Data-driven Electrification in Africa Webinar

Darlain Edeme, Africa Energy Analyst

Paris, 2024 March 26th

Agenda

1. The **Status** of access to electricity in Africa

2. GIS **Catalogue** for Energy Planning in Africa

3. Building-level Electricity Access and Demand Estimation **Model**
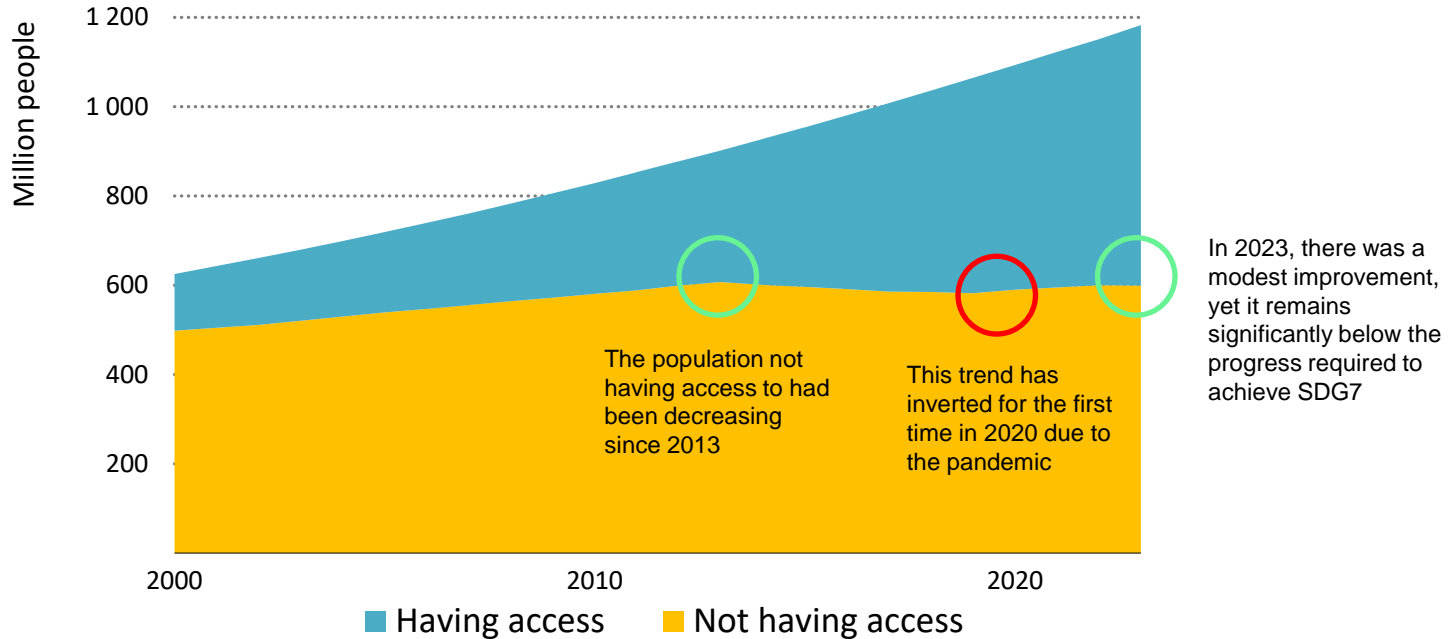
4. Conclusions

5. Q&A

Status

Africa's access expansion struggles to pace with its growing population

Population in sub-Saharan Africa, 2000-2023
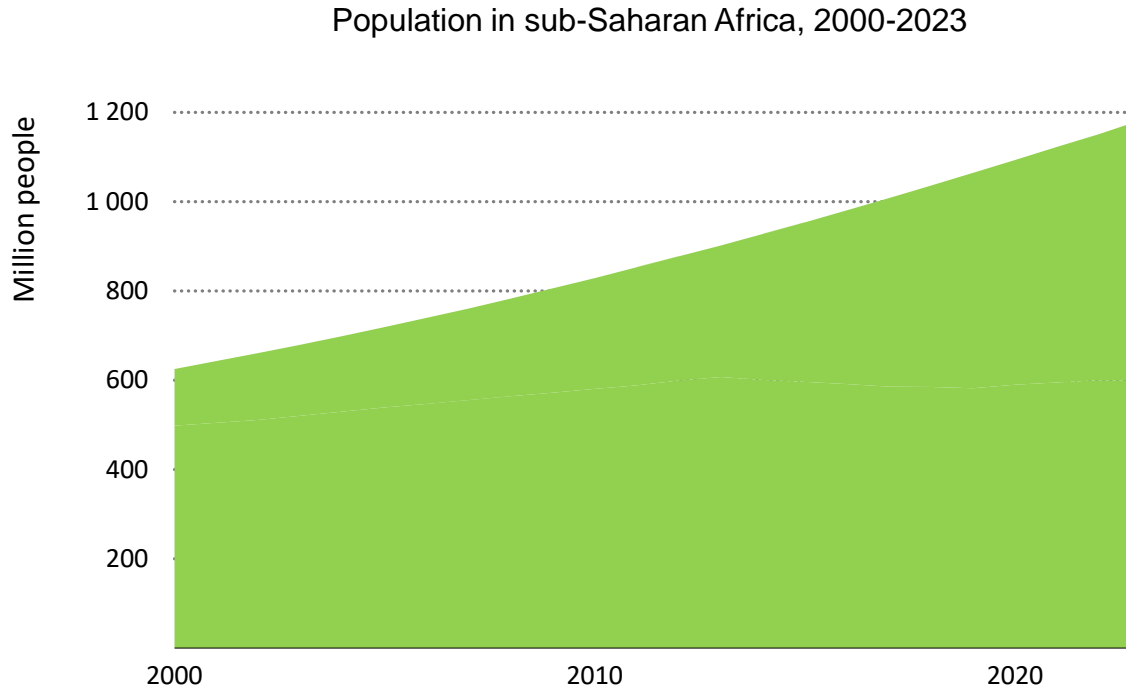
Africa's population has almost doubled since the start of this century.

