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# **Africa Unplugged:** **Policy, institutional and investment challenges in powering the continent**

African Science Academy Development Initiative (ASADI)  
Improving Access to Energy in Sub-Saharan Africa  
8-10 November 2010, Somerset West

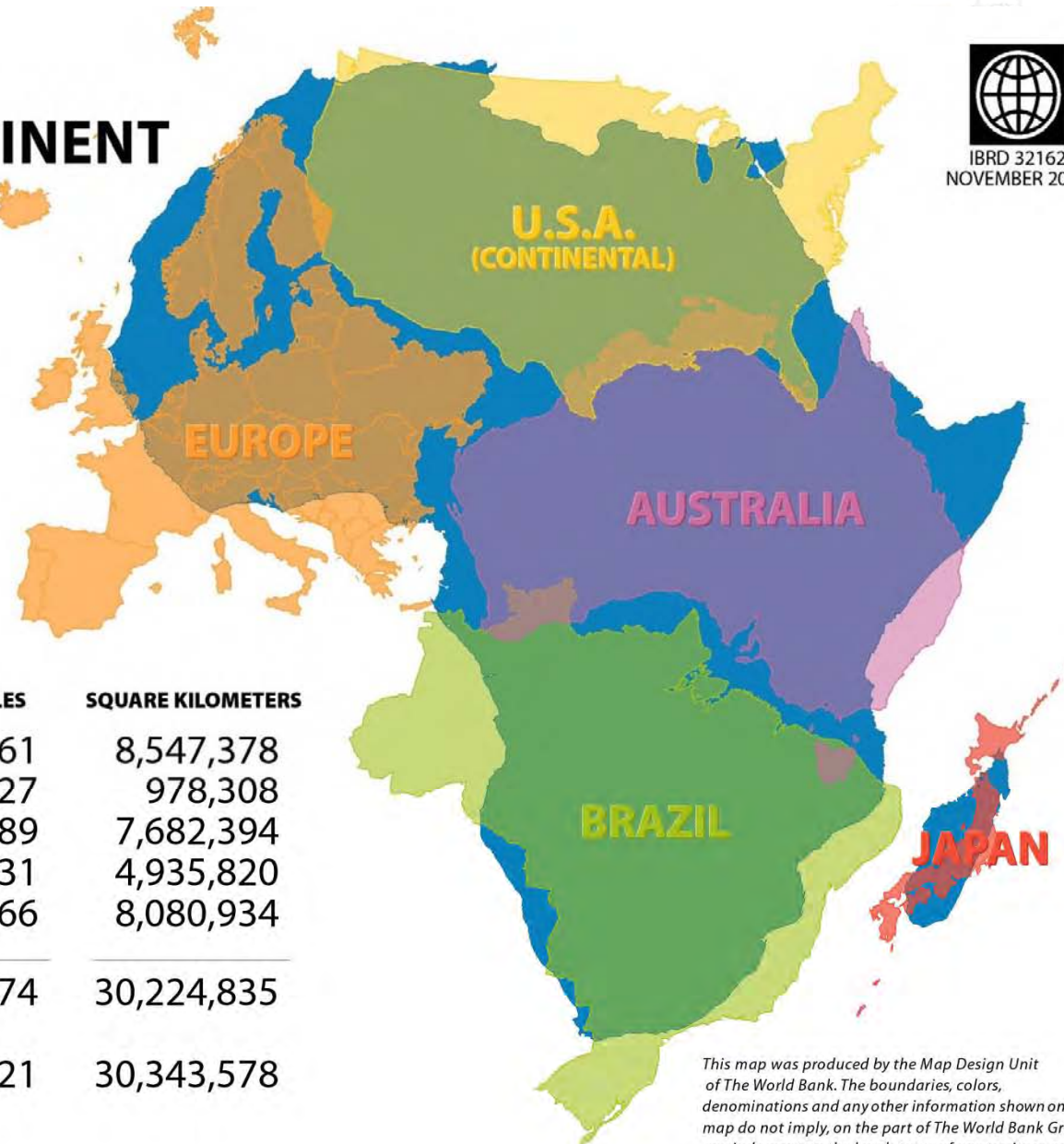
**Prof Anton Eberhard**

*Management Program in Infrastructure Reform and Regulation*  
**University of Cape Town**

# AFRICAN CONTINENT COMPARED TO OTHER LAND MASSES



IBRD 32162  
NOVEMBER 2002



	SQUARE MILES	SQUARE KILOMETERS
BRAZIL	3,300,161	8,547,378
JAPAN	377,727	978,308
AUSTRALIA	2,966,189	7,682,394
EUROPE	1,905,731	4,935,820
U.S.A. (Continental)	3,120,066	8,080,934
<b>TOTAL</b>	<b>11,669,874</b>	<b>30,224,835</b>
<b>AFRICA</b> (including MADAGASCAR)	<b>11,715,721</b>	<b>30,343,578</b>

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## Sub-Saharan Africa

- . **Land area:** Australia, Brazil, Europe, Japan plus USA
- . **Population:** Europe, Japan plus USA
- . **GDP:** less than The Netherlands

## “Average SSA country”

- . **Land area:** around the size of Texas
- . **Population:** similar to Belgium
- . **GDP:** equivalent to mid-sized OECD city

1. Africa's chronic power problems
2. Improving sector performance
3. Investment & financing



African Union



 PPIAF  
PUBLIC-PRIVATE INFRASTRUCTURE ADJUSTMENT FACILITY



 kfw  
ENTWICKLUNGSBANK



 wsp  
Water and sanitation program

 DFID  
Department for International Development

 ICA  
The Infrastructure Corporation of Africa  
The Infrastructure Corporation of Africa

## Africa Infrastructure Country Diagnostic

## Electronic power problems

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- Infrastructure is underdeveloped
- Electricity supply is often unreliable
- Power costs are high,  
subsidies regressive  
and prices barely affordable  
plus hidden costs

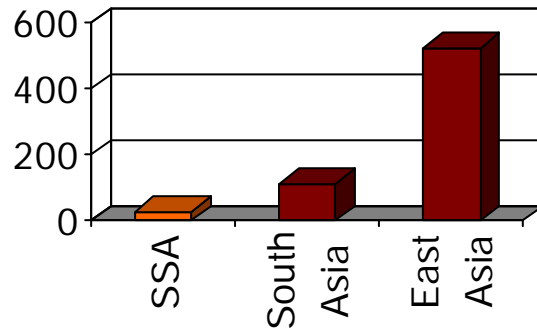
## Structure is underdeveloped

- “ Installed capacity in SSA is 68 GW
  - . Comparable to Spain
  - . Without South Africa falls to 28 GW
- “ Up to a quarter of capacity unavailable
- “ Growth in capacity stagnant
- “ Installed capacity per capita 10% of LA

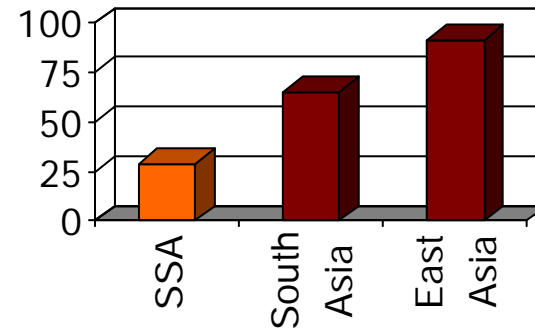
## Structure is underdeveloped

- “ Consumption per capita barely 1% of high-income countries and declining
- “ Large energy resources unexploited, distant from main centers of demand
  - . eg. hydro in DRC & Ethiopia
- “ Few economies of scale
  - . 33 out of 48 countries have <500MW
  - . 11 countries <100MW

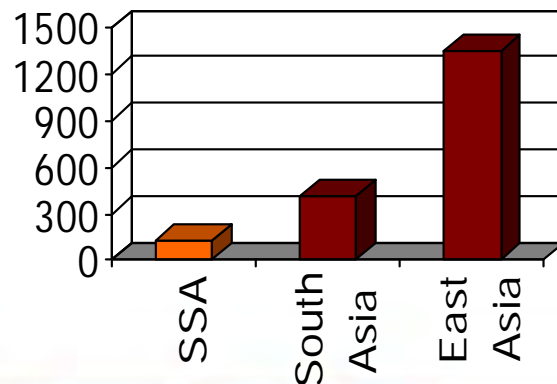
**Generation capacity**  
(MW per million population)



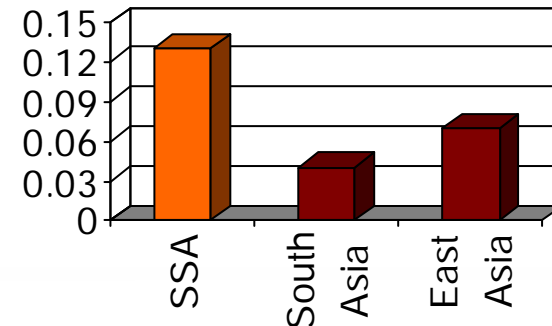
**Electrification rate**  
(Percentage of households)



