.7	-2.7	-21.5	...	-28.9
HFO	0.2	...	0.4	-4.9	-4.3	0.1	...	0.3	-3.6	-3.2
Hydro	11.5	47.5	43.4	5.1	107	...	...	...	...	0
Total	1.6	0.5	2.4	0.3	4.7	-5.2	-40.7	-20.4	-3.6	-69.9

Source: Derived from Rosnes and Vennemo, 2009 in AICD, 2011: 44.
Notes: EAPP Eastern Africa Power Pool; CAPP = Central Africa Power Pool; SAPP = Southern African Power Pool; WAPP = West African Power Pool.

insignificant. Moreover, exporting parties have frequently failed to meet their commitments to deliver power because of deficits in their own systems.

The current demand for power is mostly being met at the power pool level, but with country variations. Additionally, power outages suppress demand at the country level. For example, in Burundi, 13% of the net demand was suppressed in 2005, in Kenya 8%, and around 5% in many of the remaining countries, whereas for the overall region, the percentage of suppressed demand as a share of net demand in 2005 was 1% (AICD, 2011: 37). Harmonization of the national expansion plans would result in Ethiopia and Djibouti achieving a significant surplus in ten years' time (see Table 10).

Table 10: Electricity generation according to harmonized national expansion plans (MW)

Country	Existing Generation	Future Generation		Future Demand		Future Surplus*	
	2012	2013	2023	2013	2023	2013	2023
Burundi	49	49	269	56	204	-13%	32%
Djibouti	123	116	173	30	62	287%	179%
Ethiopia	2,179	4,890	9,140	1,964	4,912	149%	86%
Kenya	1,916	2,633	5,604	1,958	4,537	34%	24%
Rwanda	103	205	305	94	276	118%	11%
Sudan	3,951	3,878	7,466	2,019	5,956	92%	25%
Tanzania	1,205	1,423	3,573	1,213	2,479	17%	44%
Uganda	822	882	1,629	715	1,310	23%	24%

Source: SNC Lavalin International Inc. and Parsons Brinckerhoff, 2011 in EAPP and EAC, 2011.
Note:*Minus sign denotes deficit.

4. Surface transportation

COSTS ASSOCIATED WITH logistics in East Africa are higher than in any other region in the world. This can be explained mostly by lengthy administrative and customs procedures at ports, and delays at borders and other points along the roads. Capacity constraints faced at the ports, coupled with extremely cumbersome import and export procedures, add considerable time and costs to transporting goods. This affects trade not only among countries within the subregion, but also with other African subregions and with destinations in Europe and elsewhere.

The state of the East African road corridors is reasonably good and has improved further over the last five years, with the proportion of paved sections increasing (see Table 11). Strong differences between localities within the subregion are noticeable however.

Two new bills aimed at establishing one-stop border posts (OSBPs) and harmonized maximum vehicle loads should improve logistics on the subregion's networks.

4.1 Overview

Compared to other corridors in the continent, those in East Africa perform relatively well. The road network is generally in good condition, although there are patches of poor-quality roads along some corridors and significant stretches of unpaved road. East Africa has the second smallest trade density of all the African subregions, yet some of the best road conditions. While only US$5.7 million per kilometer was transported along its corridors (compared with US$8.2 million in the western subregion and US$27.9 million in the southern subregion), the implicit velocity[6] was surpassed only by the Southern Corridor (see Table 11) (AICD, 2011: 10).

Road freight tariffs average US$0.07 per tonne-kilometer, which is in the mid-range for the African subregions but still exceedingly high relative to global standards. At the broader logistics level, according to the 2010 International Logistics Performance Index (LPI) (World Bank, 2010), the costs associated with logistics in East Africa are higher than in any other region in world. The domestic LPI suggests that average lead times for exports and imports in East Africa are the highest and second-highest in the developing world, respectively, while the clearance times for landlocked countries are around five times higher than for those with port access (AIDC, 2011: 10).

The slow effective velocity of freight in East Africa can be explained by lengthy customs clearance processes, administrative delays at ports, and delays at borders. In addition roadblocks, weigh stations and random police checks that impose costs and delay trucks are pervasive (AICD, 2011: 11). Furthermore, while overall traffic and trade flows have increased, the policy environment has shown no signs of improvement. But on a positive note, the EAC sectoral council has cleared the legal content of two bills - the One Stop Border Post Bill and the Vehicle Load Control Bill – for introduction to the East African Legislative Assembly (Nakaweesi, 2012). These two bills will establish the operation of the planned one-stop border posts and the application of a uniform vehicle weight (axle load) limit for the region. This should speed up customs procedures and regularize truck loads across the subregion. Regularized truck loads should also help to prevent excessive deterioration of the road networks and therefore reduce maintenance costs.

The trucking industry in East Africa is actually more competitive and mature in

6 Implicit velocity – the total distance divided by the total time taken to make the trip, including time spent stationary at ports, border crossings, and other stops.

Table 11: Key transportation corridors for international trade in Sub-Saharan Africa

Corridor	Length (km)	Road in good condition (%)	Trade density (US$ mn per km)	Implicit velocity (km/hr)	Freight tariff (US$/tonne-km)
Central	3,280	49	4.2	6.1	0.13
Western	2,050	72	8.2	6.0	0.08
Eastern	**2,845**	**82**	**5.7**	**8.1**	**0.07**
Southern	5,000	100	27.9	11.6	0.05

Source: Teravaninthorn and Raballand, 2009 in AICD, 2011: 10.