# Africa's access expansion struggles to pace with its growing population

iea

Population having and not having access to **electricity** in sub-Saharan Africa, 2000-2023

The population not having access to had been decreasing since 2013

This trend has inverted for the first time in 2020 due to the pandemic

In 2023, there was a modest improvement, yet it remains significantly below the progress required to achieve SDG7

Million people

1 200
1 000
800
600
400
200

2000   2010   2020

■ Having access   ■ Not having access

Africa's population has almost doubled since the start of this century. Despite notable successes in electricity access, progress has lagged, exacerbated by the pandemic.

# Since 2000, the number of people without electricity in Africa has risen

Population having and not having access to **electricity** in sub-Saharan Africa, by region, 2000-2023
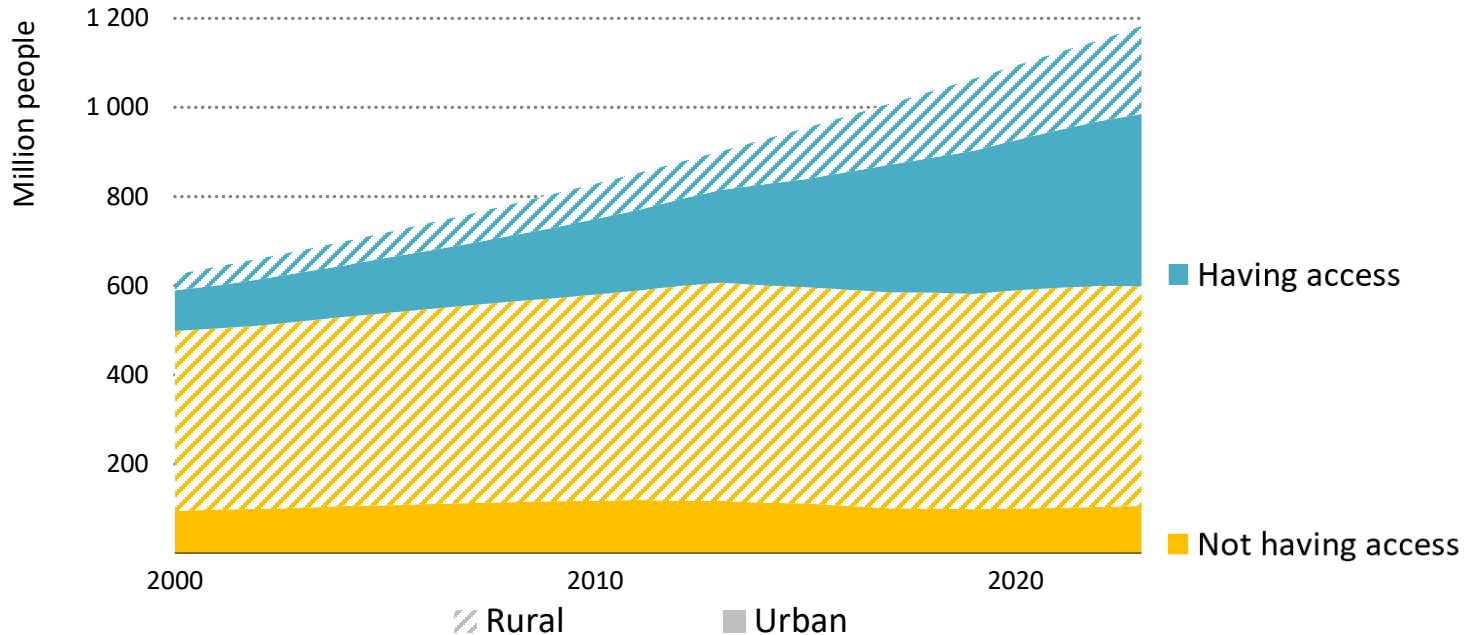
In the past 23 years there are 450 million people more with access to electricity. On the other hand, there are also 100 million people more with no access to it, and 82 % of people not having access today are in rural areas.

