GIS-ENABLED DECISION SUPPORT SYSTEMS FOR GRID MODERNIZATION AND ELECTRICITY ACCESS

ABOUT THE ESGWG

- **GIS experts:** from MEMD, ERA, UEGCL, UETCL, UEDCL and PAU
- Agreed on common mapping standards and a common geo-database hosted by MEMD for the Energy Sector in Uganda.
- **Vision:** To develop a high-quality GIS for the Energy Sector of Uganda.
- **Mission:** To collect, process and share geo-data for the Energy Sector of Uganda to be used as a management decision support tool.

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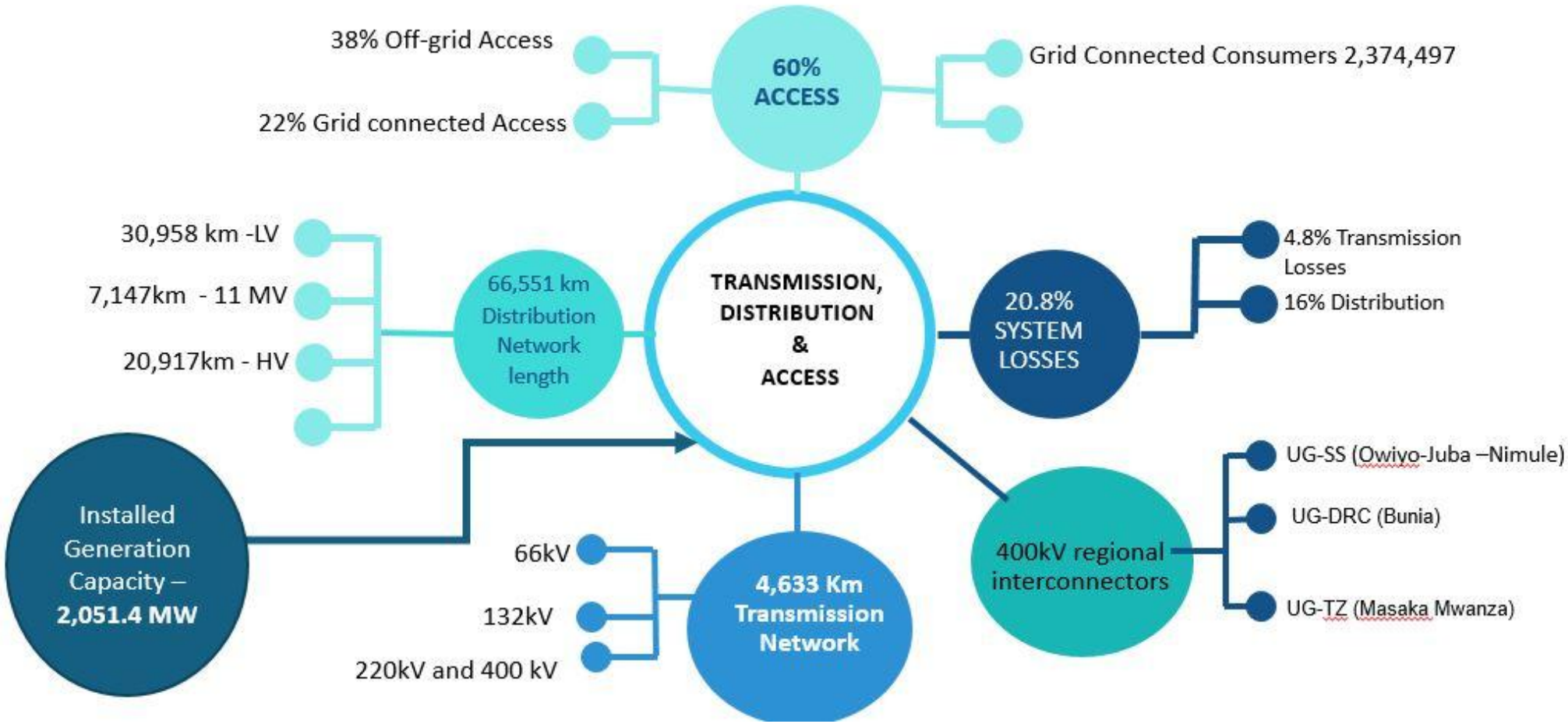
ELECTRICITY SECTOR INDUSTRY (ESI)



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ELECTRICITY ACCESS

Vision 2040

The number of people worldwide without electricity access is about 750 million with 80% (600m) located in Sub-Saharan Africa.(IEA,2023)