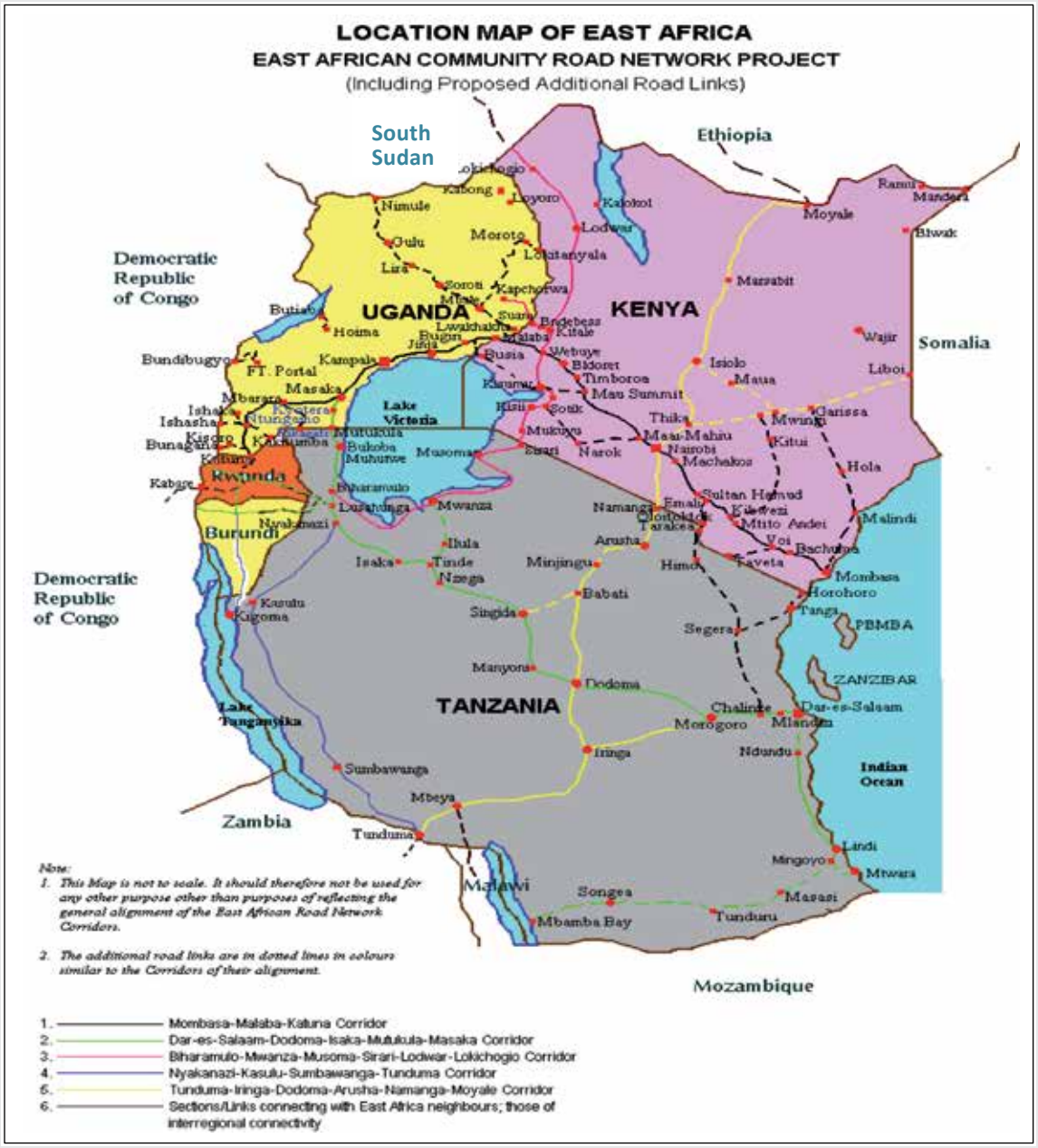
comparison with West and Central Africa. One explanation is that freight transportation rates are determined by market forces rather than by government regulations. But among logistics operators surveyed as part of the LPI study, 60–75% of the respondents from East Africa considered the port, airport, and road transportation rates to be exorbitant, while 45% of respondents from the rest of the world found the rates high or very high. Bribes are also estimated to be in the order of US$8 million per year in the East African Community alone (USAID, 2009). To gain a deeper understanding of surface transportation performance, we need to examine the national performance of the various modal components – road, railroad, and ports.

4.2 Roads

There are a number of major corridors in East Africa. The Northern Corridor runs inland from Mombasa and is by far the most significant trading corridor in the subregion. The Central Corridor runs through Tanzania. Further north, a corridor connects Addis Ababa with Djibouti, while another connects Addis Ababa with South Sudan. No major road routes link Ethiopia and Sudan with the EAC.

The *Northern Corridor* is the main corridor in East Africa and connects four of

Figure 9: East Africa Community Road Network Project



Source: East African Community Infrastructure (2013).

the five East African Community (EAC) countries (Kenya, Uganda, Rwanda, and Burundi) to the port of Mombasa. It also provides connections to South Sudan, eastern DRC, and parts of northern Tanzania (see Figure 10). It starts out in Kenya as a paved corridor that was generally in good or fair condition as at 2008. However, the Ugandan portions of the corridor are only about three-quarters paved, with a marked decline in the condition of the road infrastructure. In Kampala, the corridor then bifurcates toward Kigali (Rwanda) and Juba (South Sudan). The Rwandan portions are paved and reasonably maintained, while the northern portions in South Sudan remain unpaved but in reasonable condition. Further north in Ethiopia and Sudan, there is a marked absence of paving, even along routes of strategic significance.

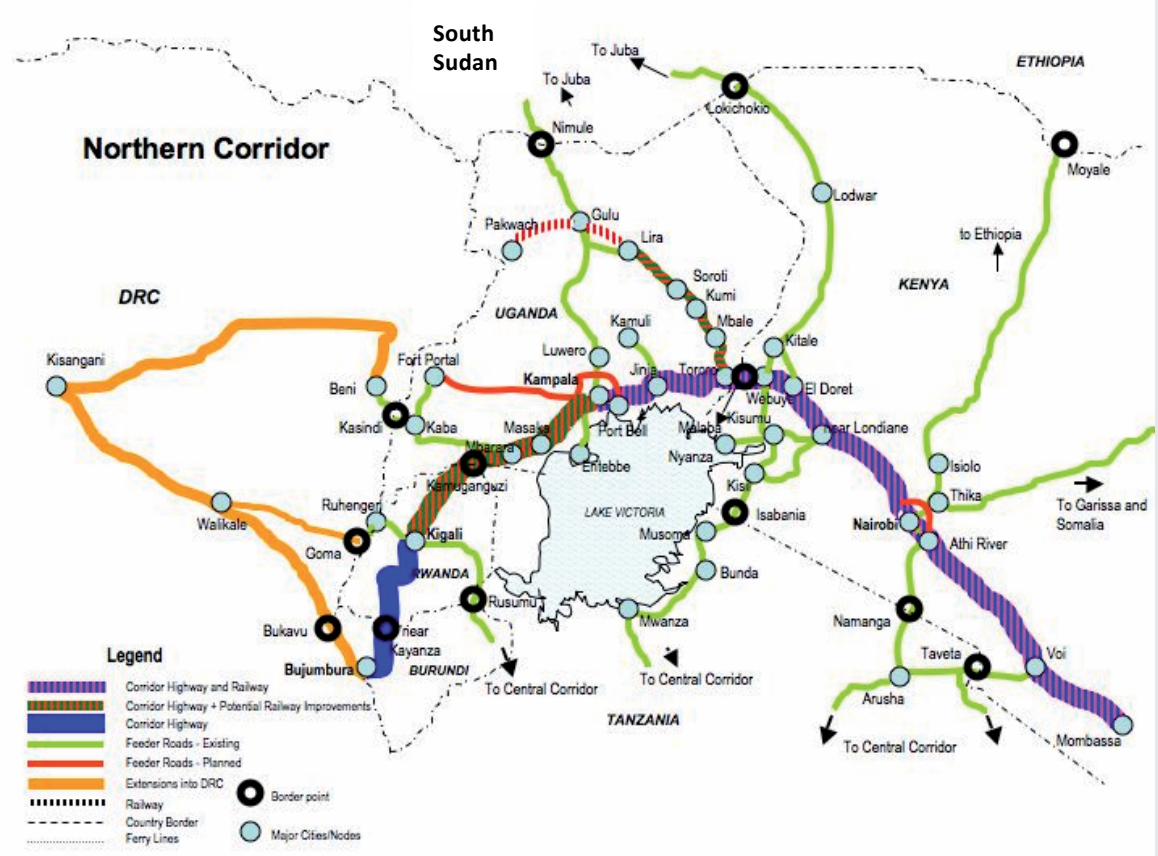
In the south of the subregion, the *Central Corridor* also plays an important role connecting the port of Dar es Salaam to markets in Tanzania, Burundi, Rwanda, Uganda, and the DRC (see Figure 11). Along the southern side of Lake Victoria, the Central Corridor route from Bujumbura to Dar es Salaam starts out in Burundi as a paved road in reasonable condition, while the Tanzanian section is only partially paved but is fairly well maintained.