Rural regions face the greatest challenges

Population having and not having access to **electricity** in sub-Saharan Africa, by region, 2000-2023
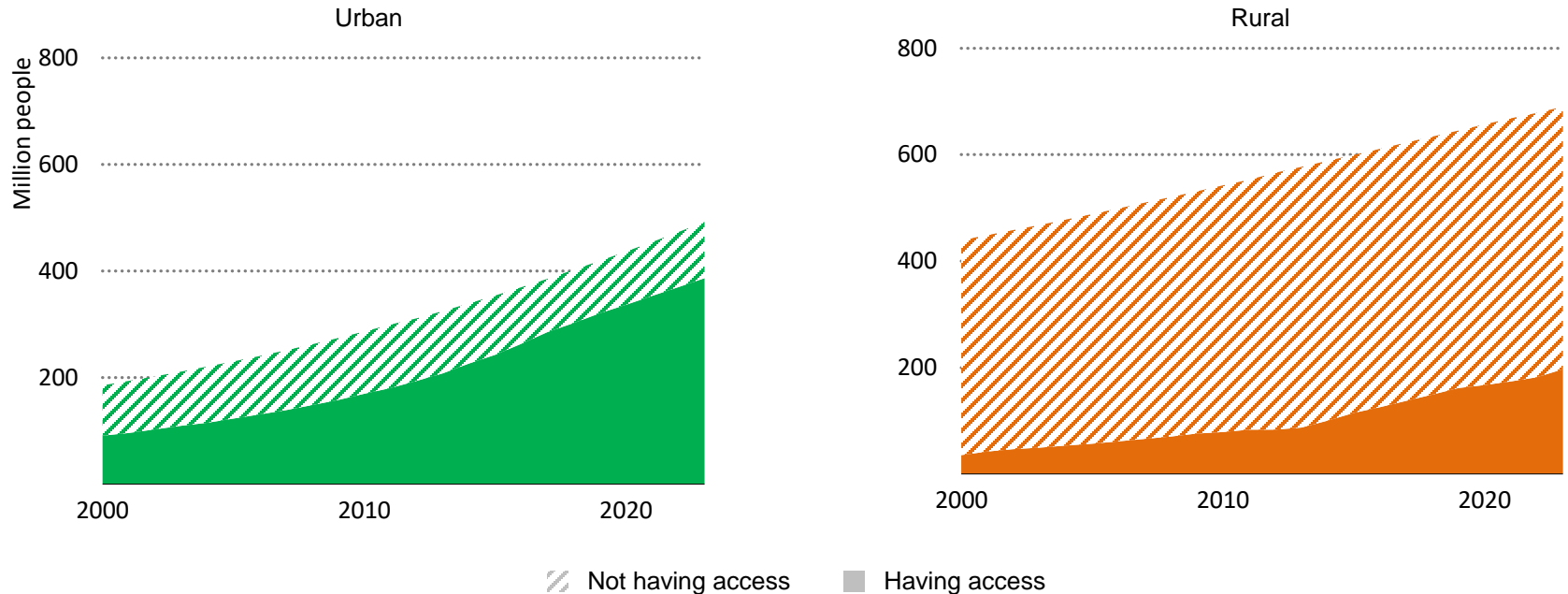
Electrification in urban areas has soared, while rural progress is slow, hindered by economic and density challenges. Off-grid solutions also struggle with regulatory and informational barriers.

Nonetheless, off-grid systems are becoming increasingly crucial

Annual increase in population with electricity access by technology in sub-Saharan Africa, 2015-2022

Smaller SHSs **Larger SHSs** **Grid and mini-grids**
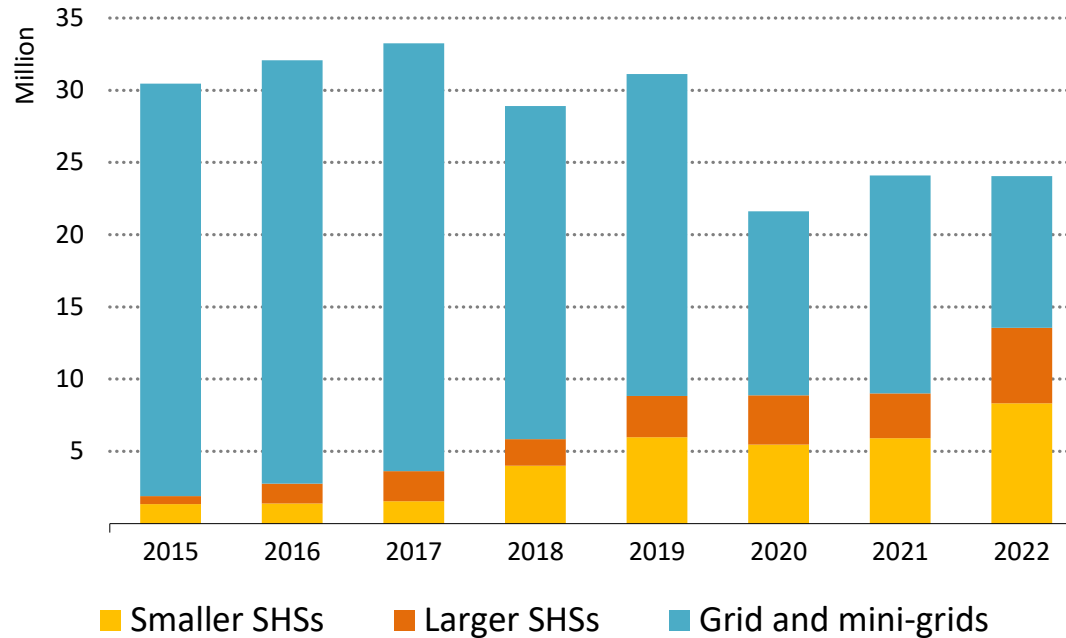
The number of people without electricity access globally is expected to decrease slightly in 2023. In 2022, solar home systems contributed to more than half of access increases in sub-Saharan Africa.

IEA   Search everything 🔍

Energy system ⌄   Topics ⌄   Countries ⌄   Data ⌄   Reports ⌄   👤

SDG7: Data and Projections

Access to affordable, reliable, sustainable and modern energy for all

Overview   Methodology

About this report

The International Energy Agency is at the forefront of global efforts to track access to affordable, reliable, sustainable and modern energy for all, and is one of the co-custodians for tracking progress on Sustainable Development Goal 7 (SDG7). The other co-custodians include International Renewable Energy Agency, United Nations Statistics Division, the World Bank, and World Health Organisation.
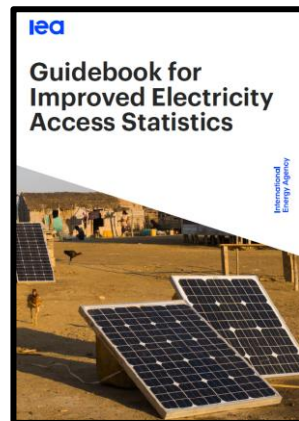
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SDG7 Database
Historical time series on access to electricity and clean cooking (SDG 7.1) and progress towards SDG targets on renewables (SDG 7.2) and energy efficiency (SDG 7.3)

Get data

IEA

Guidebook for Improved Electricity Access Statistics

International Energy Agency

GIS Catalogue for Energy Planning in Africa

What are Geographic Information Systems (GIS)?