**Electricity consumption**  
(kWh per capita per year)



**Power prices**  
(US\$ per kilowatt-hour)



Source: Africa Infrastructure Country Diagnostic

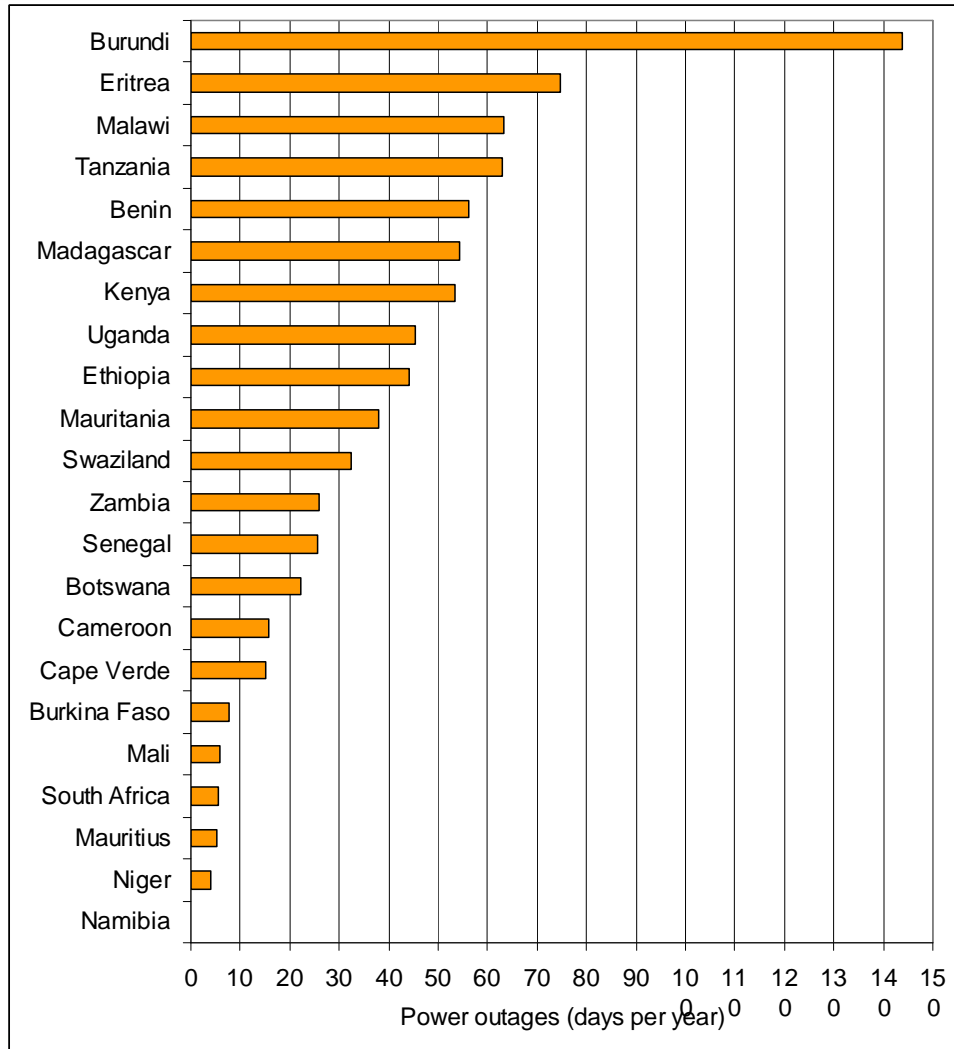


## unreliable

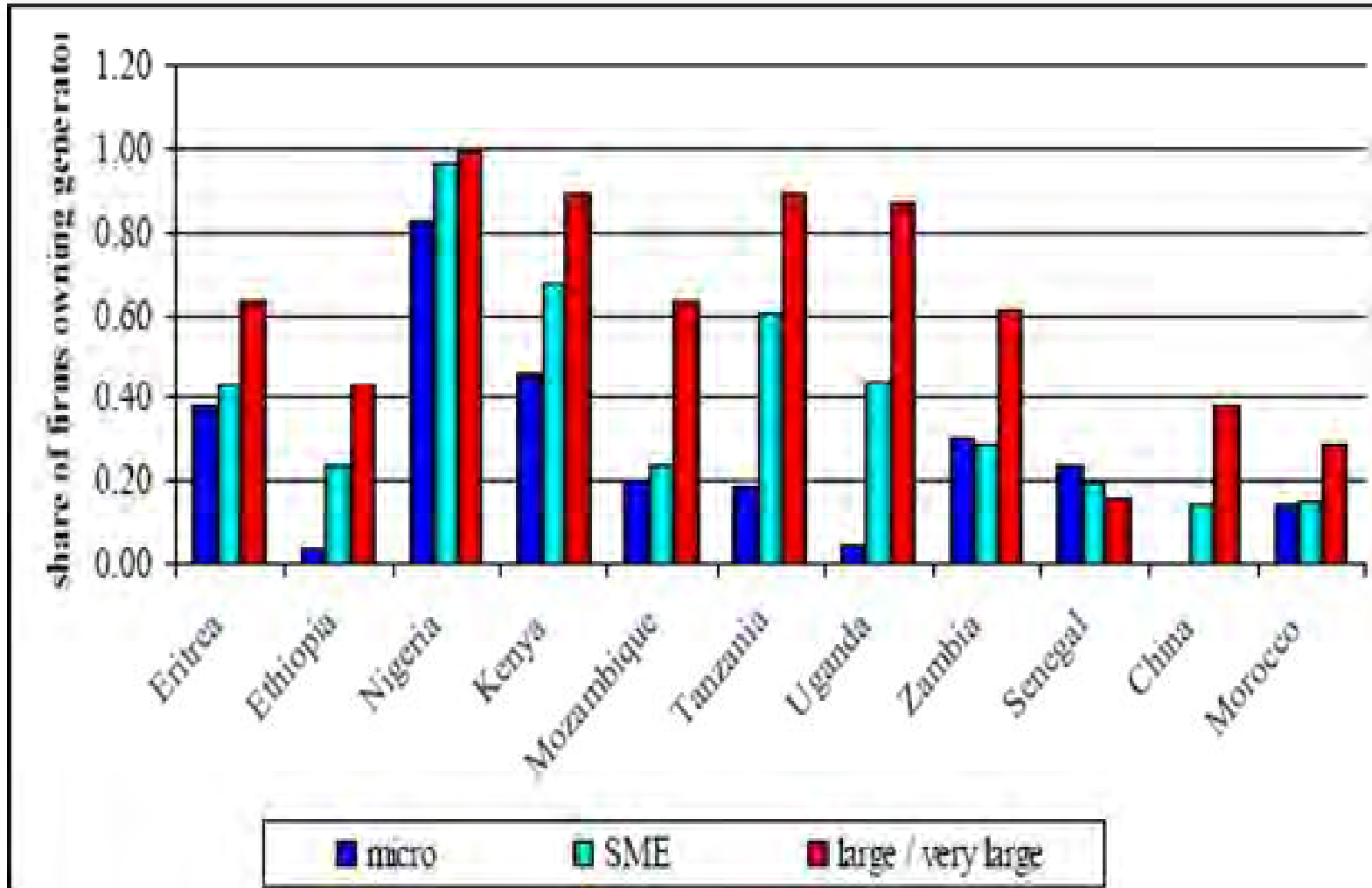
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- “ Insufficient investment in maintenance and new capacity
- “ WB Enterprise surveys reveal average of 56 days per annum with power interruptions
  - . losses in forgone sales and damaged equipment
- “ More than half of large firms have back-up generators
- “ Own-generation now a significant proportion of installed capacity