The recent publication of the *Corridor Diagnostic Study of the Northern and Central Corridors of East Africa* (EAC, 2011) responded to demand for an in-depth assessment of the performance of the corridors and preparation of an action plan to remove identified logistical impediments.

Performance indicators from this study classify roads in levels of service (LOS), such that the best operating conditions enable free flow, high average speed, and the possibility to overtake easily. There are scant data available for the Central Corridor. However, for the Northern Corridor, the study shows only 13% of roads to be in good condition, 44% in fair condition, and 43% in bad condition.

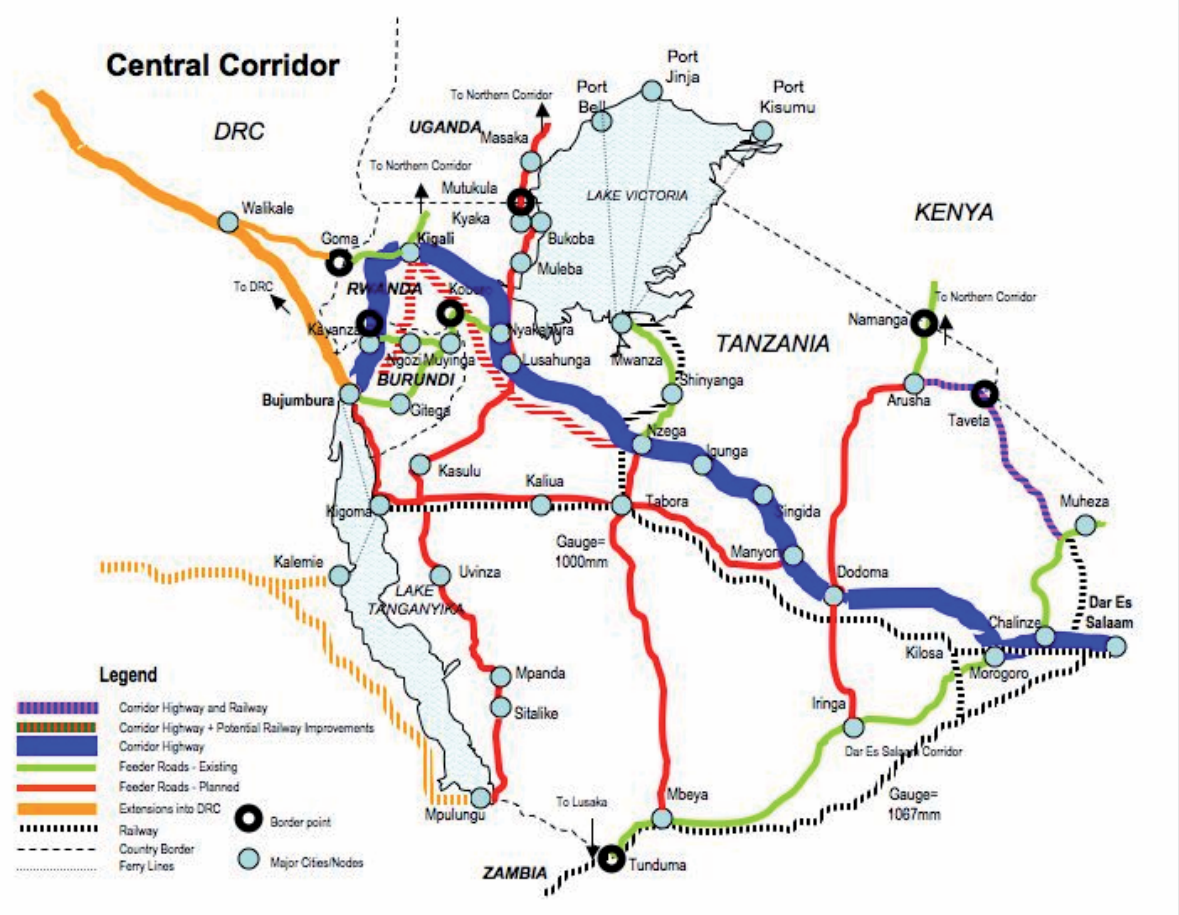
The only comparable statistic between the AICD's 2011 report and the *Corridor*

Figure 10: Northern Corridor



Source: EAC, *Corridor Diagnostic Study of the Northern and Central Corridors of East Africa, 2011.*

Figure 11: Central Corridor



Source: EAC, *Corridor Diagnostic Study of the Northern and Central Corridors of East Africa*, 2011.

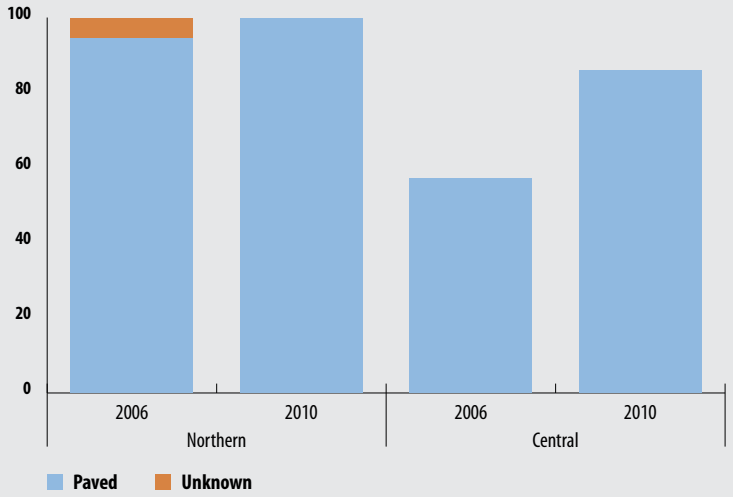
Diagnostic Study is the percentage of paved roads. The latter shows that paved roads have substantially increased along the Central Corridor. In 2006, the figure was 57%, but by 2010 it had risen to 87%. The Northern Corridor is now almost totally paved (see Table 12 and Figure 12).

Table 12: Status of the two main corridors of East Africa

Status	NORTHERN CORRIDOR		CENTRAL CORRIDOR	
	Length in km	%	Length in km	%
1 lane	1,738	91.5	3,026	80.2
2 lanes	161	8.5	747	19.8
Paved	1,896	99.8	2,651	70.3
Unpaved	3	0.2	449	11.9
Good	259	13.4	67	1.8
Fair	849	43.8	286	7.6
Poor	831	42.9	9	0.2
Total	**1,899**		**3,773**	

Source: EAC, *Corridor Diagnostic Study of the Northern and Central Corridors of East Africa*, 2011 and AICD, 2011.