Definition:

A Geographic Information System (GIS) is a technology that captures, stores, analyses, and presents data **related to positions on Earth's surface**.

Key components:

- <u>Data Input</u>: Collecting geographical and spatial data from various sources.

- <u>Data Management</u>: Storing, retrieving, and managing the collected data.

- <u>Data Analysis</u>: Using tools to analyse the spatial relationships and patterns.

- <u>Visualization</u>: Mapping and presenting data visually to enhance understanding and decision-making.
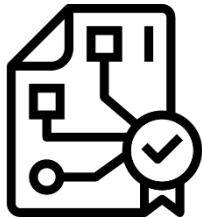
# A new reference for planners looking for GIS-based solutions

A comprehensive list of the existing **datasets** available in the sector that can be used for GIS planning.
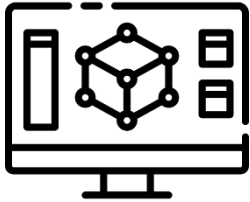
A comprehensive list of the existing **models and tools** currently available to perform GIS-based access planning.

A comprehensive list of reference **institutions** per country, that work with GIS for energy planning.
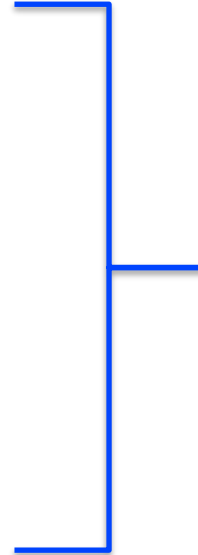
IEA GIS Catalogue for Energy Planning

The IEA GIS Catalogue is meant to be the ultimate resource for GIS-driven planning for professionals across the continent.

Africa GIS catalogue for energy planning

Last updated 21 Mar 2024

Cite   Share

Datasets   Models   By country

Category	Geographic coverage	Spatial resolution	Update frequency
Any	Any	Any	Any

Access to electricity `Non-GIS`
International Energy Agency

Website   Documentation   Get data

Details↓

Africa Electricity Grids Explorer `GIS`
World Bank

Website   Documentation   Get data

Details↓

Africa GeoPortal `Mixed`
Esri

Website   Get data

Details↓

Africa Knowledge Platform `Mixed`
European Union Joint Research Centre

Website   Documentation   Get data

Details↓

Africa GIS catalogue for energy planning

Last updated 21 Mar 2024

Datasets   Models   By country

Any

Socio-economic data

Access rate

Foreign Aid

Population density / distribution

Population growth

Urbanization

Wealth

Power infrastructure

HV grid

HV, MV & LV Grid

LV grid

Mini-grids

MV grid

Power plants

Substations

Geographic coverage
Any

Spatial resolution
Any

Update frequency
Any

Website   Documentation   Get data

Website   Documentation   Get data

Website   Get data

Website   Documentation   Get data

Africa GIS catalogue for energy planning

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Cite   Share

Datasets   **Models**   By country

Application
Any

Geographic coverage
Any

Spatial scale
Any

Spatial resolution
Any

Access Insights Platform (AIP)
Catalyst Energy Advisors

Details↓

Documentation | Get model |

Clean Cooking Planning Tool
World Bank and Modern Energy Cooking Services

Details↓

Documentation | Get model |

Congo Epela
Resource Matters,

Details↓

Documentation | Get model |

Electricity Growth and Use In Developing Economies (e-GUIDE)
University of Massachusetts - Amherst, Carnegie Mellon University, Columbia University, Rochester Institute of Technology, and University of Washington

Details↓

Documentation | Get model |

Africa GIS catalogue for energy planning

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Cite   Share

Datasets   **Models**   By country

Any	Geographic coverage	Spatial scale	Spatial resolution
	Any	Any	Any

Any

Electricity demand estimation

Electrification status estimation

Grid topology design

Infrastructure location estimation

Least-cost electrification

Multi-criteria decision-making support

Variable

Documentation   Get model

...rvices

Documentation   Get model

Congo Epela
Resource Matters,

Details↓

Documentation   Get model

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Africa GIS catalogue for energy planning

Cite Share

Datasets   Models   **By country**

Select country
Uganda

Status

Uganda's energy sector exhibits an intermediate level of Geographic Information Systems (GIS) integration, demonstrating both a foundation in GIS use and significant potential for expansion. The development of an electrification plan based on geospatial least-cost analysis highlights the sector's commitment to GIS-informed planning strategies. However, the lack of granular geospatial details for planned grid extensions underscores an opportunity to further refine these efforts. While institutions tasked with electrification strategies and plan coordination display a structured approach, increased public accessibility of detailed progress maps and evaluations would enhance transparency. Continued investment in GIS utilization, incorporating off-grid solutions and community facilities mapping, will be crucial for Uganda to achieve its energy sector goals. Here, capacity building and stakeholder engagement are paramount in fully leveraging GIS for development outcomes. The Energy Sector GIS Working Group serves as an excellent example of Uganda's progress in building a collaborative and effective GIS framework for its energy sector.

Key institutions

Directorate of Petroleum

The Directorate of Petroleum (Directorate of Petroleum) is responsible for managing petroleum resources, playing a role in energy planning that includes

Eastern Africa Power Pool (EAPP)

Uganda is an active member of the Eastern Africa Power Pool (EAPP), contributing to regional power trading and grid enhancement projects. The country focuses on

Rural Electrification Agency

The Rural Electrification Agency (REA), now integrated into the Ministry of Energy and Mineral Development, plays a crucial role in facilitating the provision of energy services to rural areas. It employs GIS technology for the mapping and identification of regions requiring electrification, significantly contributing to strategic energy access planning and the extension of services to underserved communities.

