Digitization of Energy Transmission and Distribution in Africa

The Future of Smart Energy in Sub-Saharan Countries

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The global energy ecosystem is in the middle of a significant change.

The industry is moving away from conventional large-scale infrastructure with a heavy reliance on fossil fuel-based generation, to focus on clean sustainable energy and embracing the power of digital – or smart – technology.
Sub-Saharan Africa needs energy

- ~60% population without access to electricity
- ~$14B annual investment needed to achieve >70% electrification by 2040
- 4x increase in electricity demand per capita by 2040
- 20–25% technical & commercial transmission & distribution losses

Source: GE Analysis
The 3Ds of Transformation

**Decentralization**: Economically competitive small, distributed power systems are being installed in increasing numbers.

**Decarbonization**: Low-carbon technologies such as wind and solar are exceeding growth expectations.

**Digitization**: Asset, facility and fleet level, Internet-enabled applications are proliferating.

These factors are transforming the global electric power system, creating new challenges and opportunities.
Energy will be cleaner, more accessible, intelligent, connected and responsive

**DECARBONISATION**

Shifting generation, transmission, distribution and usage towards a lower carbon future.

Renewable energy, e-Mobility, energy efficiency, new and future fuels, demand side management, etc.

- **50%** of SSA generating capacity from renewables by 2030
- **80 GW** of renewables capacity added between 2017 & 2030

**DECENTRALISATION**

New DG models with a proliferation of distributed and connected generation, closer to the point of use.

Distributed generation, energy storage, microgrids, prosumers, VPPs, P2P, etc.

- **28%** of SSA generating capacity from DG by 2030
- **50%** of new access will be from DG by 2030
- **250 MW** of battery storage by 2030

**DIGITALISATION**

Digital technologies to provide infrastructure for more flexible, intelligent, connected & responsive energy systems.

Smart grid, asset optimisation, demand response, automated trading, active energy management, etc.

- **6 million** smart meters installed in SSA by 2030
- **$12 billion** annual market for smart grid solutions in SSA by 2030

Source: Frost & Sullivan / GE Analysis
Transmission and Distribution Infrastructure

Addressing the Weakest Link

- Poor maintenance of existing infrastructure is a critical issue in the region and is one of the main causes for high levels of power supply instability.

- Despite significant increase in generation capacity in the last 10 years, the delivery of electricity is still a point of weakness due to the malfunctioning of aged transmission and distribution infrastructure.

- SSA needs to go beyond maintaining and repairing aged infrastructure ... in order to truly advance the power sector, significant changes need to be made.

- A holistic approach needs to be adopted; one that ensures sustainability, reliability and longevity of power supply.
Transforming Grid Infrastructure

Legacy grids and conventional technologies have ...

- Limited input/outputs which limit access to data to support decision making
- Limited real-time visibility and control over the network
- Vulnerability to inaccuracies
- Integration of new energy sources or new equipment causes downtime due to the complex hardwiring required to ensure compatibility
- Single flow of electricity so generation surpluses are not effectively leveraged
- High cost of repairing or replacing large aged equipment required in an analogue system
- Loss of revenues resulting from inaccuracies in meter readings

... Digital grid technologies offer

Increased efficiency, flexibility, transparency and long-term sustainability.

By utilizing internet of things (IoT) technology, the smarter grids of tomorrow will deliver all-encompassing solutions based on the convergence of operating technology (OT) with information technology (IT) and incorporating emerging concepts such as distributed generation and energy storage.
The Converging Elements of Smart Grids

Smart grids boast improved energy delivery through many characteristics.
# Benefits and Opportunities from Smart Grid Solutions