Figure 12: Comparison of paved roads between 2006 and 2011 for Northern and Central Corridors (%)



Source: EAC, *Corridor Diagnostic Study of the Northern and Central Corridors of East Africa*, 2011 and AICD, 2011.

The recent study also highlights the significant regional differences in the condition and types of corridors in East Africa. Between 84–97% of the Northern Corridor, by far the most significant artery in the region (connecting Kenya, Uganda, Rwanda, and South Sudan) is paved. By comparison, only 57% of the road from Dar es Salaam to Bujumbura is paved, and only 23% of the road from Addis Ababa to Djibouti (see Table 13).

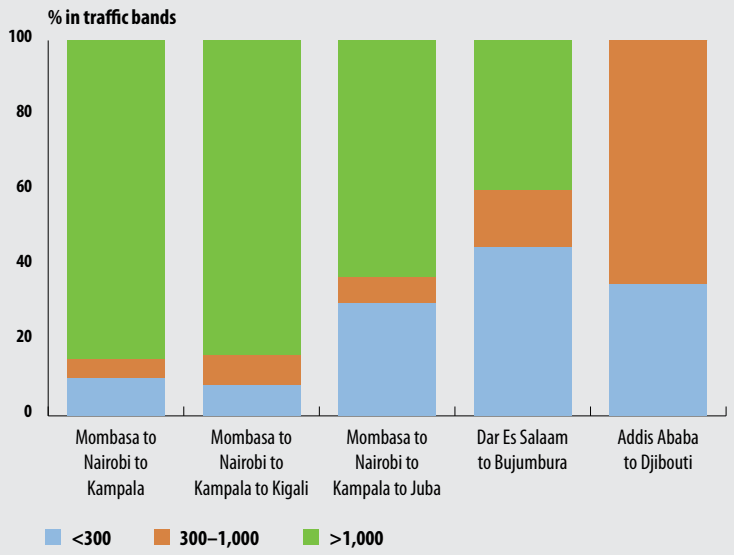
The reason for the higher level of paving along the Northern Corridor is the greater concentration of traffic. As Figure 13 indicates, most of the Annual Average Daily Traffic (AADT) is concentrated above 1,000 vehicles in the three Northern Corridor sections, compared with only 39% in the Dar es Salaam–Bujumbura corridor and 0% in the Addis Ababa–Djibouti corridor.

Table 13: Type and condition of East African road corridors, 2011

	Condition (%)			Type (%)
	Good	Fair	Poor	Paved
Mombasa to Nairobi to Kampala (Kenya – Uganda)	50	34	13	97
Mombasa to Nairobi to Kampala to Kigali (Kenya – Uganda–Rwanda)	40	36	11	94
Mombasa to Nairobi to Kampala to Juba (Kenya – Uganda–South Sudan)	44	48	9	84
Dar es Salaam to Bujumbura (Tanzania–Burundi)	45	36	6	57
Addis Ababa to Djibouti (Ethiopia –Djibouti)	37	17	16	23

Source: EAC, *Corridor Diagnostic Study of the Northern and Central Corridors of East Africa*, 2011.

Figure 13: Annual Average Daily Traffic (AADT) by corridor, 2011

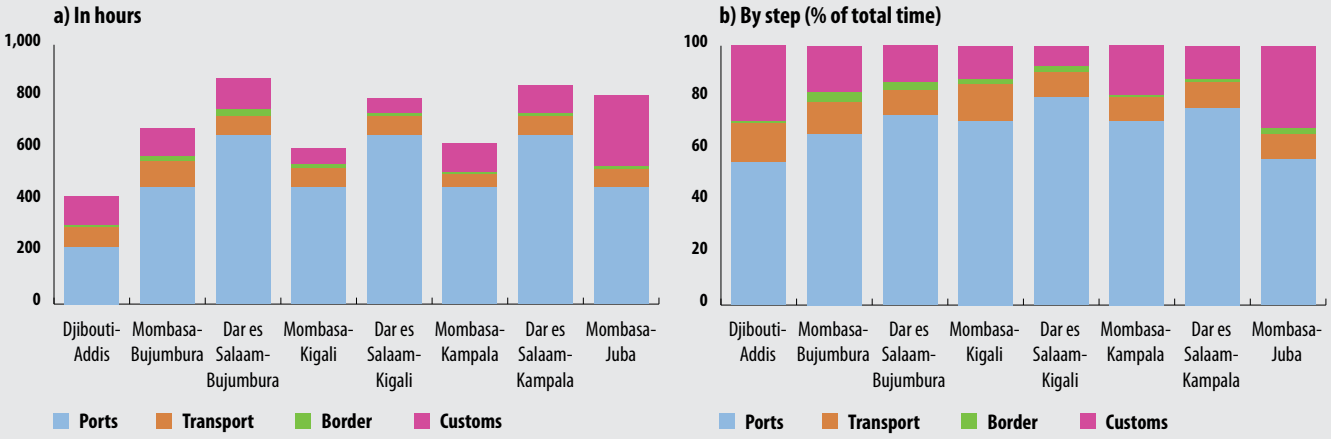


Source: EAC, *Corridor Diagnostic Study of the Northern and Central Corridors of East Africa*, 2011.

The competitiveness of each corridor can be gauged by aggregating the time and costs associated with transport, administrative processes (customs) at ports, and long waits incurred along the route. The cost of moving imports (or exports) along each of these key arteries and the times taken for this movement are key elements of competitiveness for both international and intraregional trade.

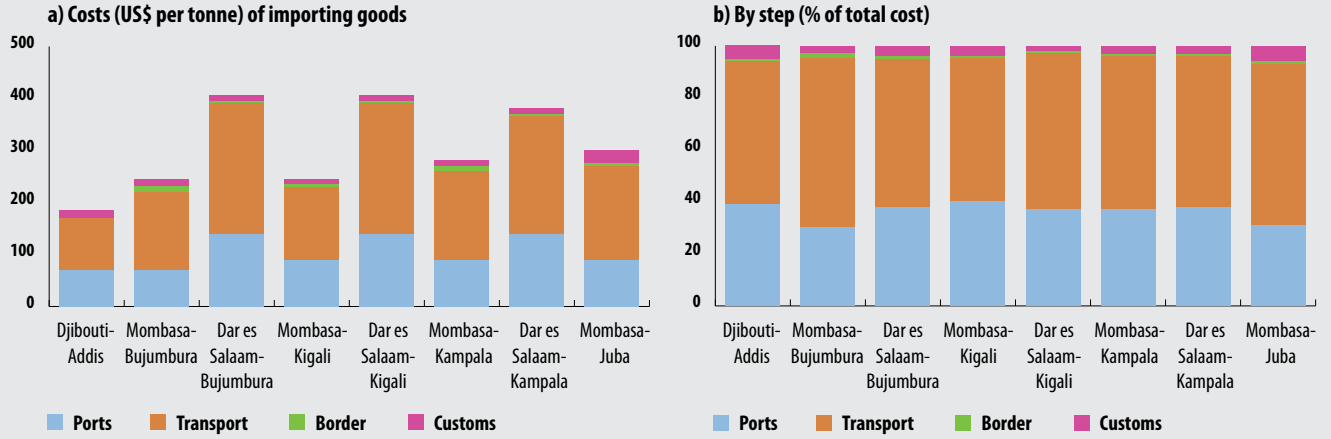
There are significant cost differences among road corridors serving landlocked countries and a strong negative correlation between lower traffic volumes and cost. As the traffic increases, the unit costs of transportation (per tonne) decrease. Costs and times are more significant for the four landlocked East African countries (Ethiopia, Burundi, Rwanda, and Uganda) due to inefficient ports, high freight rates, and delays at borders. Among the road corridors serving landlocked countries, there are significant cost differences. Based on the three main intraregional arteries in East Africa, the cost of importing goods from a landlocked country lies in the range of US$170 to US$370 per tonne-kilometer. Overall, travel to landlocked Burundi, Rwanda, and Uganda is cheaper via the Northern Corridor than via the Central Corridor. For Burundi, the Northern Corridor has a competitive edge over the Central Corridor. This is striking because Bujumbura is closer to Dar es Salaam than to Mombasa (AICD, 2011: 16). Port times generally constitute 50–80% of the total time required to move imports to landlocked countries. Similarly, costs at ports and high transportation rates constitute more than 90% of the total cost of importing goods (see Figures 14 and 15).