Uganda Bureau of Statistics

The Uganda Bureau of Statistics is the principal data collecting, processing, analyzing, and disseminating agency of the government, providing demographic and geographic data important for energy access planning and collaborating with various energy institutions to integrate GIS data for planning purposes.

Learn more ⊙

Country datasets   Country models

Category
Any   ⌄

Access to electricity `Non-GIS`   Website   Documentation | Get data |
International Energy Agency
Details↓

Africa Electricity Grids Explorer `GIS`   Website   Documentation | Get data |
World Bank
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Africa GeoPortal `Mixed`   Website | Get data |
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Africa Knowledge Platform `Mixed`   Website   Documentation | Get data |
European Union Joint Research Centre
Details↓

African Energy `Mixed`   Website | Get data |
Cross-border Infromation
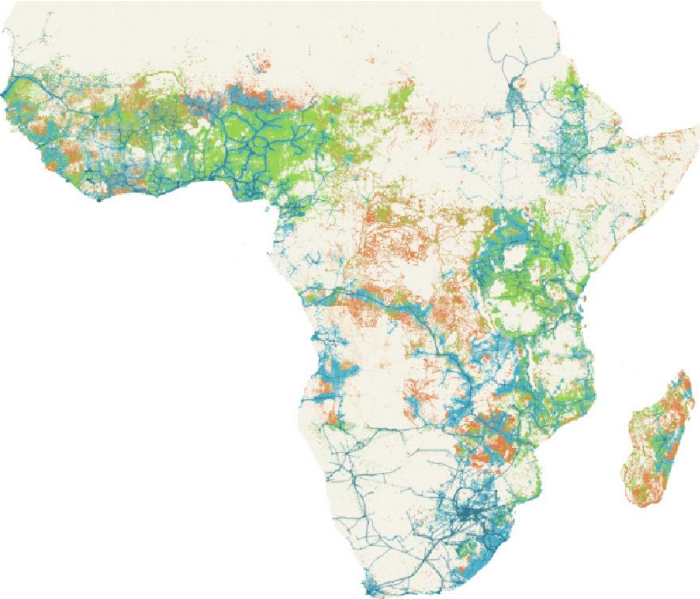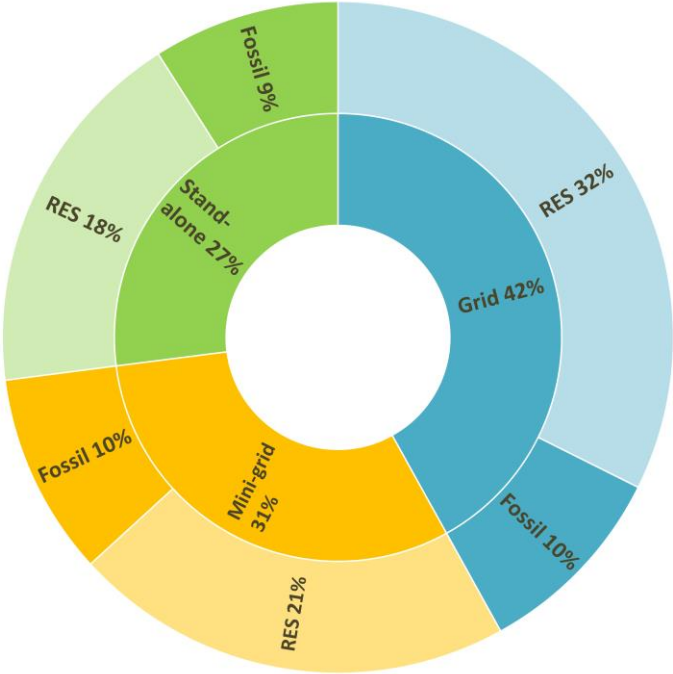
Geospatial modelling for effective electricity access policies

People gaining access to electricity in Africa by 2030 by technology in the Sustainable Africa Scenario 2022-30
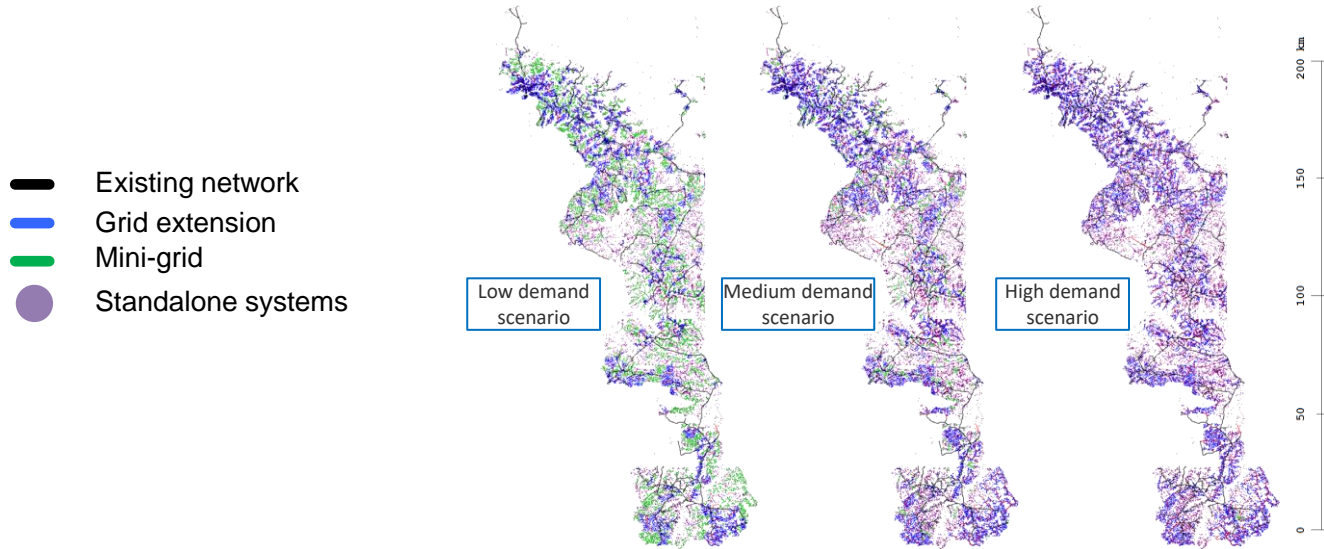
Connections
- On-grid
- Mini-grid
- Stand-alone systems