# lity

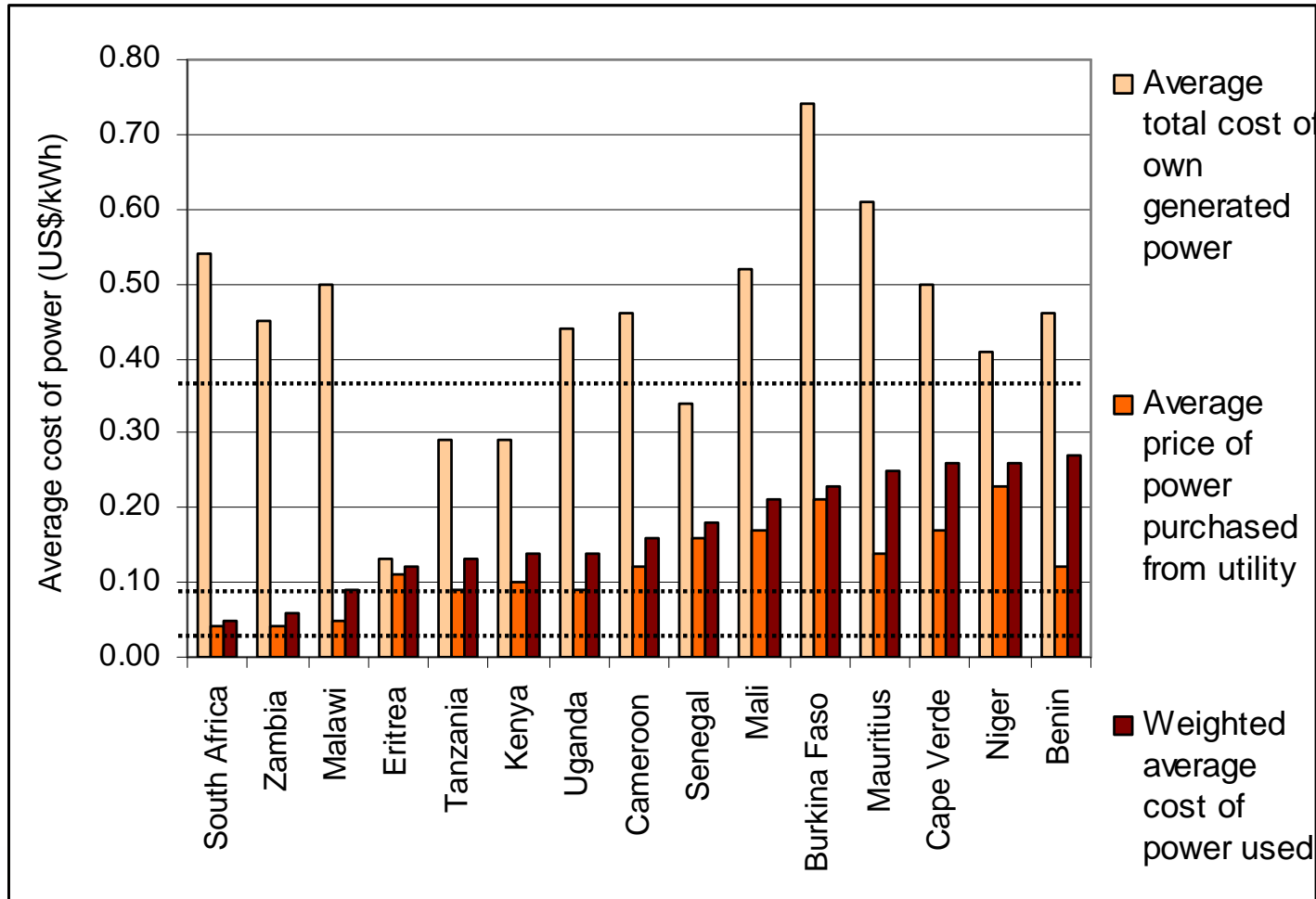


# ses that rely on back-up generation



Source: Estache, 2005, p.31. Evidence from the Investment Climate Assessments

# power costs



Source: Africa Infrastructure Country Diagnostic

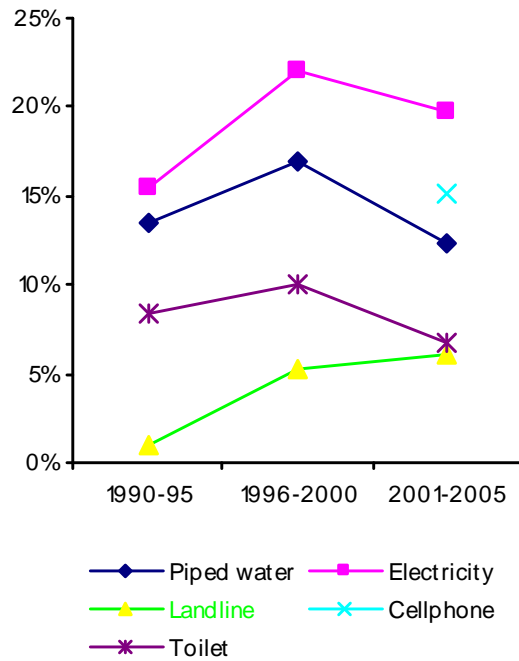
# ess to power



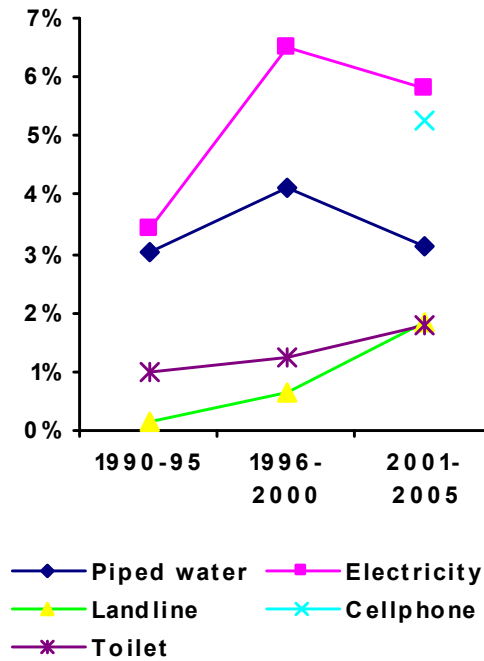
Source: Earthlights, 2000