- **SDG 7:** Achieve Affordable and clean energy.
- **Vision 2040**: To achieve 80% electricity access by 2040

Need for data-driven approaches to inform energy planning

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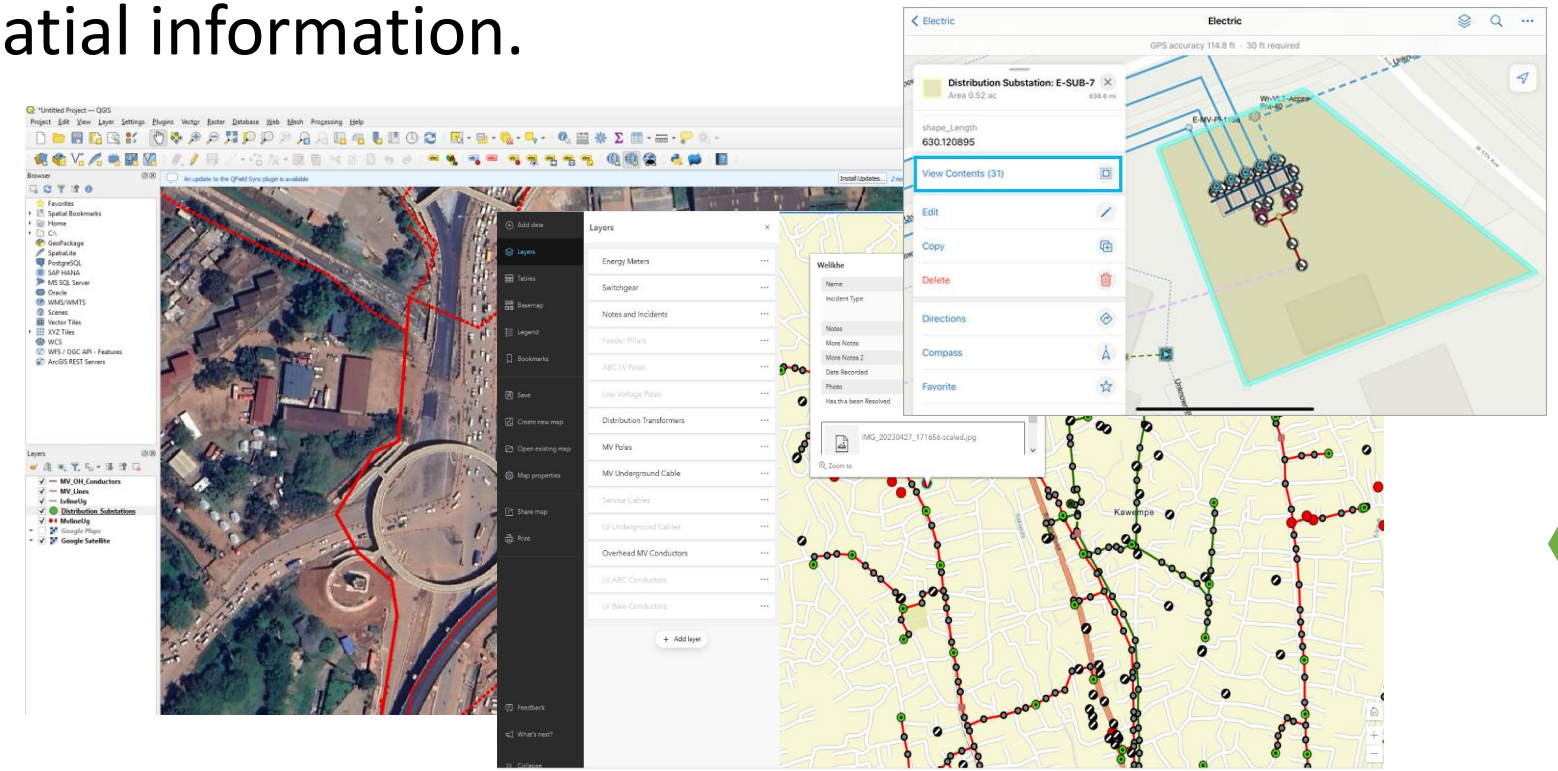
GIS

What is GIS?

Geography ➡ Information ➡ Systems

A tool/system for collecting, managing, analysing spatial information.