Figure 14: Time required to import goods by road through alternative gateways



Source: Data collected from World Bank, 2008; Nathan Associates, 2010; and AICD ports database.

Figure 15: Cost of importing goods by road through alternative gateways



Source: World Bank, 2008; Nathan Associates, 2010; and AICD ports database.

The Nairobi–Thika Superhighway: a successful interregional road project

The 50-km Nairobi–Thika superhighway is a positive example of a large project undertaken jointly by different actors in order to improve the regional road infrastructure. The area covered lies within the Nairobi Metropolitan and Central Province, including large sections of the City and Thika district. The superhighway is an important part of the regional and continental transport corridor from Cape Town, South Africa to Cairo, Egypt.

The project's total cost amounted to US$ 360 million, of which US$180 million was provided by the African Development Bank. The Kenyan Government contributed US $80 million and the EximBank of China US$100 million.

The superwayhigh will serve approximately 1 million people who live along the road network. The main beneficiaries comprise commuters who travel daily to the Central Business District e.g. workers, students, shoppers, and traders. It will reduce the time taken for goods to reach urban markets and so enhance the supply chain.

The superhighway's major impact will be to reduce transport costs and journey times in the region. The time taken to traverse Thika town and Nairobi has fallen from two to three hours to 30-45 minutes (AfDB, 2012). The project will contribute to transforming the country into an economic hub and will boost trade with other countries in the region.

NAIROBI (Xinhua) – The Nairobi-Thika Super Highway in Kenya which was officially opened by President Mwai Kibaki in November 2012 . XINHUA PHOTO – DING HAITAO

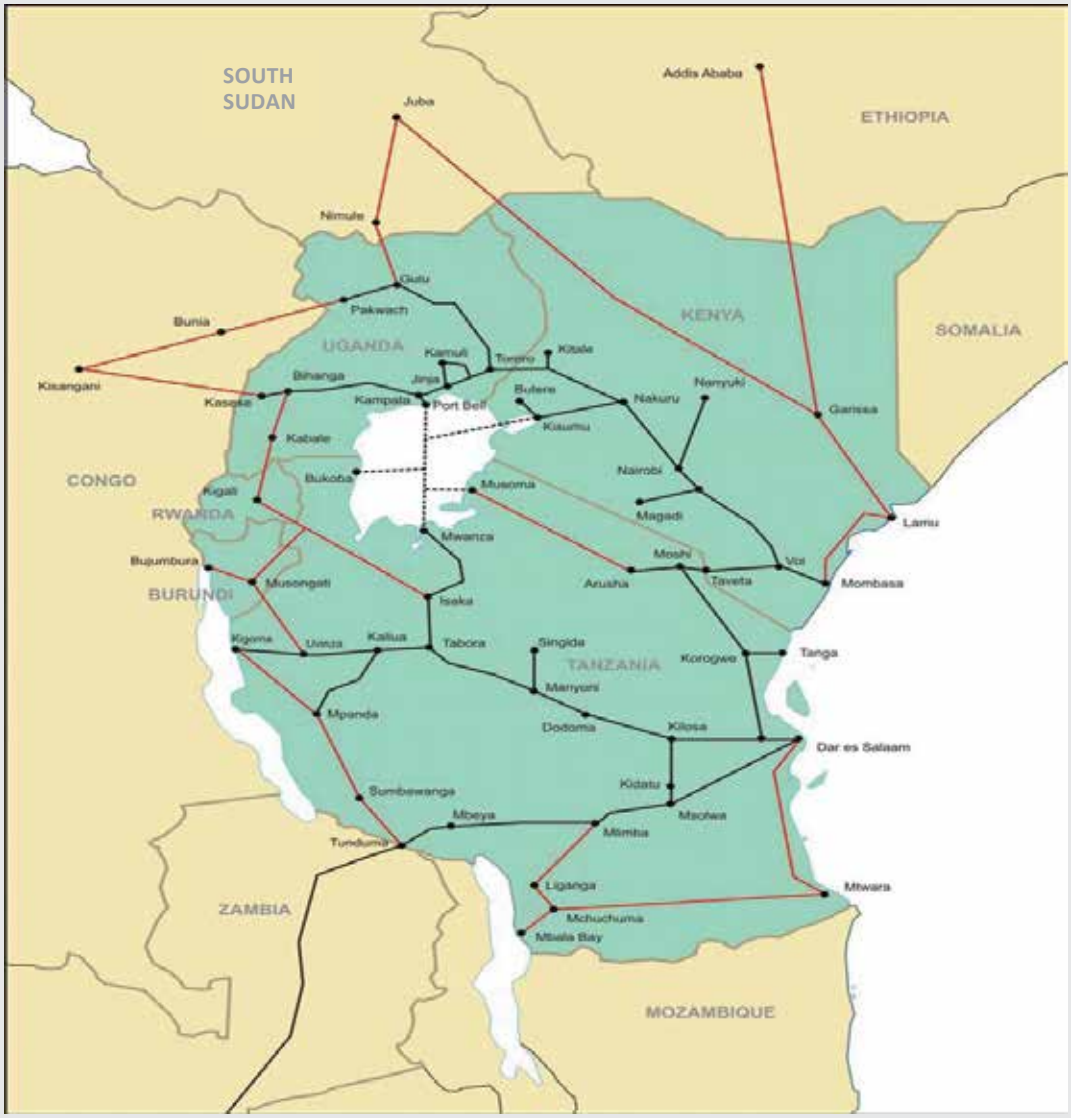
An aerial view of Thika Highway, Nairobi, Kenya.

4.3 Railroads

Except for Tazara, there is no effective regional railroad network within East Africa. Furthermore, the existing rail networks are very lightly used, which hinders regional integration. The national rail networks of the East African member states are mostly independent of one another, again with the exception of Tazara, which is linked into the southern African network. This situation poses a stark contrast to that in Southern Africa, where national railroad systems form a regional network that spans half a dozen countries. Further integration of East Africa's rail systems is complicated by the use of different gauges in the subregion. Only three of East African railroad lines span more than one country.