# Progress over time

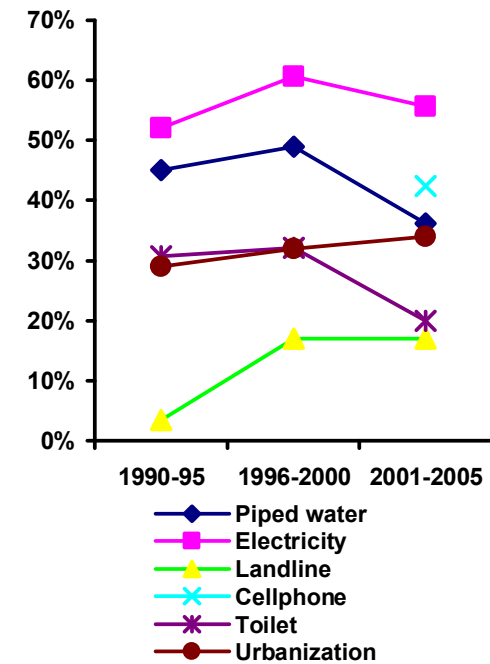
### National



### Rural

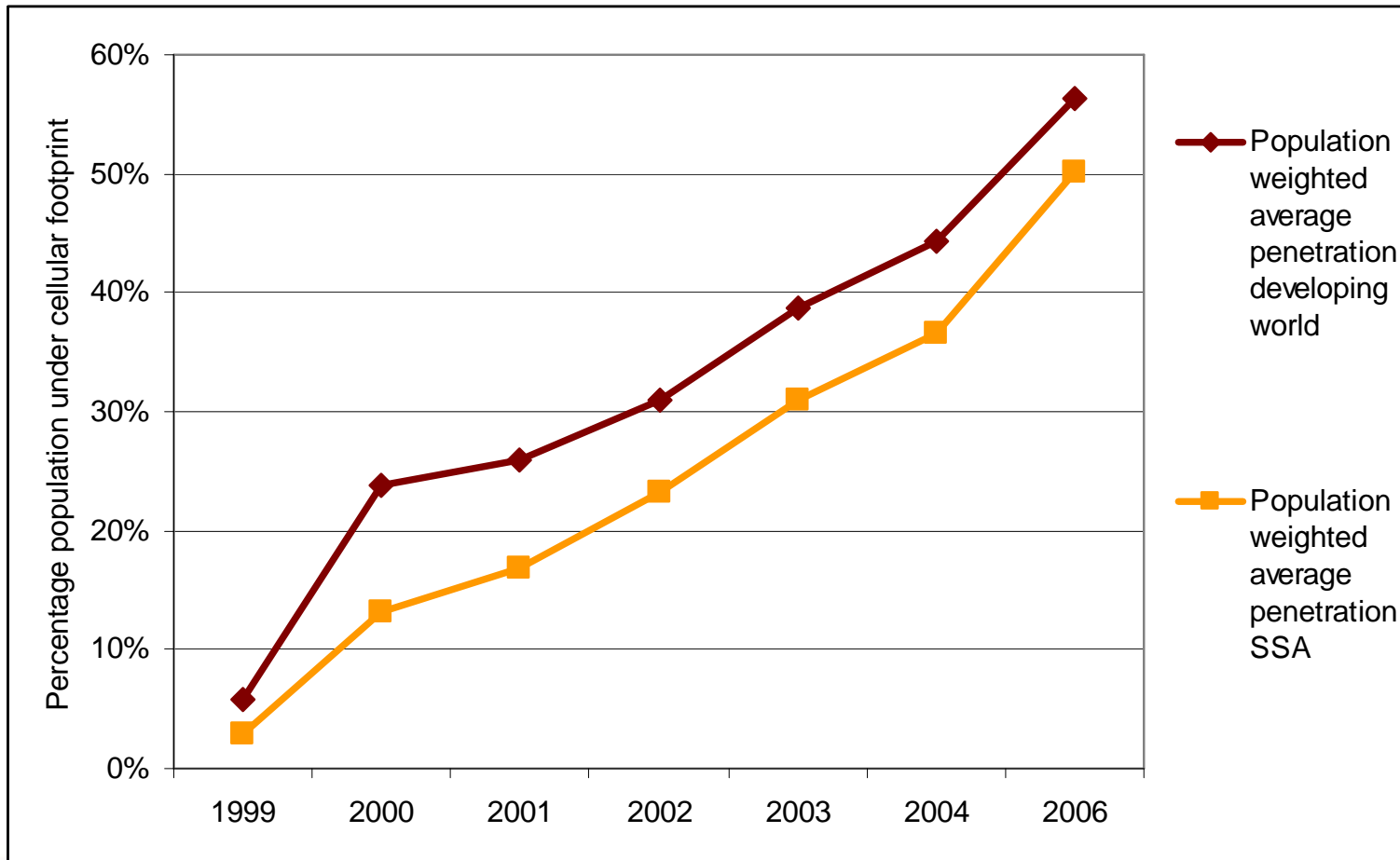


### Urban

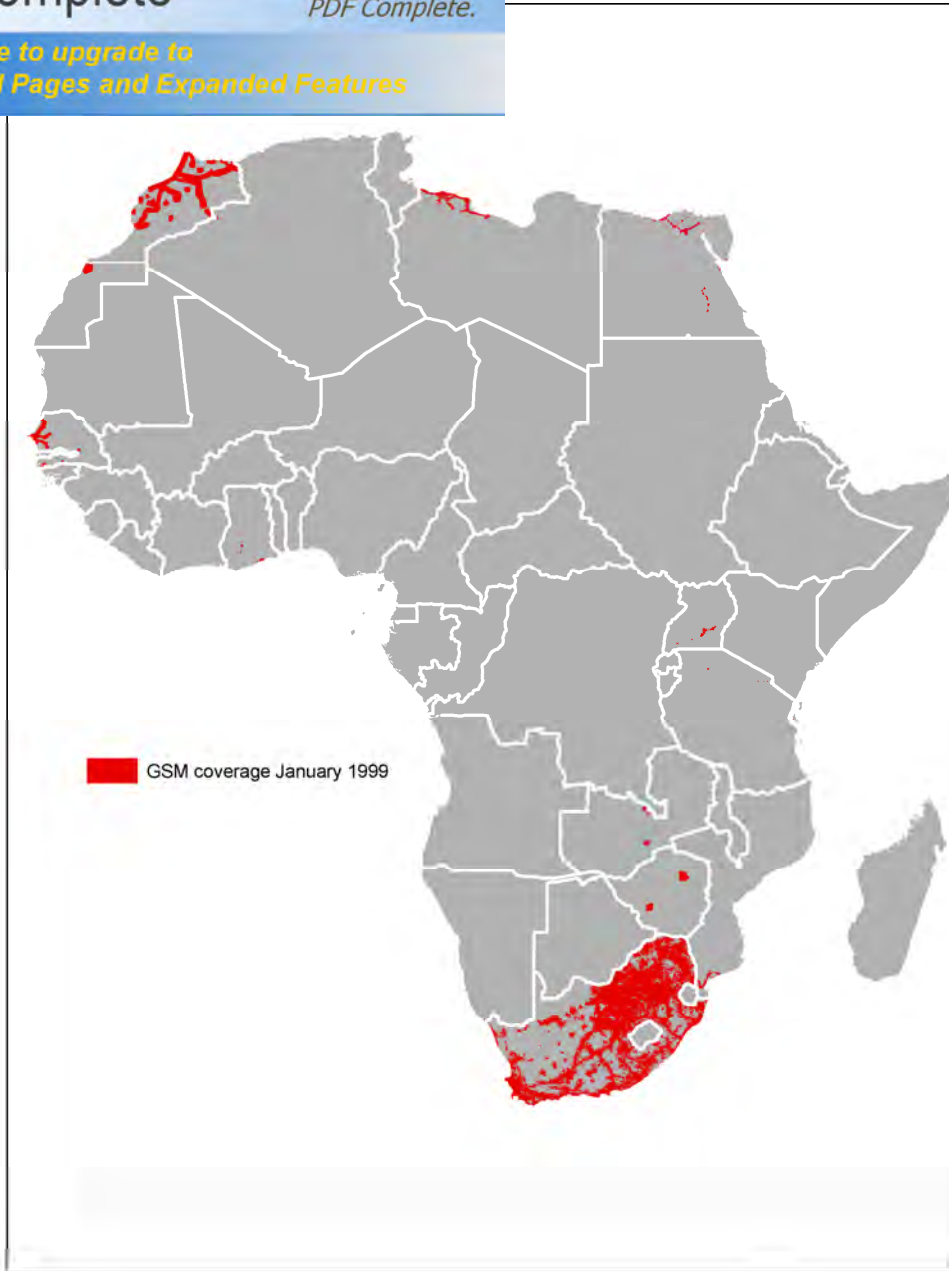


Source: Africa Infrastructure Country Diagnostic, 2007 forthcoming

# growing mobile footprint

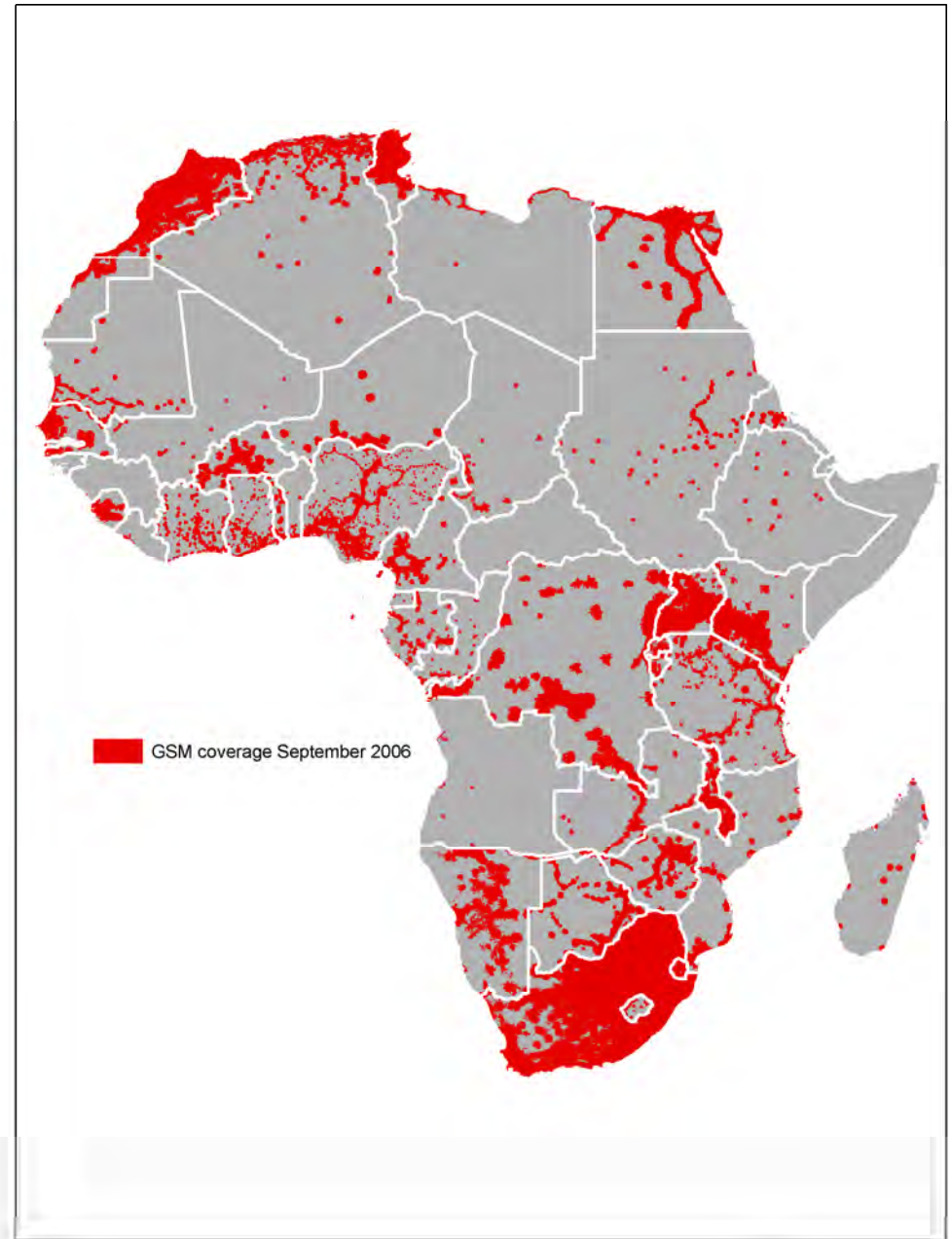
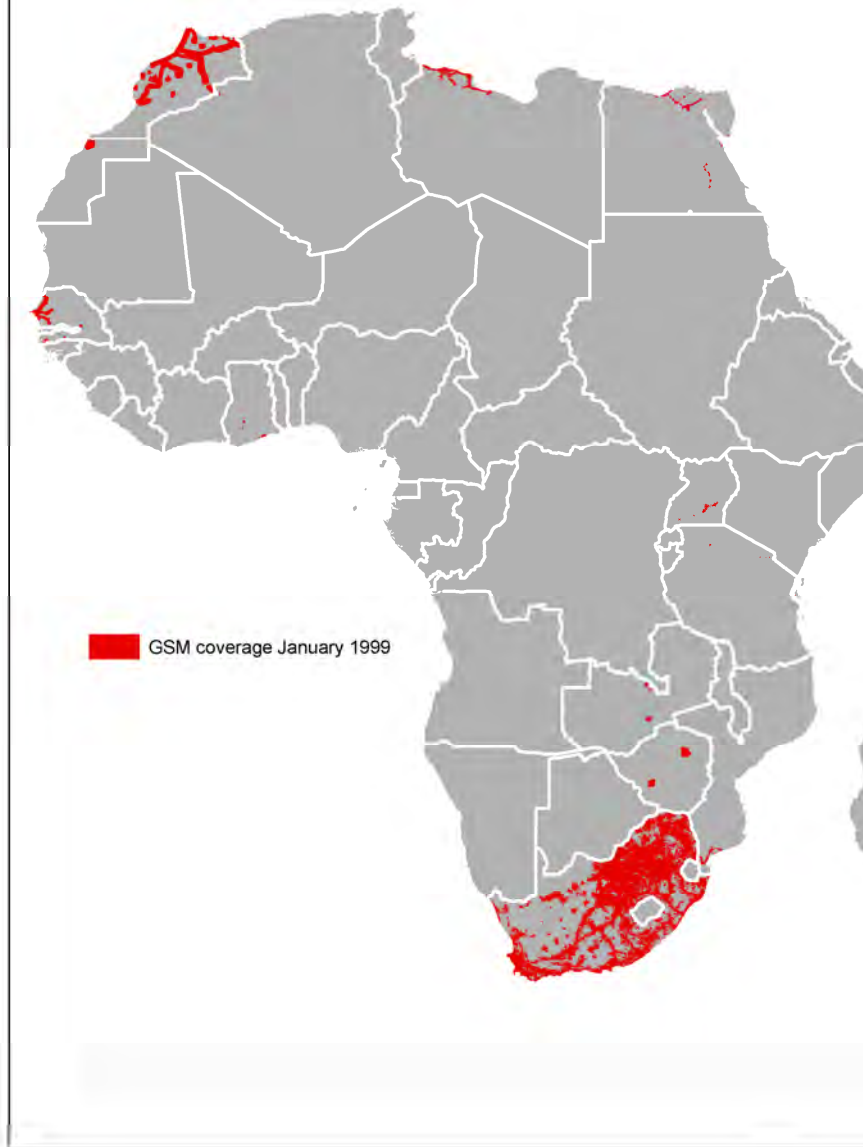


