

Green Networking for African Research and Education Institutions: *A Roadmap to Sustainable Digital Infrastructure*



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INTRODUCTION

Africa's research and education institutions are rapidly embracing digital transformation, but the environmental footprint of growing digital infrastructure poses sustainability challenges. Research and Education Networks (RENs) demand high-performance, always-on connectivity, often leading to high energy consumption and electronic waste accumulation. As argued by Baliga et al. (2011) balancing energy consumption in storage, processing, transport is fast becoming a challenge to institutions and is spiraling out of sustainability parameters.



Context and Problem Statement

- Rapid digital transformation of Research and Education Networks (RENs) across Africa.
- Institutional pressure to scale ICT without sustainability planning
- Significant increase in energy consumption and e-waste.
- Dependence on fossil-based energy sources with environmental impact.
- Need for resilient, climate-aligned digital infrastructure.



Objectives of the Study

The following are the main objectives of the research study



Assess how solar, virtualization, and energy-aware routing can be integrated into NREN operations



Identify key enablers and barriers to green networking in Africa



Propose a roadmap for transitioning to green and sustainable RENs.



Methodology

Our methodology involved a review of emerging practices and case studies across East and Southern Africa. We did not conduct a direct consumer survey. Instead, our data was qualitative and evidence-based, drawn from pilot initiatives within selected NRENs and universities, alongside their institutional sustainability reports and policy documents

Approach	<input type="checkbox"/> Review of emerging practices and case studies across East and Southern Africa
Data Sources	<input type="checkbox"/> Pilot initiatives from selected NRENs and universities. <input type="checkbox"/> Institutional sustainability reports <input type="checkbox"/> Policy frameworks and donor-funded projects.
Analysis Techniques	<input type="checkbox"/> Comparative assessment of green ICT interventions. <input type="checkbox"/> Evaluation of policy alignment with SDGs and Agenda 2063. <input type="checkbox"/> Identification of success factors and barriers.



Emerging Practices and Green Technologies

Energy-aware routing protocols should be implemented at the network level, aligning with the research of Akbar (2018) on green network optimization

- Solar-powered edge data centres
- Virtualisation to reduce energy load.

- Energy-aware routing protocols for efficient networks.
- IoT-based tools for real-time energy monitoring.



Policy and Institutional Support

According to Kaza et al. (2018), Policy and institutional support are vital for promoting sustainable Research and Education Networks in Africa. Aligning initiatives with Agenda 2063 and the UN SDGs encourages green ICT adoption, while strong leadership and effective e-waste management frameworks help integrate environmental responsibility into institutional operations.



Integrate e-waste management and sustainability reporting.

Promote donor engagement and policy incentives for green innovations.

- Align green ICT strategies with Agenda 2063 and UN SDGs (9 & 13).
- Strengthen institutional leadership on sustainability.

Affordability and Access Strategies

- ❑ Use open-source tools for energy monitoring.

- ❑ Encourage multi-stakeholder collaboration among government, academia, private sector, and donors.

- ❑ Adopt shared cloud platforms to avoid infrastructure duplication..



Enablers and Barriers to Green Networking

Enablers

- ❑ Regional cooperation through UbuntuNet Alliance.
- ❑ Access to international green technology funding.
- ❑ Growing environmental awareness.
- ❑ Use of open-source tools and cloud based solutions.

Barriers



Limited local expertise in green ICT.



High initial investment costs.



Lack of supportive regulatory frameworks.




E-waste handling challenges



Lack of regulatory frameworks



NEXT STEPS

- Initiate continental dialogue on green digital infrastructure.
 - Encourage adoption of sustainable ICT practices.
 - Foster collaboration for climate-resilient, future-ready education systems in Africa
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Green Networking Roadmap

Short-term (1–2 years)

- Energy audits, capacity building, pilot solar nodes.
- Virtualisation of selected data services.

Medium-term (3–5 years)

- Policy adoption and incentives, shared cloud infrastructure.
- Strengthened donor and private sector engagement.

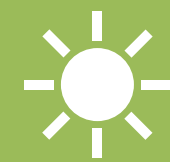
Long-term (5+ years)

- Fully integrated sustainable REN models across Africa.
- Institutionalised environmental reporting and monitoring.

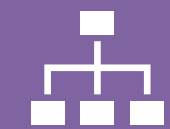
Key Messages and Recommendations



- Green networking is both achievable and cost-efficient.



- Combining renewable energy, virtualisation, and smart monitoring offers measurable benefits.



- Policies and governance frameworks are critical enablers.



- Collaboration across stakeholders ensures sustainability.



- Reference frameworks: SDGs, AU Agenda 2063, national climate strategies.

Closing and Acknowledgements

- Contact: lekhoosun@gmail.com | +266 59945175
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- “Building climate-resilient, future-ready research and education systems in Africa.”
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