Transmission lines (>69 kV)
- ––– Existing
- – – – Planned

Pie chart labels:
- Fossil 9%
- RES 18%
- Stand-alone 27%
- RES 32%
- Grid 42%
- Fossil 10%
- Fossil 10%
- RES 21%
- Mini-grid 31%

The IEA has enhanced geospatial tools and data for comprehensive electrification planning. These improvements will bolster government-level planning capacities and lead to more impactful policies for universal electricity access.

Importance of accurate demand modelling

Least-cost electrification technology sensitivity to electricity demand

Legend:
— Existing network
— Grid extension
— Mini-grid
● Standalone systems

Low demand scenario

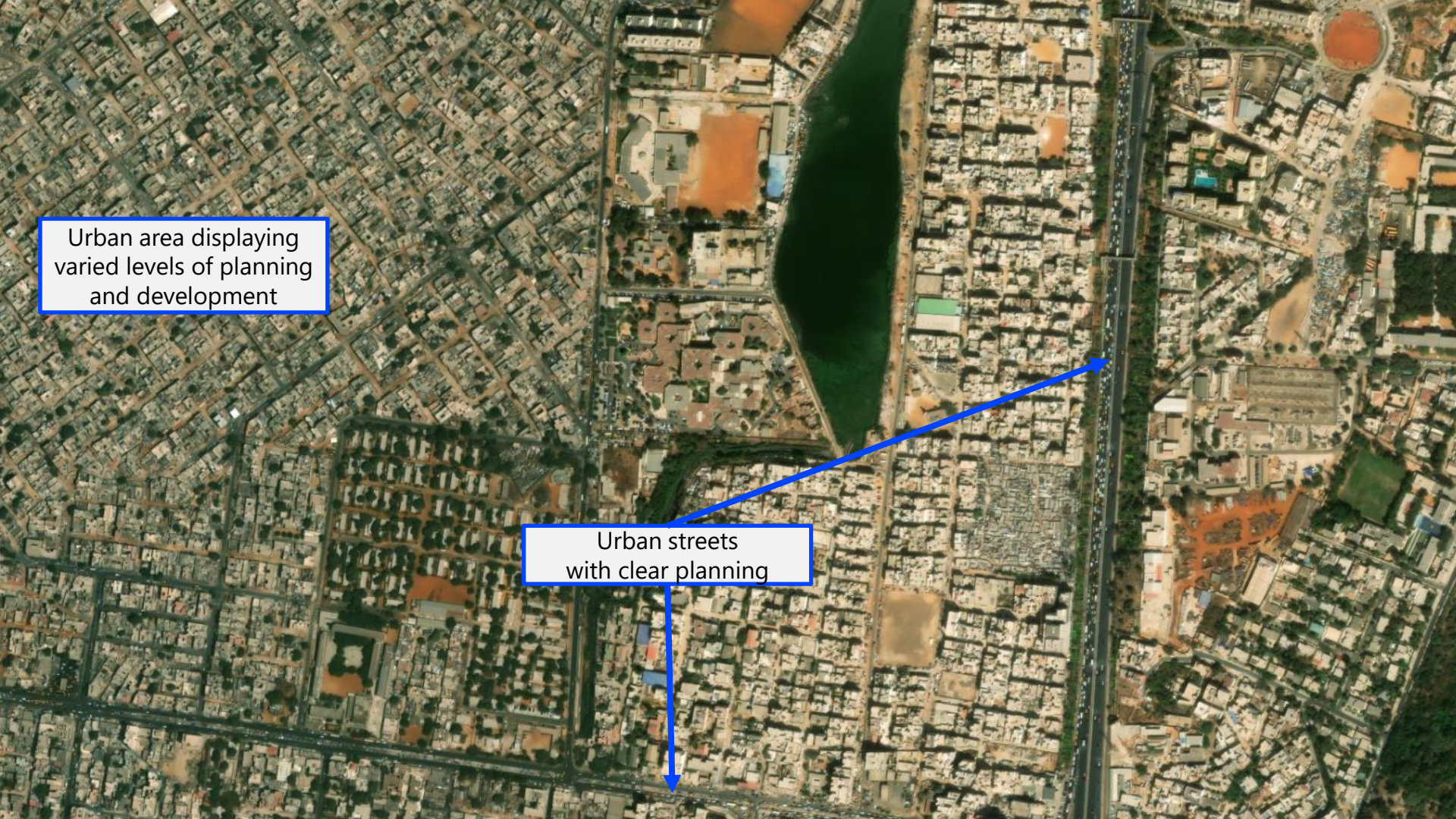Medium demand scenario

High demand scenario

Accurate demand assessment is critical for efficient resource allocation in energy planning, preventing overbuilding costs and avoiding underbuilding that can stifle economic growth.

Building-level Electricity Access and Demand Estimation Model

It is possible to gain high-resolution insights from space

Satellite imagery contains key indicators like building size and density, roof materials, and vegetation extent, serving as proxies to estimate the relative wealth of areas and their energy demands.