Source: Adapted from GSM Association, 2006

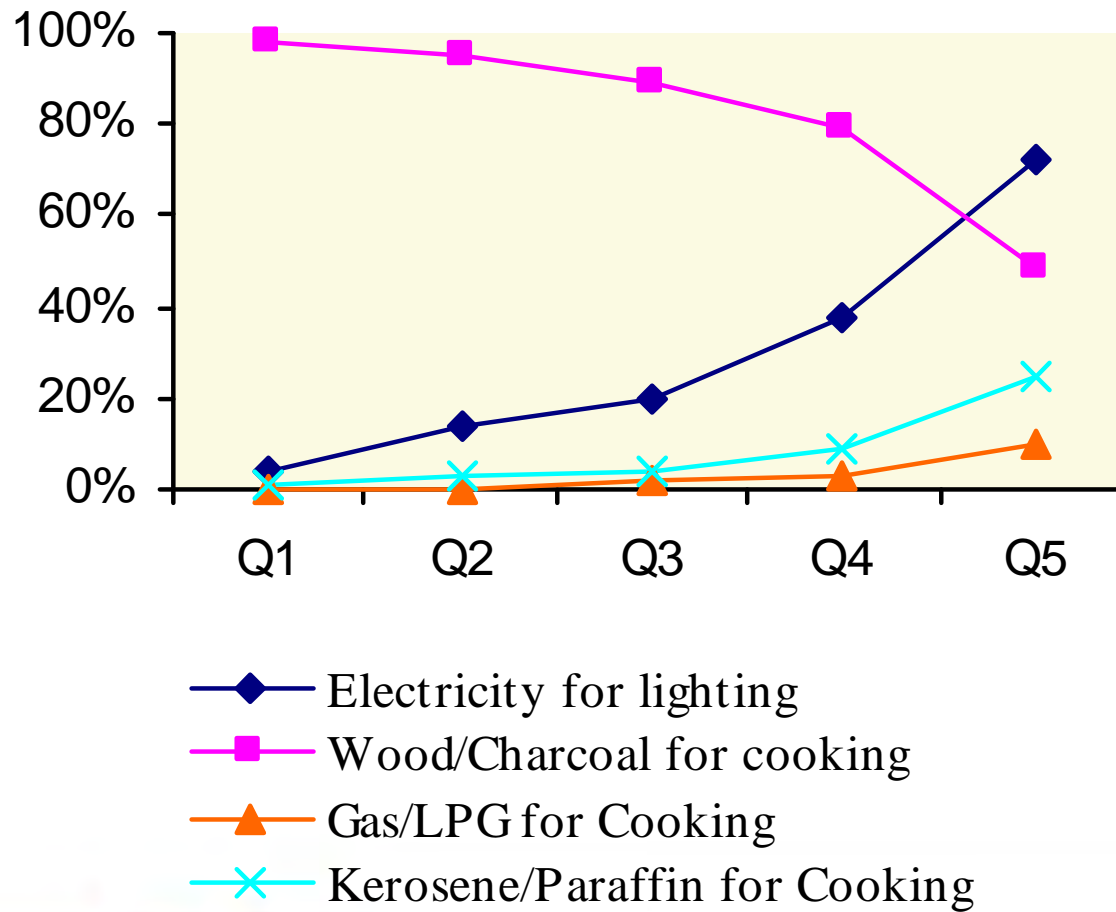


Source: Africa Infrastructure Country Diagnostic



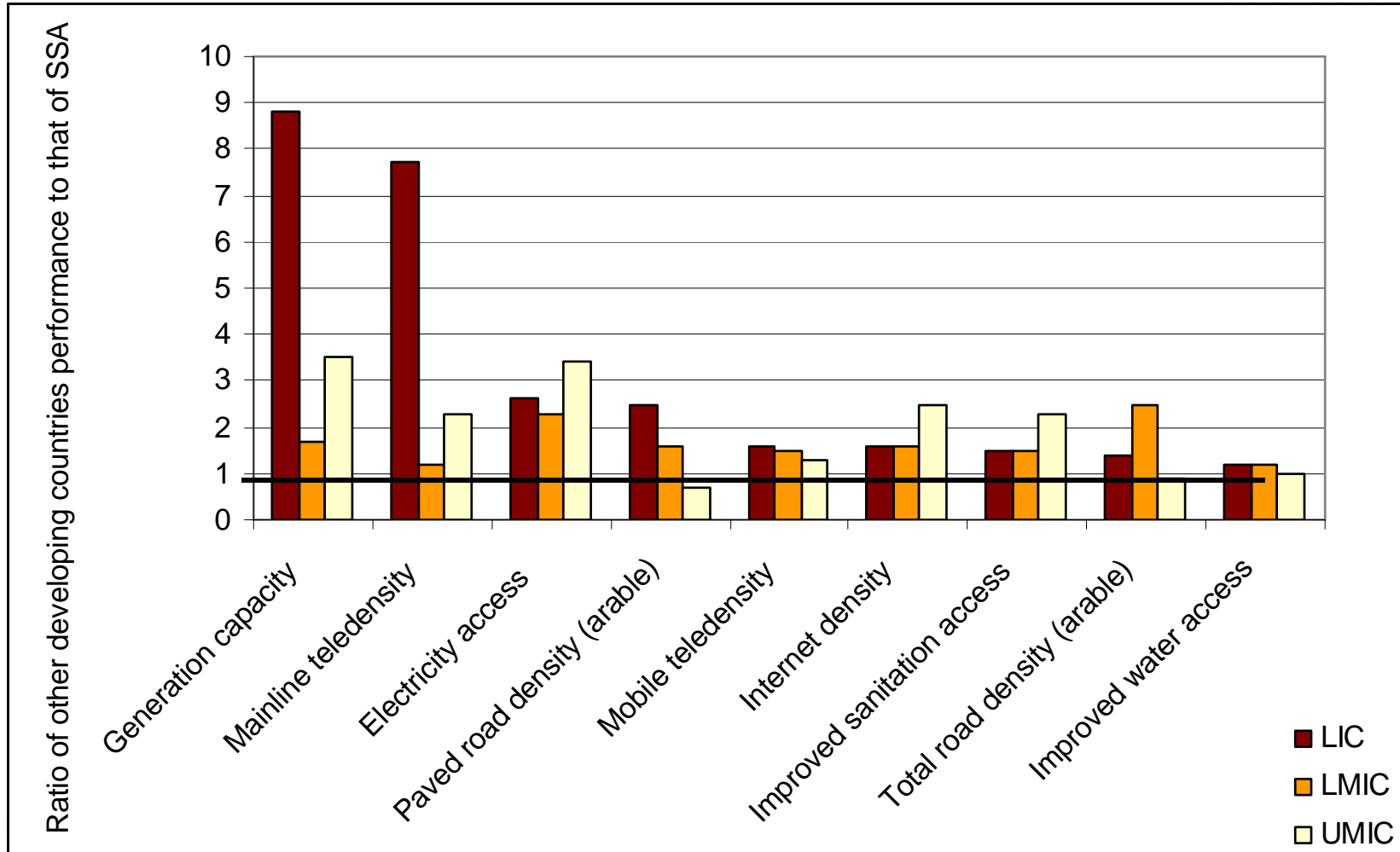


# Energy by income quintile



Source: Africa Infrastructure Country Diagnostic

# Against peers



Source: Africa Infrastructure Country Diagnostic

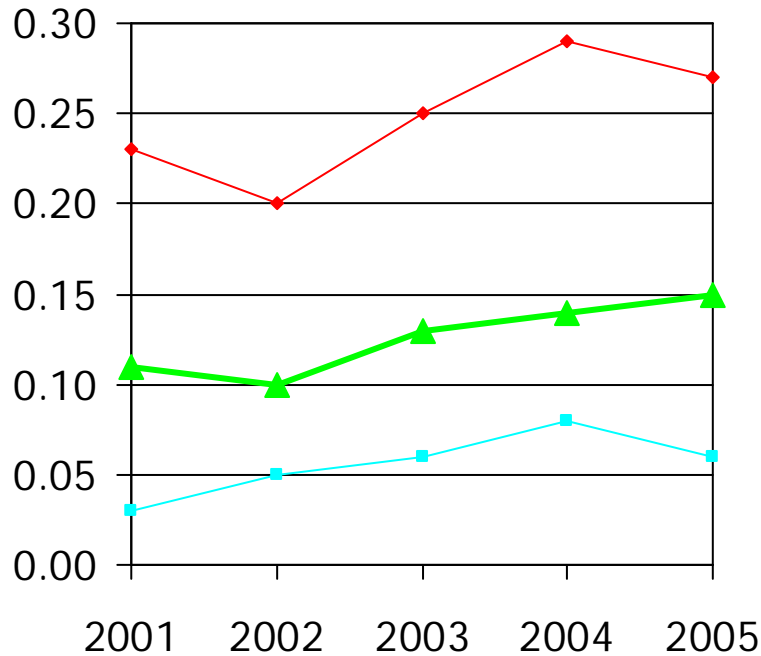
# fallen behind South Asia

	Base Year		Year 2000	
	SSA	SAS	SSA	SAS
Paved arable density	71	477	1,037	670
Total road density	1,525	757	2,556	1,408
Mainline density	4	2	22	21
Generation capacity norm.	71	26	73	137
Improved water access	51	72	63	70
Improved sanitation access	30	31	35	47

Note: Base year varies by sector: roads 1960, ICT 1970, power 1980, WSS 1990

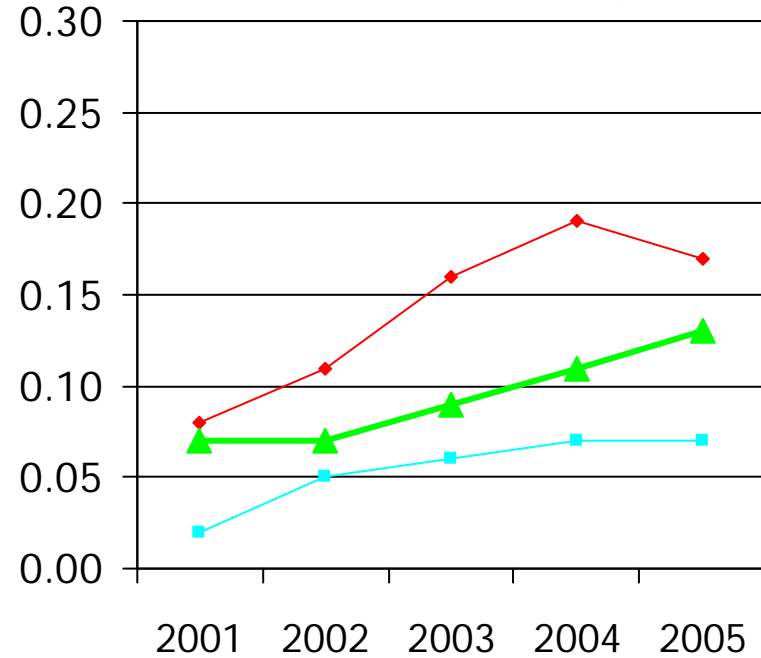
Source: Africa Infrastructure Country Diagnostic

# it insufficient revenues



—◆— Diesel    —■— Hydro    —▲— Overall

**Average operating cost**

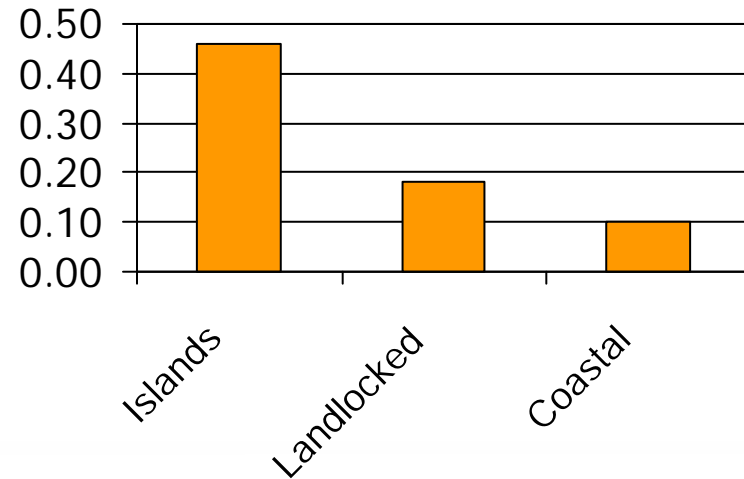
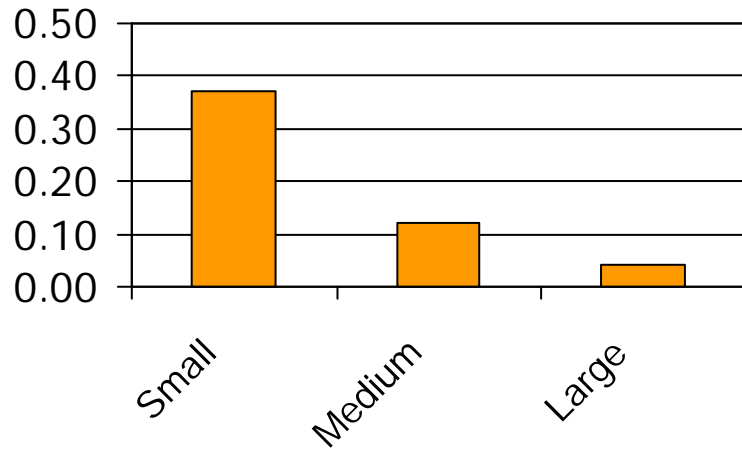
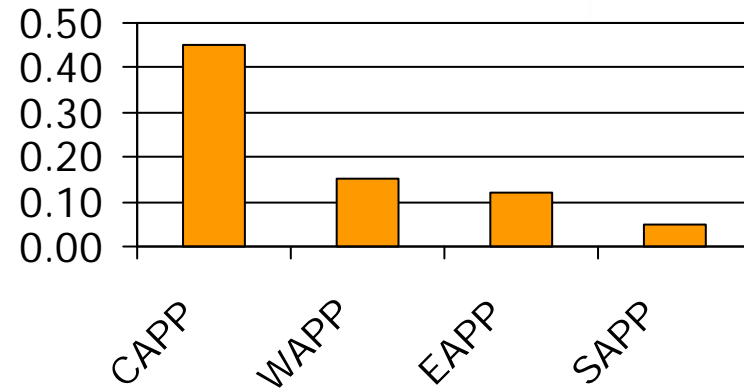
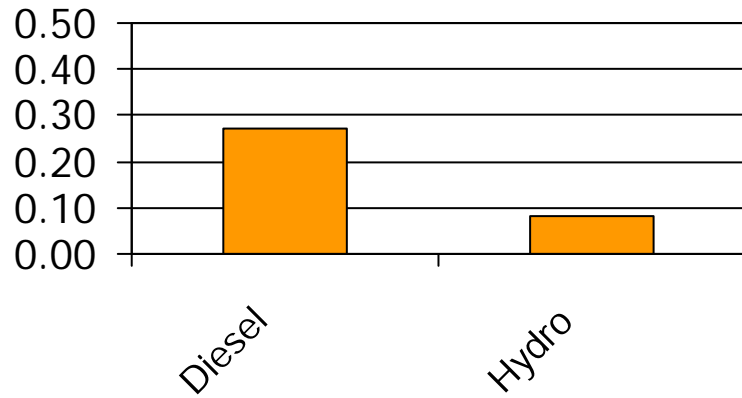