Poor operational performance (with the exception of Tazara and the Tanzania

Figure 16: EAC current rail network with proposed new lines



Legend:
- **Current Railway Line:**
- **Proposed Railway Line:**
- **Ferry**

Source: East African Community Infrastructure (2013).

Railways Corporation), together with light use of existing rail networks, makes the economic case for integration in the rail sector less cogent. The more pressing priority is to improve the performance of national systems to allow them to compete more effectively with road transportation (AICD, 2011: vi).

4.4 Ports

East African ports substantially increased their container and general cargo traffic between 1995 and 2005. The average annual rate of growth of container traffic and general cargo traffic through East African ports during this period was 10.7% and 10.8% per year, respectively (AICD, 2011: 21). However, East African ports do not compare favorably with those of Southern Africa, and even less so with global best practice, in terms of performance and charges (see Table 14). The services provided by East African ports are nearly twice as expensive as those in other global ports.

Table 14: Comparative performance across East African ports and African subregions

Performance Indicator	Djibouti	Mombasa	Port Sudan	Dar es Salaam	East Africa	Southern Africa	West Africa	Global Best Practice
Container dwell time (days)	8	5	28	7	5-28	4-8	11-30	<7
Truck processing time (hours)	12	5	24	5	4-24	2-12	6-24	1
Container crane productivity (container per hour)	17	10	8	20	8-20	8-22	7-20	20-30
Charges								
Container cargo handling charge (US$ per TEU)	135	68	150	275	135-275	110-243	100-320	80-150
General cargo handling charge (US$ per tonne)	8	7	10	14	6-15	11-15	8-15	7-9

Source: AICD, 2011: 24.

Owing to the rapid expansion of traffic, a few of the subregion's ports are experiencing capacity constraints and congestion. The international standard for port dwell time is seven days or less. However in East Africa, containers routinely spend more than a week in the terminal. The result is congestion and port inefficiency. This is most notable in the case of Mombasa and Dar es Salaam, where the volume of general cargo and container traffic significantly exceeds design capacity. Port Sudan is also experiencing capacity constraints with respect to container traffic. All three of these ports are also reaching their limits with respect to dry-bulk cargo. There is some scope for easing capacity constraints by improving the efficiency of port performance, although ultimately new investments will be required (AICD, 2011: 21).

Performance of individual ports in East Africa varies (see Table 14). Mombasa and Dar es Salaam exhibit generally good performance that is within global best practices on some indicators. On the other hand, Port Sudan and Djibouti exhibit much lower port efficiency levels.

The capacity constraints faced at the ports of Mombasa and Dar es Salaam, coupled with extremely lengthy import and export procedures, add considerably to the time required to clear goods. The long detention of goods in port has become a major obstacle to distribution and a major contributor to logistics costs, thereby impeding trade.

5. Information and Communications Technology

EAST AFRICA'S ICT sector is characterized by high costs and low penetration. However, a trend of falling prices and higher penetration has been observed, particularly where there is access to submarine cables. The most pressing issue for the subregion is to complete the fiber-optic backbone and provide broader coverage to all of East Africa. Around 3,565 kilometers of fiber-optic cable is needed to complete the network. This represents a major investment of US$96 million but promises high rates of return, particularly for Sudan (116%) and Uganda (304%).

5.1 Overview

East Africa has the highest costs and lowest penetration of internet services among all the African subregions, while the density of fixed-line telephone users and mobile users is among the lowest in Africa. Per 100 inhabitants, EAC has 0.02 broadband subscribers, 0.05 internet subscribers, and 21 mobile telephone subscribers (see Table 15). However, recent 2011 data from the International Telecommunication Union (ITU) shows that mobile penetration doubled between 2008 and 2011, due to improvements in service provision.

Within East Africa there is strong GSM coverage around Lake Victoria – spanning Rwanda, Uganda, and Kenya. Coverage in Burundi, Sudan and Tanzania is less extensive but good. Ethiopia stands out for its low mobile coverage and penetration. The density of internet and broadband subscribers, and international internet bandwidth are generally low across East Africa, but they are particularly low in Burundi (see Table 16).

Table 15: Access and pricing in the ICT sector by regional economic community

Indicator	CEMAC	ECOWAS	COMESA	EAC	SADC
Broadband subscribers (per 100 inhabitants)	0.01	0.03	0.04	**0.02**	0.36
International Internet bandwidth (per capita)	11	16	9	**11**	19
Internet subscribers (per 100 inhabitants)	0.06	0.24	0.09	**0.05**	0.53
Main telephone lines outside largest city (per 100 inhabitants)	0.2	0.39	0.53	**0.24**	1.89
Mobile telephone subscribers (per 100 inhabitants)	22	25	12	**21**	31
Prices (US$)					
Prepaid mobile monthly price basket	15.11	14.04	9.09	**12.18**	11.32
Price of a 3 minute call to USA	5.68	0.83	2.2	**1.37**	1.5
Price of the 20 hour Internet basket	67.97	79.98	50.91	**95.7**	75.6
Price of the fixed telephone monthly price basket	12.59	9.35	6.85	**13.33**	13.27

Source: AICD, 2011: 48

Table 16: Access in the ICT sector, by country

	Burundi	Kenya	Rwanda	Tanzania	Uganda	Ethiopia	Sudan
Coverage of mobile network (% of population)	60	92	90	60	97	10	70
Mobile telephone subscribers (per 100 inhabitants)	3.17	30.23	6.98	20.92	18.25	1.64	20.04
Internet subscribers (per 100 inhabitants)	0.01	0.04	0.03	0.09	0.03	0.03	0.11
Broadband subscribers (per 100 inhabitants)	0.00	0.05	0.03	0.00	0.01	0.00	0.11
International Internet bandwidth (Mbps)	4	885	31	200	344	245	705

Source: AICD, 2011: 49.

Prices vary widely among the countries. Telecom services in Ethiopia and Sudan are generally cheaper than the EAC countries. Most recent estimates for mobile prices range from less than US$3 per month for a standard basket of services in Ethiopia and Sudan to almost US$18 per month in Kenya. The median price for a standard basket of services in the subregion is around US$9. The price of dial-up service reveals wide variation (by up to a factor of 10) across countries, ranging from US$15 per month in Ethiopia to US$148 per month in Tanzania (see Table 17).

There are also substantial differences in call rates between the countries. In the EAC, the cost of international calls to another EAC country substantially exceeds that of international calls to the US. The difference is as much as 14 cents per minute in Kenya and 19 cents in Tanzania. Internet prices also generally remain high in the EAC due to the lack of submarine cables.

The most pressing issue for the region is to complete the fiber-optic backbone to improve the GSM coverage and reduce the price discrepancy between EAC and broader East Africa.