ArcGIS
Bently
QGIS
GRASS GIS

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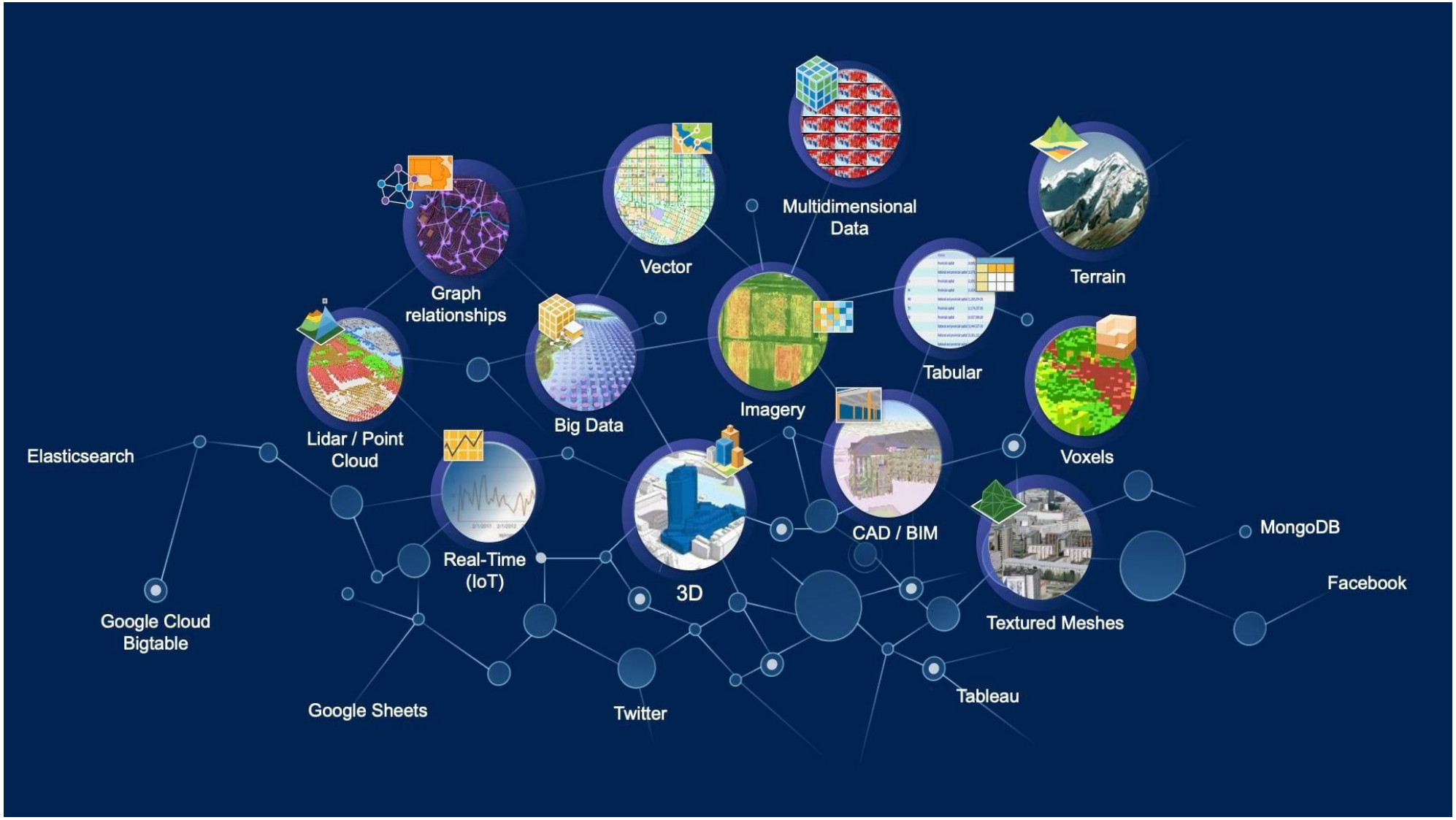