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Opportunity</th>
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<tbody>
<tr>
<td>Increased grid flexibility</td>
<td>Smart grids provide multiple opportunities for automation at any point of the value chain.</td>
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<td>Demand response and demand side management</td>
<td>Through two-way digital communication and control capabilities, operators are able to manage electricity flow to and from the consumer by switching off unnecessary appliances.</td>
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<td>Increased interoperability</td>
<td>All equipment complies with International Electricity Commission (IEC) standards code 61850, ensuring that all equipment will be easily integrated into the system with no downtime required.</td>
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<td>Facilitate integration of diverse generating assets</td>
<td>With increased interoperability, integration of all power generation types, including renewable energy sources and distributed generation, is made easier.</td>
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<td>Preventative maintenance</td>
<td>Through the use of smart sensors, all components of the grid are monitored and faults are simple to identify and locate, allowing them to be repaired or replaced before the rest of the grid is compromised.</td>
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<td>Cyber security</td>
<td>Improved resilience to cyber attacks on the grid.</td>
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Source: Frost & Sullivan / GE Analysis
Hotspots for Smart Grid Investments in SSA

**Mali**
- ±200 small diesel mini-grids with a significant number in the process of hybridisation
- Subsidies via AMADER, which makes all major decisions regarding microgrids

**Senegal**
- 30 microgrid projects in operations with hundreds in pipeline
- Well regulated, 2-pronged concession approach for private sector involvement in microgrids
- 80% upfront investment subsidy for private investors for grid extension and off-grid electrification
- Mini-concessions for private micro-utilities for stand-alone microgrids in remote communities (Local Initiative for Rural Electrification projects)

**Nigeria**
- Over 25 solar microgrids
- Aggressive drive for renewables with National Renewable Energy And Energy Efficiency Policy (NREEEP)

**South Africa**
- First hybridised microgrid to integrate solar PV
- Island microgrid model powering Robben Island
- Eskom has spent $180m upgrading its network of transmission stations on power lines

**Zambia**
- First fully digital substation in Africa
- Installation of smart hydro power off-grid hybrid plants using kinetic energy in rivers
- Plans in progress to construct its first wind power plant

**Rwanda**
- Government is providing 445,500 new off-grid connections to give access to 1.8 million people

**Kenya**
- Kenya is a geothermal world superpower
- Building Africa’s biggest wind farm to produce a 5th of Kenya’s power
- Mobile phone-based money transfer service, M-KOPA, used to pay for prepaid meters
- Micro-grid network in rural areas using smart meters linked to a cloud-based server
- 27 green (PV and wind) minigrids planned
- Safaricom investing Sh200 million for an innovation lab testing IoT devices

**Tanzania**
- 17MW of small hydro and biomass projects
- Digital platform (Tigo Pesa) to pay for on-grid and off-grid prepaid meters
- Rural Energy fund provides grants and connection subsidies (€380/connection) or up to 80% of T&D costs

**Ghana**
- Ghana Grid Company implemented Computerized Maintenance Management System in 2017
- Installation of smart hydro power off-grid hybrid plants using kinetic energy in rivers

**Malawi**
- Implemented an Energy Management System for real-time monitoring
- National banks are authorised to deduct electricity directly from bank accounts

**Ethiopia**
- Plans to become the wind power capital of Africa
- Africa’s first waste-to-energy plant generating 50MW
- Upgraded its transmission lines with 1,600kms fibre optics network for an optical switching network to pave the way for smart grid technologies
- Currently installing smart grid solutions through AMI, including pre paid card billing system

**Source:** Frost & Sullivan / GE Analysis
Digital Grid Roadmap in SSA

Four game changers have emerged that will have the biggest impact on the digital grid roadmap in SSA:

- Renewable energy
- Energy storage
- Metering
- Distributed energy

We are poised for an exceptionally exciting decade of transformation and opportunity.
Steps to Grid Modernization
GE has a suite of solutions to cater to every step of the process

6 steps utilities and industries can follow to as that they are building a smart grid:

- Building a Database of Records
- Design and Planning Phase
- Grid Operation Optimisation
- Asset Management
- Customer Analytics
- Sustainability

Key Outcomes
- Improved quality and reliability of power
- Optimized overall grid function
- Enhanced longevity and sustainability of the grid
Thank You