Table 17: Pricing in the ICT sector by country (US$)

	Burundi	Kenya	Rwanda	Tanzania	Uganda	Ethiopia	Sudan
Prepaid mobile monthly price basket	11.5	17.8	11.5	9.5	9.2	3.6	3.8
Price of a 3 minute call to USA	2.4	1.8	1.3	0.7	1.4	3.3	1.3
Price of the 20-hour Internet basket	52.0	82.0	85.0	148.0	58.0	15.0	29.0
Price of fixed telephone monthly price basket	2.5	19.4	7.8	11.3	13.2	1.7	4.5

Source: AICD, 2011: 49.

Given that fixed-line services have largely been overtaken by mobile services in East Africa, the regional availability of roaming arrangements on mobile tariffs is in many ways much more relevant than the level of international fixed-line tariffs. East Africa pioneered borderless mobile roaming, with free incoming calls and local tariffs. But so far only limited progress with intraregional roaming has been achieved, particularly connecting Kenya–Tanzania, Kenya–Uganda, Uganda–Rwanda and Uganda–Tanzania. Regional cooperation has been partly introduced through the incumbent telecom operators. The East African Regulatory Post and Telecommunications Organization (EARPTO), an EAC regulatory body, is less active than similar subregional organizations, although it has made some progress.

Foreign investment has contributed to connectivity and service enhancement, particularly when the same investor is involved in different countries. For example, Zain offers attractive mobile prices for its subscribers roaming between Kenya, Tanzania, and Uganda. Collaboration over mobile roaming and fiber-optic connectivity between Rwandatel and Uganda Telecom has also been facilitated by common ownership (AICD, 2011: 51).

Opening up the telecommunications market has also resulted in price decreases, particularly in Kenya. This has led the way in East Africa for the establishment of gateways with licenses for multiple mobile operators and to cheaper international call tariffs (World Economic Forum, 2007).

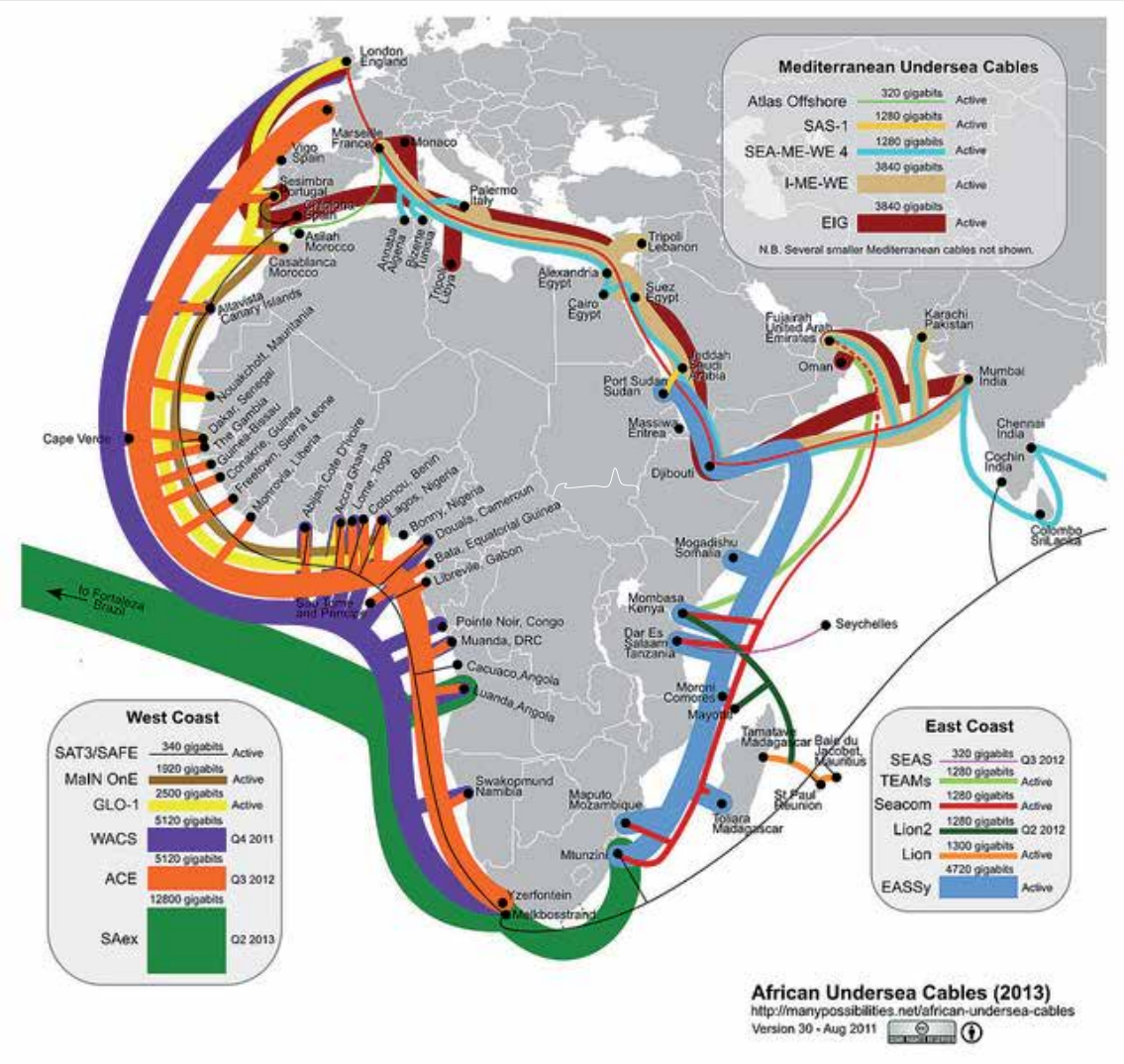
New ICT Park at Konza in Nairobi

5.2 Submarine cable access

For years, EAC suffered from a shortage of international connectivity, due to its lack of undersea fiber-optic cables. As at 2007, most of the EAC countries lacked access to submarine cables (Ethiopia and Sudan have gained access for some time through SAS-1). However, since 2009 this situation has been changing with the advent of three new cable systems: SEACOM (South Africa–East Africa–South Asia–Fiber Optic Cable), The East African Submarine Cable System (EASSy) and the TEAMS cable, linking the United Arab Emirates and Kenya (see Figure 17). The installation of these new submarine cables is spurring upgrades and the expansion of domestic backbones and cross-border agreements for onward transmission throughout the region (AICD, 2011: 52).

Experiences from Sub-Saharan Africa show that countries with submarine cable access enjoy greater benefits, e.g. lower prices and improved connectivity speeds. Moreover, these become even higher if there is competitive access to the gateway (see Table 18). Experience from other African countries suggests that connecting a country to a submarine cable can reduce the costs of broadband Internet by as much as 75%. Not only does this bring substantial savings to existing broadband users, but the substantial price reduction generally induces additional uptake of the broadband service (AICD, 2011: 55).

Figure 17: Mediterranean Undersea Cables



Source: *http://www.flickr.com/photos/ssong/6025279006/in/photostream/*

Table 18: Comparison of Internet and phone charges in Sub-Saharan Africa, with and without access to submarine cables

	Share of countries (%)	Price per minute for a call within Sub-Saharan (US$)	Price per minute for a call to US (US$)	Price for 20 hours per month of dial-up Internet access (US$)
No access to submarine cable	67	1.34	0.86	67.95
Access to submarine cable	32	0.57	0.48	47.28
Monopoly international gateway	16	0.70	0.72	37.36
Competitive international gateways	16	0.48	0.23	36.62

Source: AICD, 2011: 53.