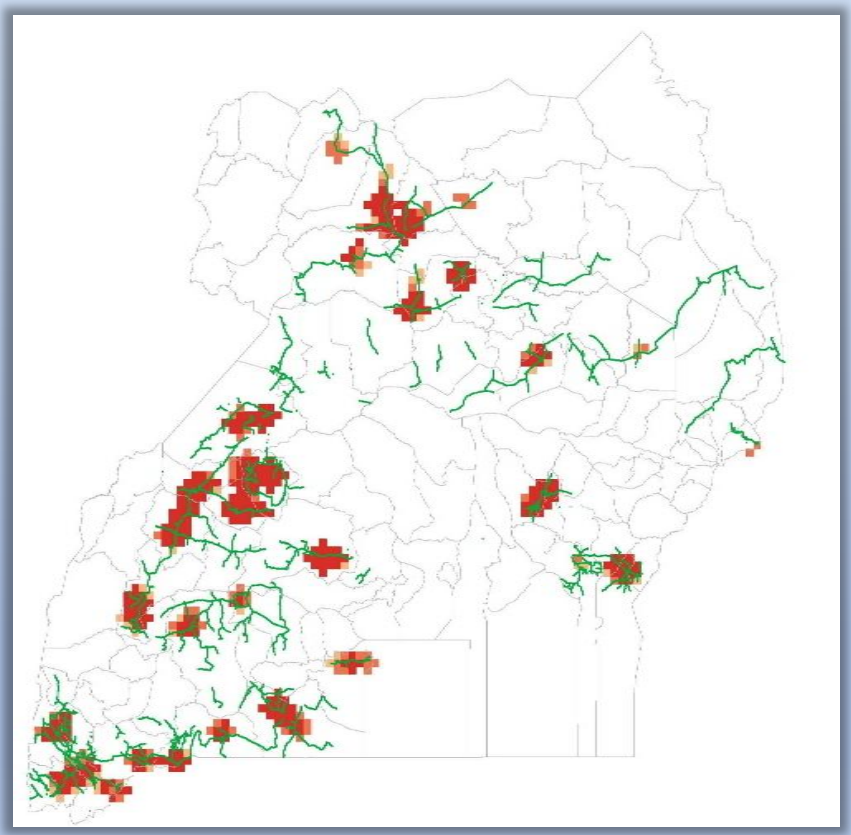
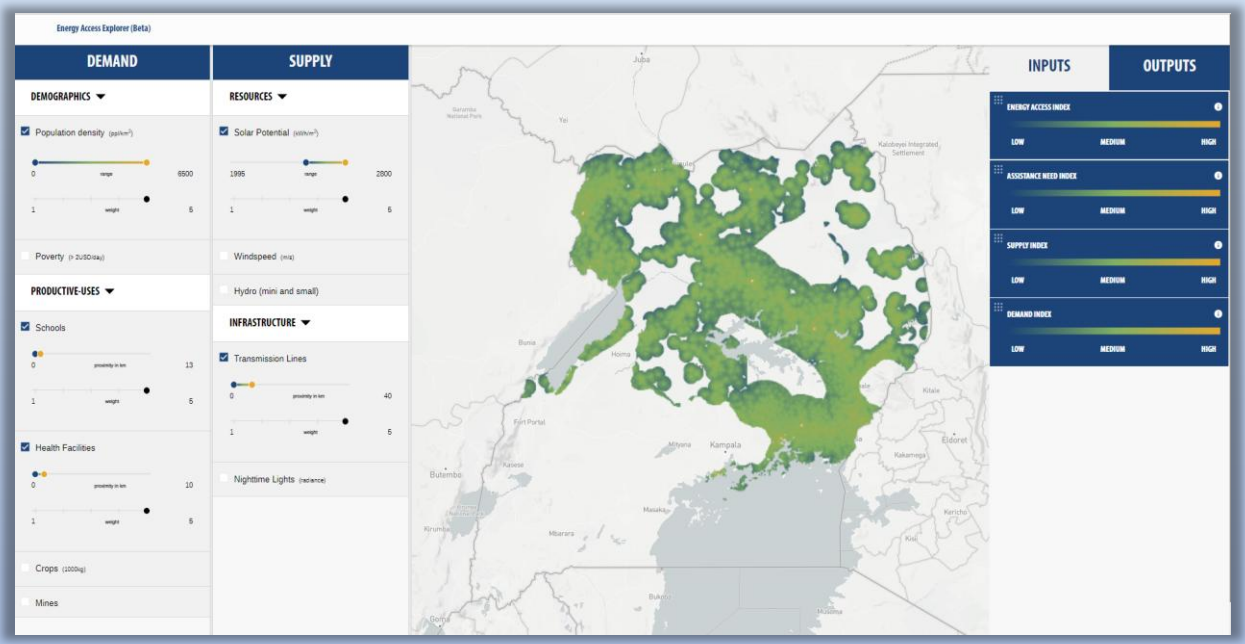
Data Sources