Urban area displaying varied levels of planning and development
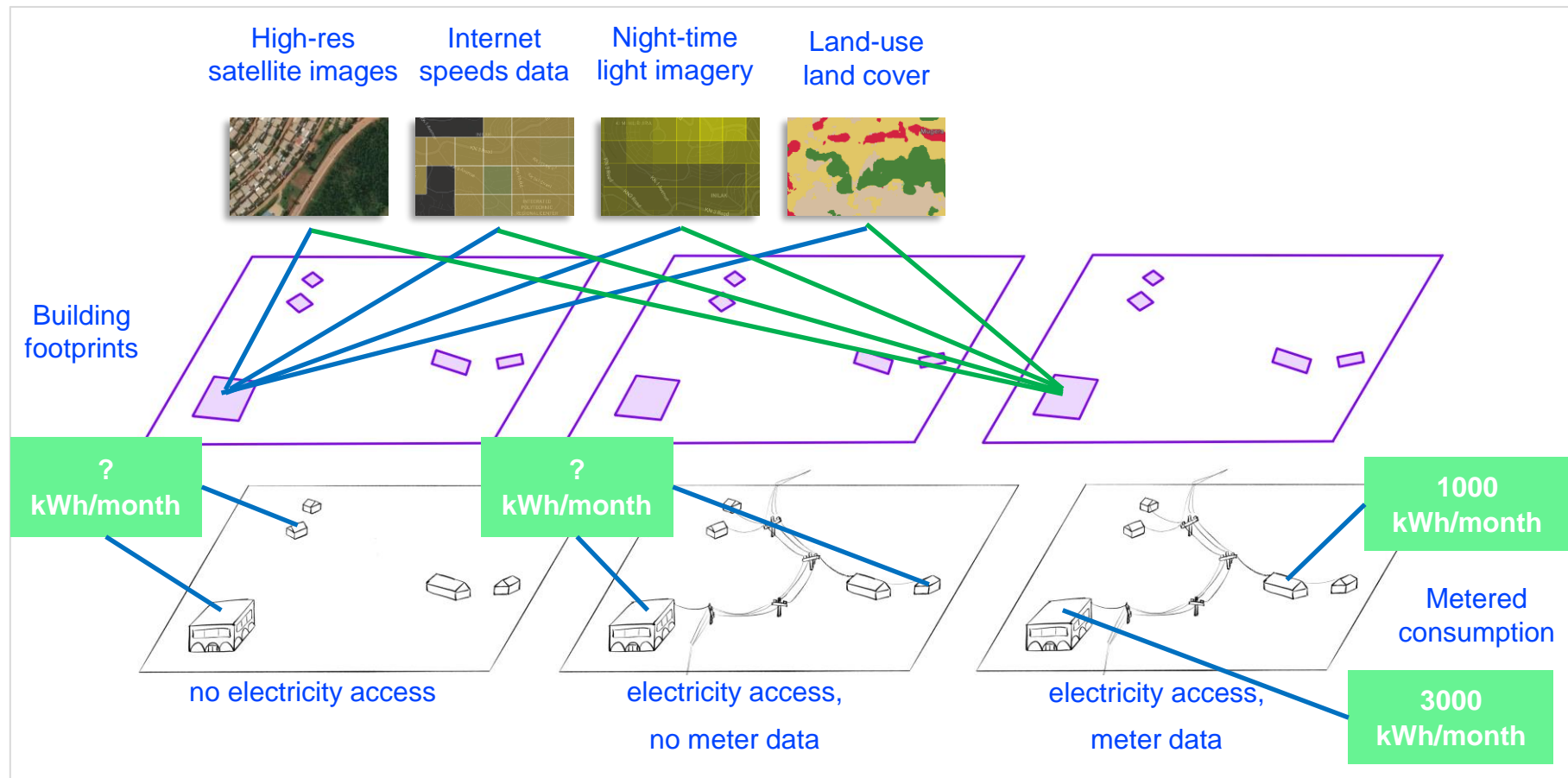
Urban streets with clear planning

Unpaved dirt road

Surrounding buildings indicative of lower-income residents

Commercial uses

Unpaved national road

Input data for the machine learning model

High-res satellite images Internet speeds data Night-time light imagery Land-use land cover

Building footprints

? kWh/month

? kWh/month

1000 kWh/month

3000 kWh/month

Metered consumption

no electricity access

electricity access, no meter data

electricity access, meter data

Conclusions

Potential applications

- **Data application in decision-making**: Data guides funders, including philanthropies and investment entities, in making informed portfolio decisions, shaping support programs specifically tailored for sub-Saharan Africa.

- **Enhancing local planning capabilities**: Granular data empowers local statistics divisions to refine their planning efforts, focusing on areas lagging in energy access, understanding the impact of off-grid solutions, and assessing progress in regions with active off-grid company operations.

- **Supporting project development**: Project developers leverage detailed data for business planning, including advance equipment orders, target setting, and the creation of compelling business pitches and press materials—providing an ancillary benefit of enhanced market positioning.

- **Policy and planning tool integration**: The data underpins policy decisions on electrification strategy, offering a foundational layer for GIS-based planning tools. Its granularity and open-source nature furnish planners and businesses with essential modelling capabilities for demand estimation, grid network planning, and customer analytics.

Aggregation enables scaling across the entire country.