—◆— Diesel    —■— Hydro    —▲— Overall

**Average revenue**

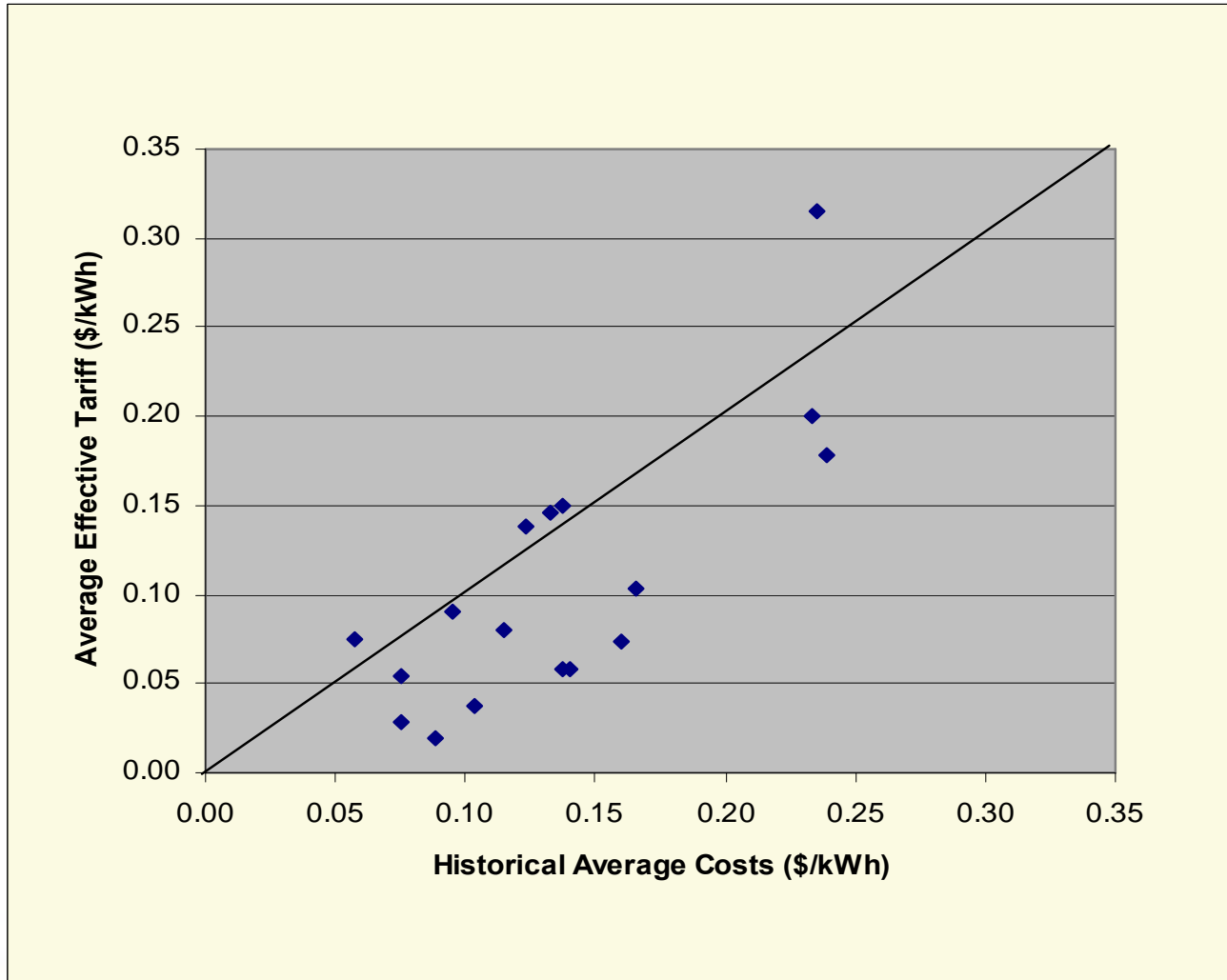
Source: Africa Infrastructure Country Diagnostic

are high



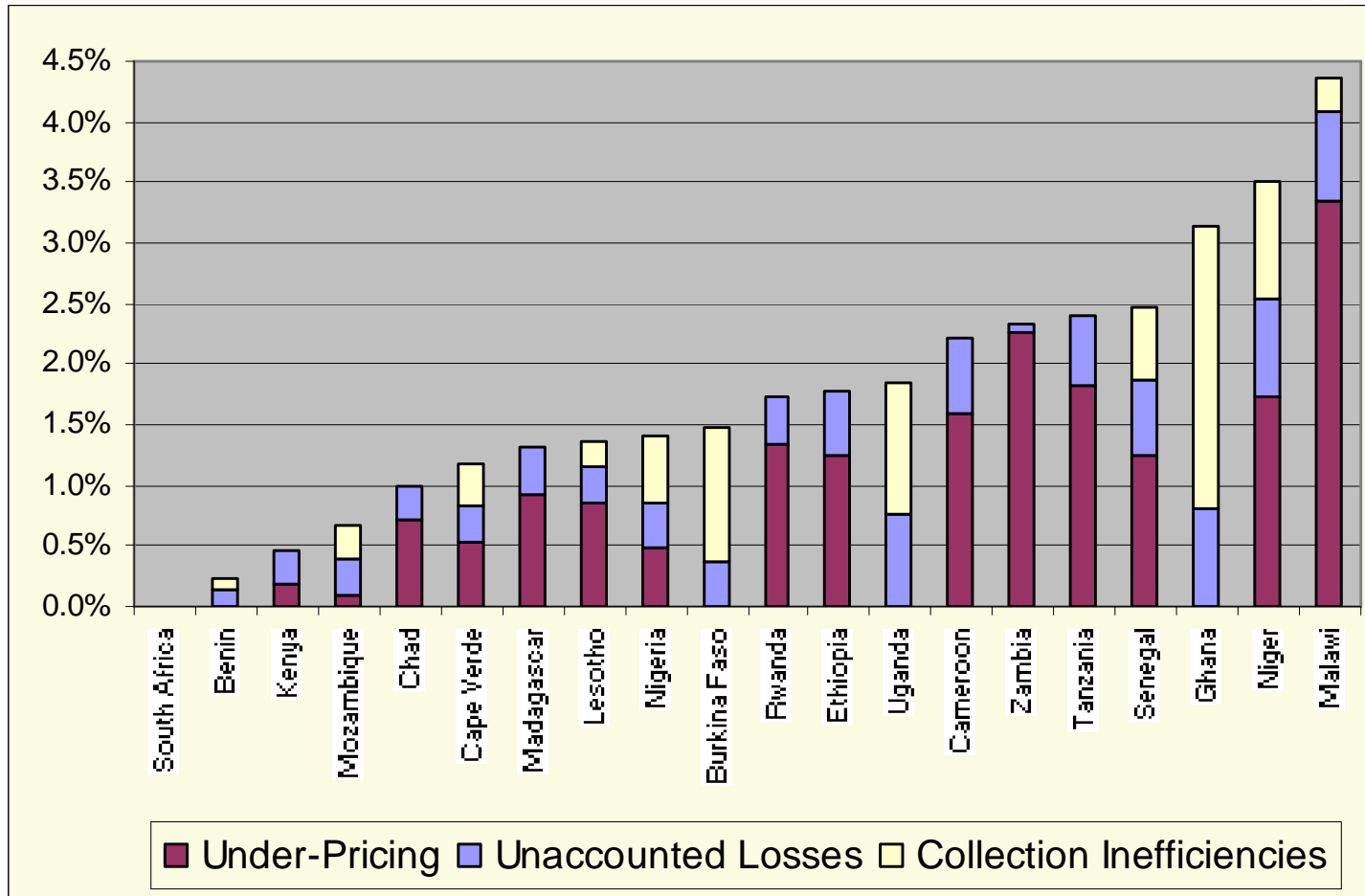
Source: Africa Infrastructure Country Diagnostic

# Do not recover costs



Source: Africa Infrastructure Country Diagnostic

# i-fiscal costs



Source: Africa Infrastructure Country Diagnostic



# revealed in prevalence of emergency power leases

	Emergency capacity (MW)	Percentage total capacity	Cost as percentage GDP
Angola	150	18	1.0
Gabon	14	3	0.5
Ghana	80	5	1.9
Kenya	100	8	1.5
Madagascar	50	36	2.8
Rwanda	15	48	1.8
Senegal	40	17	1.4
Sierra Leone	20	133	4.3
Tanzania	180	20	1.0
Uganda	100	42	3.3

## exacerbated by

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- “ Drought
- “ High petroleum prices
- “ Damage to infrastructure through wars
- “ Rapid demand growth