Table 19: Investment needs to complete gaps in East Africa's fiber-optic backbone

Region/Country	Gap (km)	Investment (US$ mn)
East Africa	3,565	96
Burundi	90	2
Ethiopia	408	11
Kenya	894	24
Rwanda	198	5
Sudan	670	18
Tanzania	1,220	33
Uganda	85	2

Source: AICD, 2011: 55.

5.3 Intraregional connectivity: completing the fiber-optic backbone network

To complete the regional fiber-optic backbone network in East Africa and obtain full intraregional connectivity, around 3,565 kilometers of new fiber-optic links are needed. This translates into a required investment of US$96 million. Tanzania and Kenya would account for 60% of the total investment needs (see Table 19).

The benefits of completing regional integration of ICT networks would be substantial relative to the modest costs. The overall benefits are estimated at US$53 million per year for the subregion, against a one-time cost of $96 million. As shown in Table 20, completing East Africa's regional fiber-optic network promises high rates of return, particularly for Sudan (116%) and Uganda (304%). The bulk of the benefits would derive from the addition of new broadband users. Regional integration is therefore a positive business prospect for broadband service providers (AICD, 2011: 55).

Table 20: Expected rates of return to selected East African countries from expanding the fiber-optic network in the subregion

	Broadband price (US$/mo.)		Broadband Subscriptions ('000s)		Benefits (US$ mn/yr)	Costs (US$ mn)	Rate of Return (%)
	Baseline 2008	Induced	Baseline 2008	Induced			
Burundi	…	...	0.2	...	...	2	...
Ethiopia	486.5	304.1	0.4	5.5	6	11	59
Kenya	39.8	24.9	3.3	120.9	11	24	46
Rwanda	88	55.0	4.2	6.5	2	5	42
Sudan	23.25	14.5	44.6	354.3	21	18	116
Tanzania	63.56	39.7	6.4	43.5	7	33	22
Uganda	194.37	121.5	4.8	9.1	6	2	304

Source: AICD, 2011: 56.
Note: ... indicates unavailable data.

6. The Africa Infrastructure Development Index (AIDI)

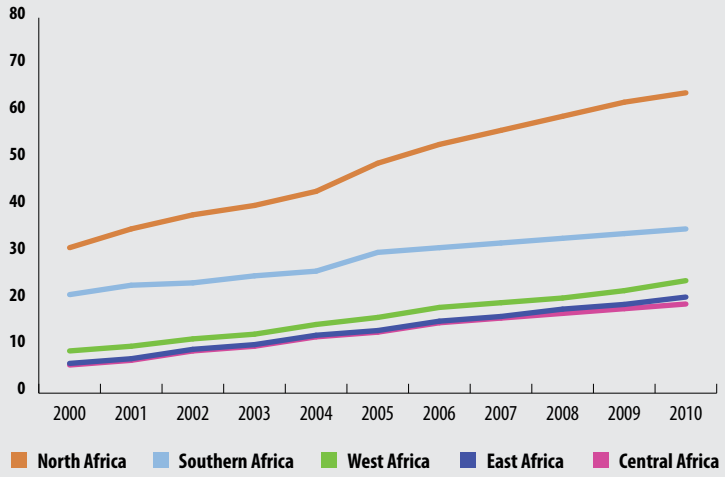
THE AFRICAN DEVELOPMENT Bank has developed an infrastructure index in order to assess the level of infrastructure development across the continent and each of its subregions. The African Infrastructure Development Index (AIDI) is based on five indicators: Net Electricity Generation, Telephone Subscriptions, Paved Roads, Access to improved water, and Access to improved sanitation. The index is a weighted average of the normalization of each of the indicators. The index has been constructed for the period 2000 to 2010 for each African country according to available data.

The index for each subregion is depicted in Figure 18. The East Africa subregion shows a lag in the infrastructure indicators. In the period 2000–2006 it recorded scores similar to those of the Central Africa subregion, but has improved on these in recent years. East Africa still ranks below the other subregions in terms of its infrastructure indicator scores.

The East African Community (EAC) countries of Burundi, Kenya, Rwanda, Tanzania, and Uganda, as well as Sudan and Ethiopia, exhibit different rankings in the index. Figure 19 depicts the disparities among the countries. Ethiopia and Tanzania's indices reveal significant delays in infrastructure supply. These lagging countries also exhibit the poorest results for the continent as a whole. Kenya has improved its infrastructure indicators and this has been translated in an important index upgrade. Yet, the overall performance of the subregion is still poor, despite a positive and improving trend for each of indicators.

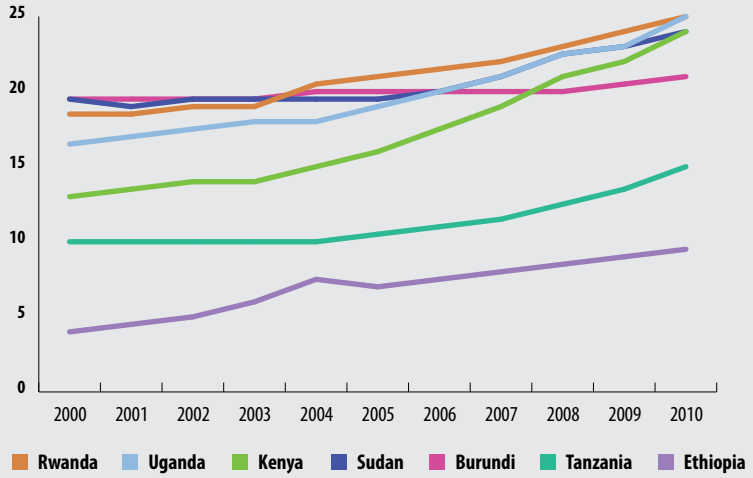
The African Infrastructure Development Index (AIDI) reflects low levels of investment in African infrastructure in past years, especially set against the context of rapid urbanization and growing consumer demands. East Africa is among the lagging subregions in the African continent. In addition, major disparities are evidenced by the index when taken at the country level. However, a more positive trend in the last decade reflects a scaling-up of efforts by each of the countries and the emergence of new investors.

Figure 18: Africa Infrastructure Development Index by subregion



Source: Data from African Development Bank Group, AIDI. Draft.

Figure 19: Africa Infrastructure Development Index, selected countries (EAC)



Source: Data from African Development Bank Group, AIDI. Draft

7. Concluding remarks

EAST AFRICA FACES substantial infrastructure challenges across different subsectors. In recent years, improvements have been made in the access to improved water and sanitation, internet density and road corridors. There are important growth opportunities in productivity-related infrastructure areas – namely, energy production, logistics and ICT. This brief has highlighted the evolution of the subregion in five different infrastructure areas (water & sanitation, electricity, energy production, surface transportation and ICT) in light of updated data and new information.

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