Share of population with and without access to electricity by consumption level, selected location

Settlements polygon

With access	Without access

Share of buildings
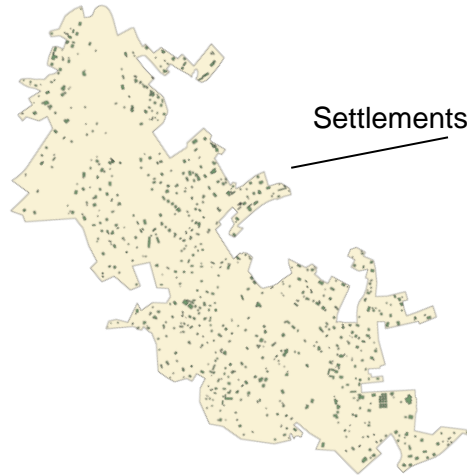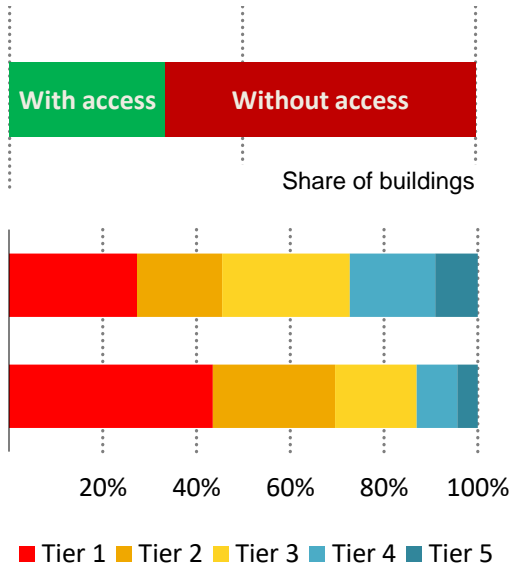
Using basic GIS techniques, you can **aggregate data at the settlement level** to determine the percentage of electrified buildings within each. This allows you to categorize cities and villages across a region based on their level of electricity access

With access

The model estimates the **current** consumption for buildings that currently **have access** to electricity

Without access

The model estimates **future** electricity demand for buildings that currently **lack access** to it

20% 40% 60% 80% 100%

■ Tier 1 ■ Tier 2 ■ Tier 3 ■ Tier 4 ■ Tier 5

|	
Number of buildings:	**153**
Population:	**752**
Per capita average electricity demand:	**22 kWh/month**

This GIS-format dataset, produced for pilot countries, enables you to calculate a community's total energy needs by aggregating building-level data. This supports cross-community comparison and strategic rollout planning.

More granular country-level access statistics are now achievable

Share of electrified population by Consumption **IEA Bundle** and **MTF Tier**
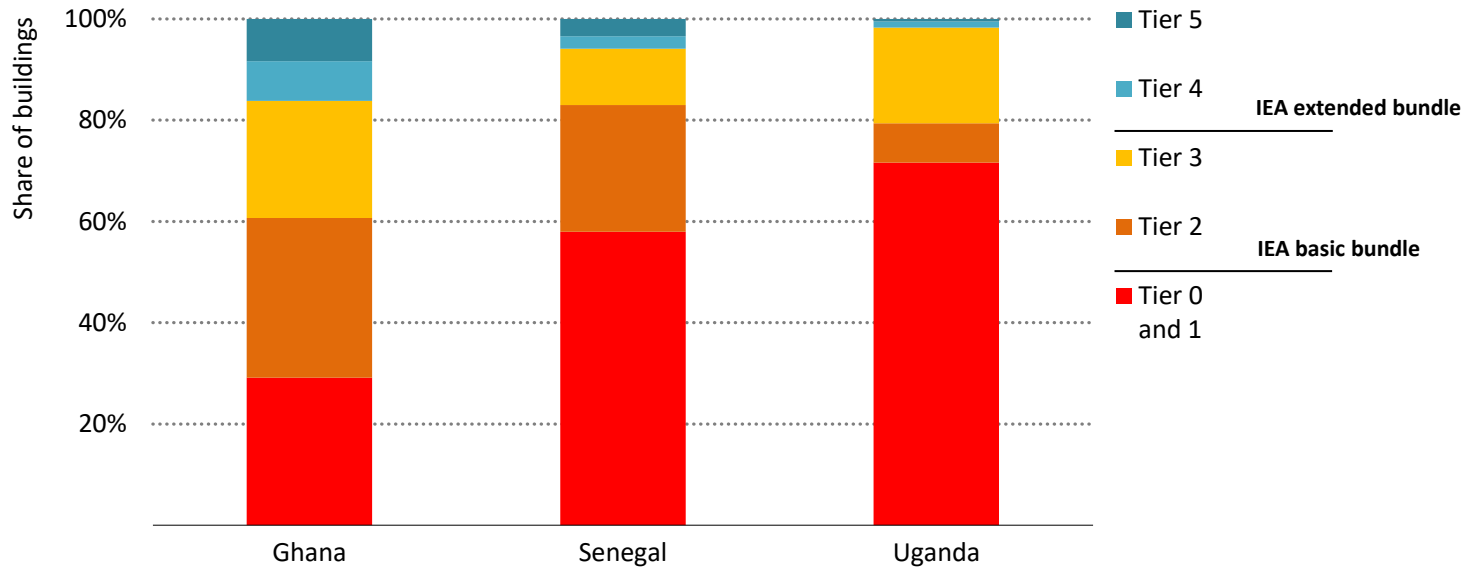
Despite electrification, current electricity consumption remains minimal, with a predominant majority of the population utilizing only the basic bundle or slightly more, equivalent to MTF Tier 2 levels.

Target stakeholders

- Government agencies and policymakers

- Utility companies

- International Development Organizations

- Non-governmental organizations (NGOs)

- Local governments and municipalities

- Investors and financial institutions

- Energy researchers

- Technology companies and energy startups

Next steps

- Integration with GIS-based models and tools
- Collaboration with partners

- Geographical scaling
- Model enhancement

darlain.edeme@iea.org
gis@iea.org