Reforming the electricity industry in East Africa

David Newbery  Cambridge University

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http://www.econ.cam.ac.uk/electricity
Source: Eskom  
Uganda 5%; Kenya 15% electrification
Uganda and Kenya

- visit with World Bank Aug/Sep 2004
- both countries reforming ESI
  - Uganda fully unbundled, concessioned
  - Kenya partly unbundled, mixed
- low electrification, variable costly power, poor interconnections, past inefficiencies, corruption
- lost decades: Uganda civil war, Kenya stagnates
- private management as possible cure?
Existing grids

Long, fragile
low voltage

Source:
Acres: EAPMP

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Uganda: history

• Amin coup 1971, GDP collapses
  – capacity deteriorates from 150 MW to 100 MW
  – prices peak 19 cents (1979), losses to 41%
  – corruption: a cancer in ESI

• 1986 Museveni starts recovery
  – FDI returns, growth resumes, capacity needed

• 1994: IPP dam? Implausible without reforms
  – UEB proposes SB with IFI-financed dam
  – 1999: cabinet goes for unbundling, privatisation
Uganda: generation sources

- 285 MW capacity at Nile Source
  - almost run-of-river, output varies with Lake level, October 2004 at 220 MW
  - 2004: peak demand 350 MW, daily load shedding
  - ~100 MW (?) private thermal back-up

- Nile potential: 2,000 - 2,800 MW

- Next choice - Bujagali: 200-250 MW
  - 1998 AES signs PPA with UEB and GoU
Uganda restructuring

• Electricity Act 1999 unbundles UEB into
  – UEGCL, UEDCL, UETCL (G,D & T) 2001
  – UEGCL: 20 yr concession to Eskom 2003
  – UEDCL: 20 yr concession to Eskom/Globaleq ’04
  – T: UETCL 2001 SOE, holds PPAs, exports,
  – Electricity Regulatory Authority
    • issues, modifies licenses, establishes & approves tariffs
    • 2004 Gen capacity fee = $5.4/MW/hr = $47/kW/year
    • domestic tariff 9c/kWh + 52 c/month
    • large industrial: peak = 4c/kWh + $10/month
Pricing and investment

- hydro costly, lumpy $1,400-2,000/kW
  - interest cost (10%, LF:75%) = 2.1-3 cents/kWh
  - op. cost = 0, or export value, or VUE (71 c/kWh)
  - peak demand evenings: voting households
  - transmission expensive ($120 m for Bujagali)

- weak interconnection to Kenya: 50-80MW
  - Kenya has storage hydro
  - strengthen link as part of hydro expansion plan
  - but expensive ~ $500/kW?
Kenya electricity production

GDP $(95) m

0 500 1,000 1,500 2,000 2,500 3,000 3,500 4,000 4,500 5,000 5,500 6,000 6,500 7,000 7,500 8,000 8,500 9,000 9,500 10,000


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Kenya: brief history

• KPLC as SB, SO,T&D; various G authorities
  – 1994-5 EdF advises separating commercial from regulatory functions
  – Tariffs < 30% LRMC, WB presses to raise
• Electric Power Act 1997 unbundles G, allows IPPs
  – expensive IPP PPAs signed 1998
  – 2004 barge mounted plant towed off
• 1997 KenGen established
• 1998 ERB established “not independent”
  – responsible for merit order
• 2001 drought, emergency G leased, KPLC losses
Kenya capacity and output

- Thermal KenGen
- Thermal IPP
- Hydro
- Imports
- Geothermal

Capacity MW

Output 2002/3 scaled to peak demand

Generation

- 4,800 MWh
- 2,400 MWh
- 0
Kenya: generation options

- peak demand 833 MW, supply 1121 MW
- dominated by hydro, some storage (months)
  - little left unexploited, remainder expensive
- geothermal costs $3000/kW = $73/MWh
- thermal $70-90/MWh (MS diesel cheapest)
- IPPs: capacity payments:
  - $213/kW OCGT; $305 MSD; $502 geothermal
  + (high) variable fuel cost
Where next?

- New Energy Act due 2004 to establish:
  - independent regulator, State Geothermal co. sells steam
  - IPO of 30% of KenGen
  - Rural Electrification Agency
  - Unbundle T from KPLC, eligible customers

- Still need a BST and sensible tariff
- Better trading with Uganda
- Medium speed diesels least cost?
  - Lends itself to IPPs
  - Could KenGen do it cheaper?
East Africa Co-operation?

- East Africa Federation
  - collapsed acrimoniously after independence
  - East African Community restored 2000
  - develops EA Power Master Plan Study 2004
- Uganda: run-of-river hydro
- Kenya: some storage hydro, geothermal
- Tanzania: gas, potential access to SA
- but transmission weak, distances long
Existing and planned inter-connectors

Source: Acres EAPMP
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Alternative links

100 MW

200 MW

Source: Acres EAPMP
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East Africa Power Master Plan

• Least cost expansion plan for region 2003-4
• aim at 220+ kV
• Upgrade Uganda-Kenya to support Bujagali
  – interconnector for increments in capacity (200MW)
• connect Arusha-Nairobi
  – GoK and GoT jointly finance study
• EA Power Pool until integrate with SAPP
  – needs Govt MOU, coordination, control, settlement
Rural electrification

- very expensive, very low demand (50 kWh/m)
  - quite high solar panel penetration
  - no tradition of cooperatives as in Asia, US,
- commercial use to justify local distribution
- bids for best value capital subsidy
  - tariff needs to cover running cost
- Output-based aid promising (Mozambique)
- Uganda ahead of Kenya with REB
What do we learn?

• At independence vertically integrated ESIs OK (?)
• Corruption undermined management, investment
• Hydro, geothermal hard to sell to private investors
• IPPs and private finance costly
  – Separate building/drilling from concession to operate?
• Management contract works well in Tanzania
  – Is it sustainable? Or only if it evolves into a concession?
• Concession for D and G looks promising
  – Takes care, time to negotiate, few potential players
• Donor financing still needed?
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Acronyms - 1

BST: Bulk supply tariff
D, G, T: distribution, generation, transmission
EAPMP: East Africa Power Master Plan
ERB: Electricity Regulatory Board (Kenya)
ESI: electricity supply industry
GoK, GoU: Govt of Kenya, Uganda
IFI: International Financial Institution
IPP: independent power producer
KPLC: Kenya Power and Light Company
LF: load factor
MOU: Memorandum of Understanding
MSD: Medium speed diesel
PPA: Power Purchase Agreement
OCGT: open cycle gas turbine (can run on jet fuel)
SB: Single Buyer
SO: System Operator
REB: Rural Electrification Board
SAPP: South Africa Power Pool
UEB: Uganda Electricity Board
VUE: value of unserved energy