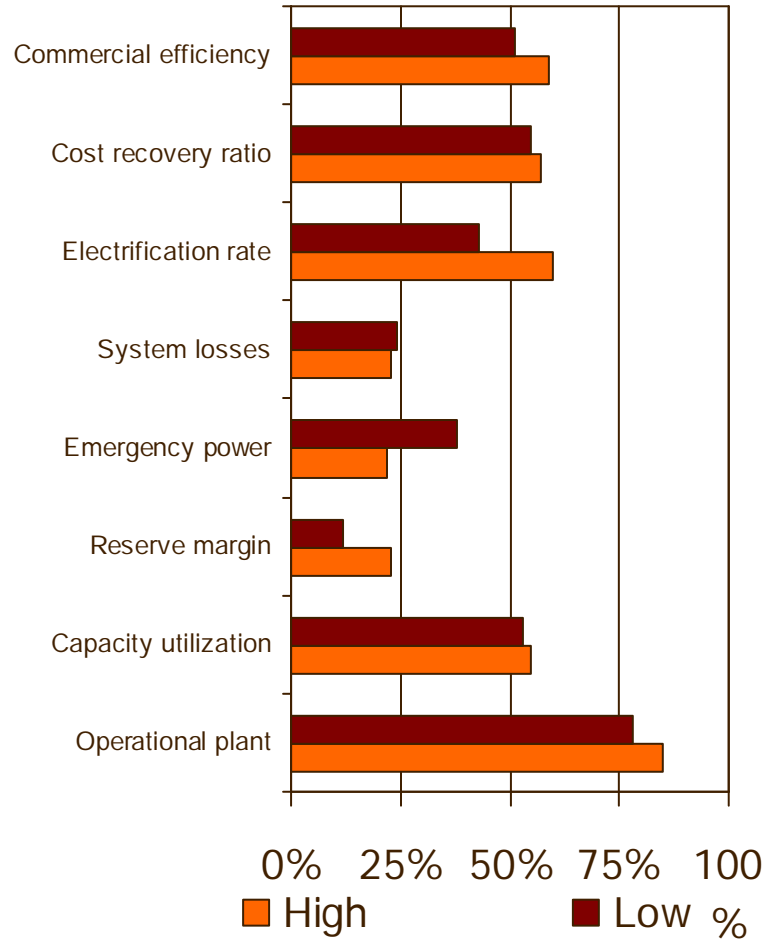
# Performance

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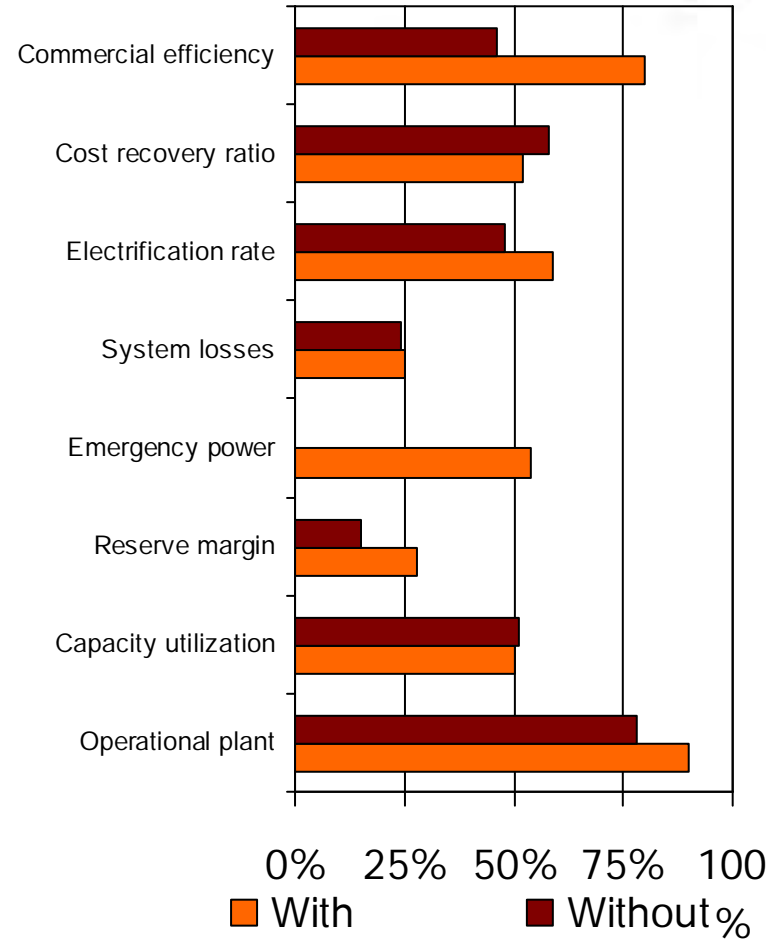
- “ Reforming state-owned enterprises
- “ Rekindling private sector participation
- “ Managing hybrid power markets
- “ Targeting electrification
- “ Expanding regional power trade

## State-owned enterprises

- “ State-owned utilities still dominant
- “ Two-thirds of utilities have undergone some form of governance reform
  - . Corporatisation
  - . International accounting standards
  - . Performance monitoring
  - . Exposure to private capital markets
- “ Reformed utilities perform better



**SOE Governance**



**Private Sector Participation**

Source: Africa Infrastructure Country Diagnostic

# Form of SOEs

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## 1. Clarification of roles and responsibilities

- “ Separation and clarification of government's different roles
- “ Public entity management legislation
- “ Codes of corporate governance
- “ Performance contracts
- “ Effective supervisory / monitoring agencies
- “ Transparent transfers for social programmes

## 2. Changing the political-economy of the firm

- “ Improved transparency and information
- “ Corporatisation
- “ Commercialisation
- “ Structural reform and direct competition
- “ Mixed-capital enterprises
- “ Customer-owned enterprises

## 3. Improved regulatory design

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## ons of private participation

- “ 80% of AICD countries have enacted power sector reform law
- “ 66% have regulators & these countries generally perform better
- “ More than 40 IPPs across Africa, totaling 8000MW
- “ Concessions, leases & management contracts . some disappointing
- “ Cf. recent reviews

# Challenges of hybrid markets

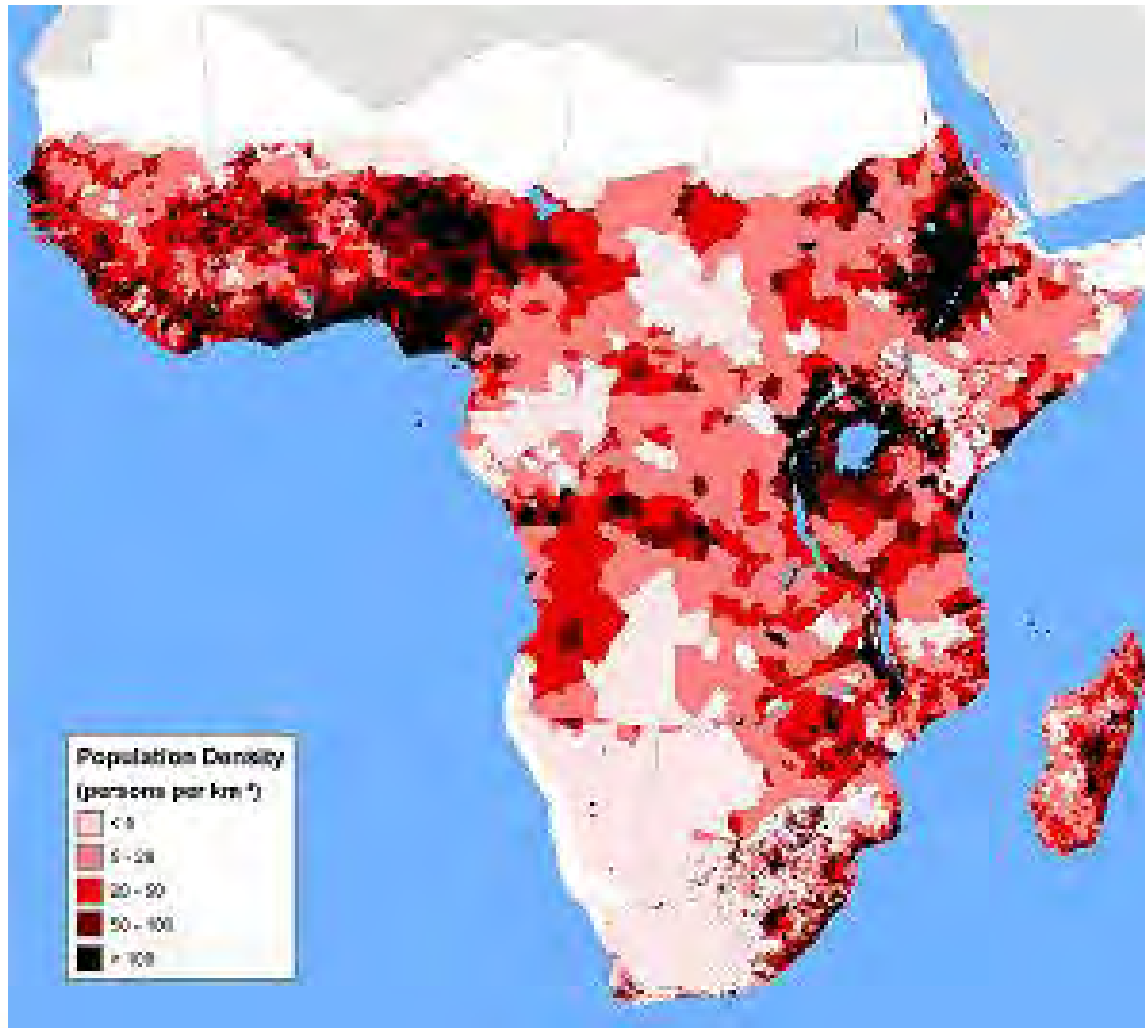
- “ Demise of standard model of reform
- “ Incumbent SOEs remain dominant
- “ IPPs introduced on margin
- “ New challenges for securing investment
  - . Responsibility for power expansion planning
  - . Transparent criteria for allocating new build opportunities between SOE & IPPs
  - . Institutional responsibility & capacity for procuring IPPs, use of international competitive bidding processes
  - . Procedures for dealing with unsolicited bids
  - . Institutional responsibility and capacity for contracting (non-exclusive Single Buyer Office?)
  - . Transparent criteria for dispatch



## ion efforts more effectively

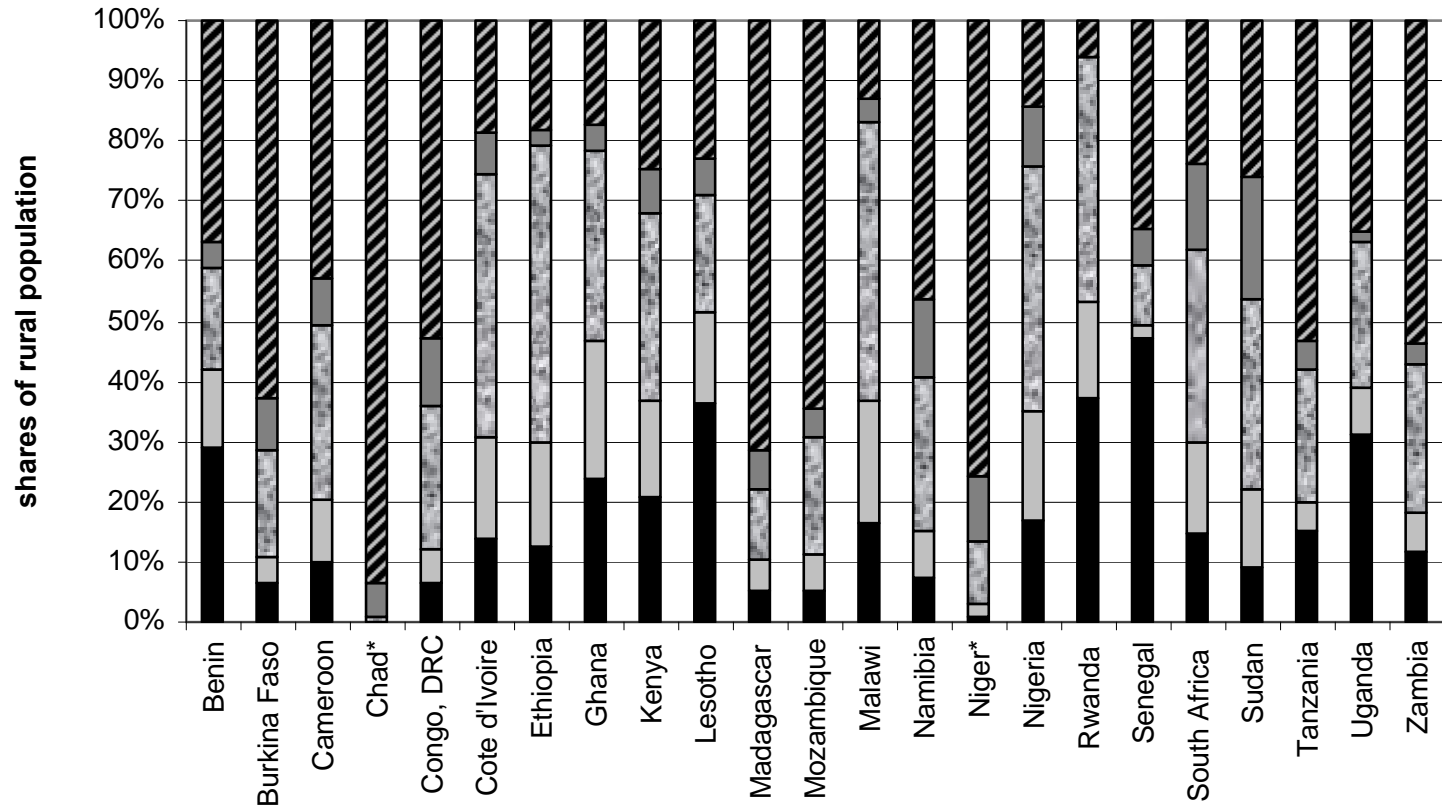
- ” Less than 30% of population have access
- ” Two-thirds population in SSA still rural
- ” Cheaper to electrify urban areas, followed by higher density rural areas
- ” Off-grid technologies (such as PV) still expensive
- ” Focus on more cost-effective areas & technologies
- ” Urban customers can cross-subsidize rural areas
- ” Electrification funds & clear planning criteria NB
- ” National grid electrification has been more effective than rural elec agencies & funds supporting decentralised private operators (Mostert 2008) . but national utilities need to be reasonably efficient

# al non-connected population



Source: Africa Infrastructure Country Diagnostic

# Shares of population from grid



- remote: > 50 km from substation AND (not in power plant buffer AND > 10 km from lit urban area AND not lit pixel)
- isolated or off-grid: > 50 km from substation AND (in power plant buffer² OR < 10 km from lit urban area OR lit pixel)
- 20 - 50 km from substation¹
- 10 - 20 km from substation¹
- < 10 km from substation¹ or < 5 km from MV line

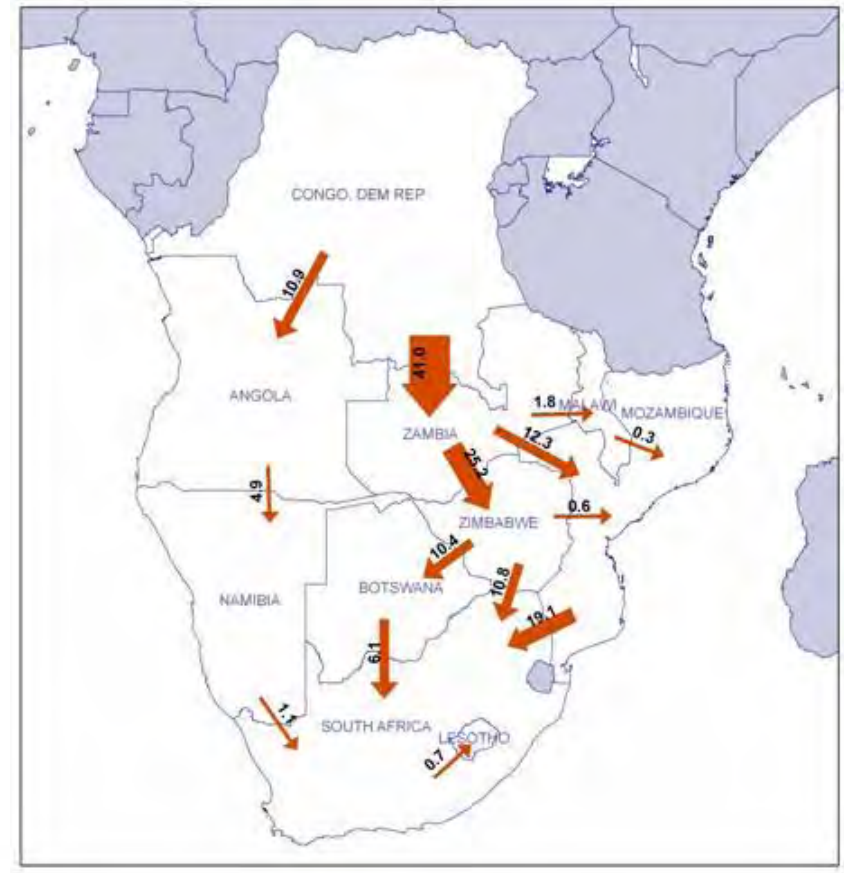
Source: Africa Infrastructure Country Diagnostic

# Increased power trade

(a) Trade stagnation



(b) Trade expansion

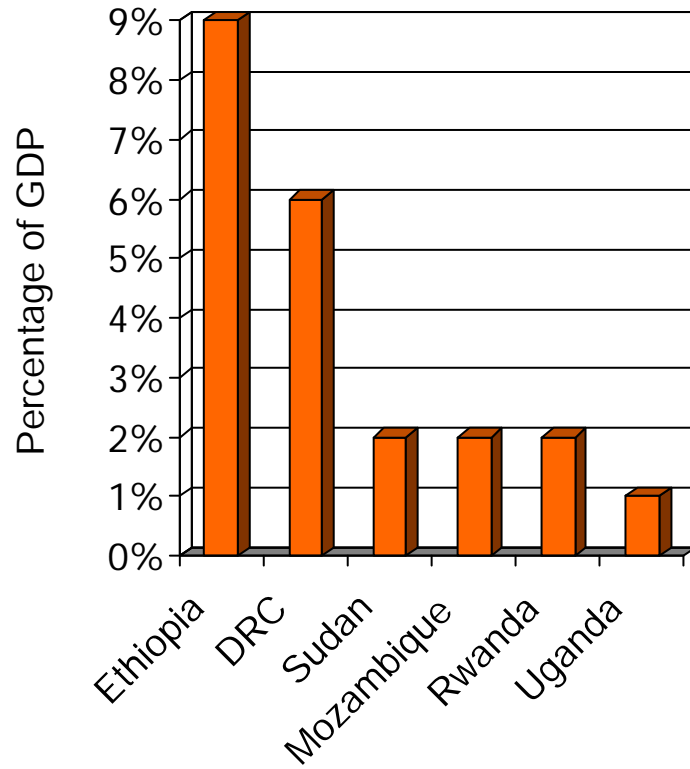


Source: Africa Infrastructure Country Diagnostic

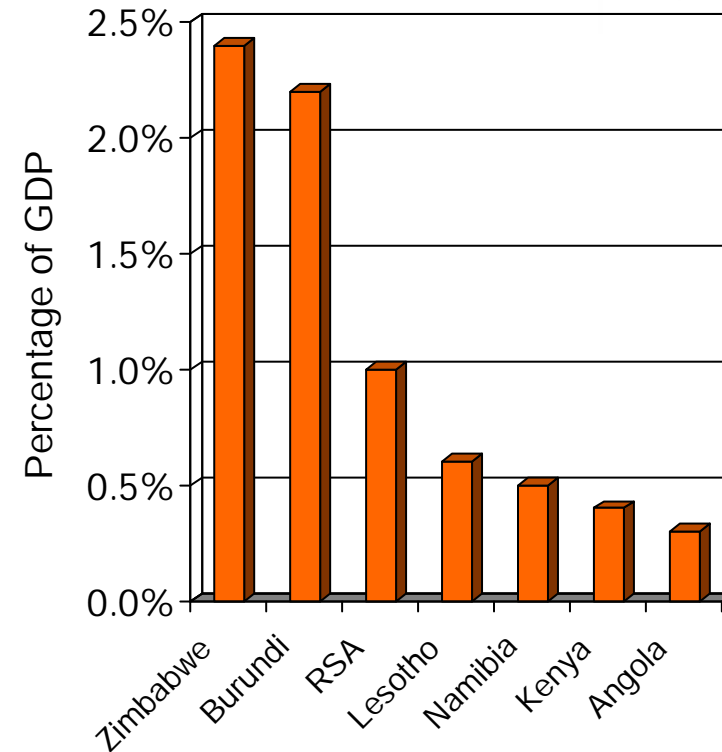
## onal trade

- “ Expanded trade facilitates least-cost development of power generation resources
- “ Hydro will substitute for thermal and will thus lower carbon emissions . 70 mill tons CO<sub>2</sub> per annum (i.e. about 20%)
- “ Share of hydro capacity increases substantially with higher oil and carbon prices
- “ Annual savings estimated as US\$2,7 bn
- “ High returns. Additional capital investment in SAPP recouped in less than a year. Other areas recouped in 3 to 4 years with 20-33% returns
- “ Countries with high domestic power costs have substantial benefits (e.g. Guinea-Bissau, Liberia and Niger could save 6-7 US c/kWh), also Angola, Burundi, Chad, Ghana, Malawi, Sierra Leone, Togo, etc
- “ Export countries can earn significant revenues (e.g. DRC, Ethiopia, Guinea and Cameroon).

# Trade and export



Major Exporters



Major Importers

Source: Africa Infrastructure Country Diagnostic

# Spending & needs and financing flows in SSA

## Spending needs

	\$ billions	% GDP
Capex	26	4.2
Opex	14	2.2
Total	40.6	6.4

## Existing financing flows

Opex	Capex					
Public sector	Public sector	ODA	Non OECD	PPI	Total Capex	Total Spending
<b>7</b>	<b>2.4</b>	<b>0.7</b>	<b>1.1</b>	<b>0.5</b>	<b>4.6</b>	<b>11.6</b>

Improving operational efficiencies: - \$3.3 bn; cost recovery - \$2.2 bn

**Financing gap \$23 billion**

- “ Power crisis is characterized by low capacity, low connection rates, high prices and poor reliability
- “ Expanded regional trade will lower costs and expand access
- “ Government fiscal resources, ODA, private investment and emerging sources of capital are not entirely plugging finance gap
- “ Thus important for African utilities to improve their performance and financing
- “ And new challenges in hybrid power markets need to be addressed to accelerate private investment





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