GIS and Electricity Access

Potential Customer Hotspots





Application Areas:

1) Planning
2) Site suitability analysis
3) Investment Targeting
4) Monitoring and Evaluation of EA Interventions
5) Cost analysis

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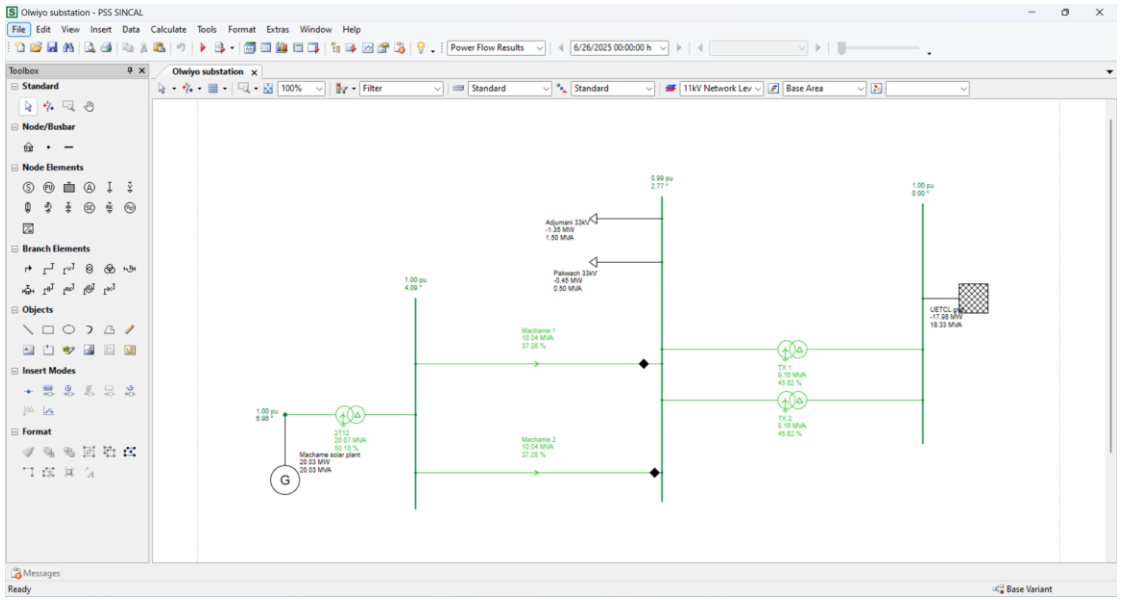
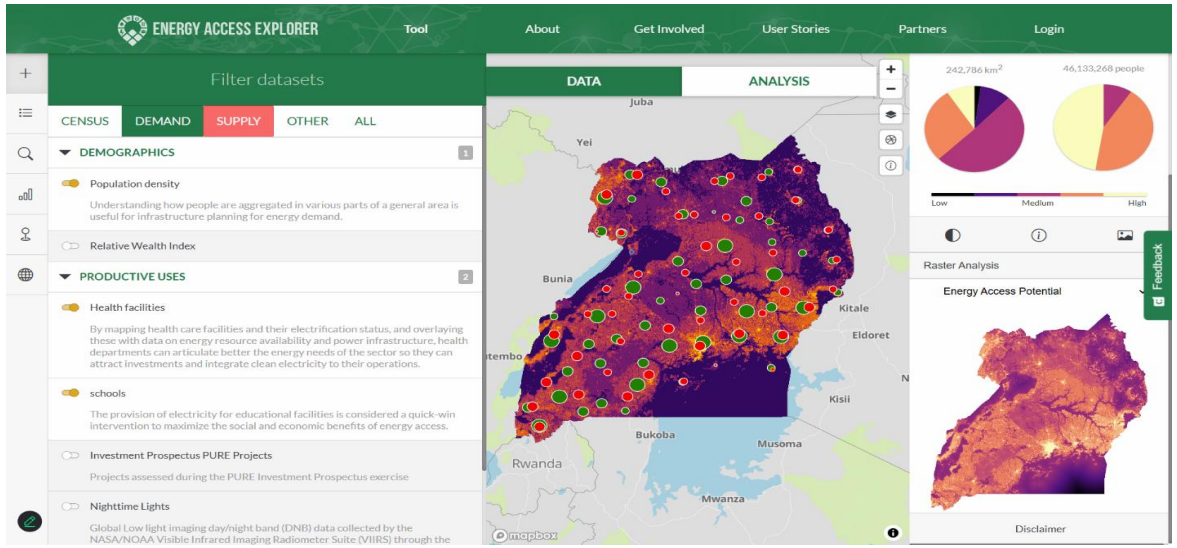
Interventions in Grid Modernization

Integrated Grid Planning





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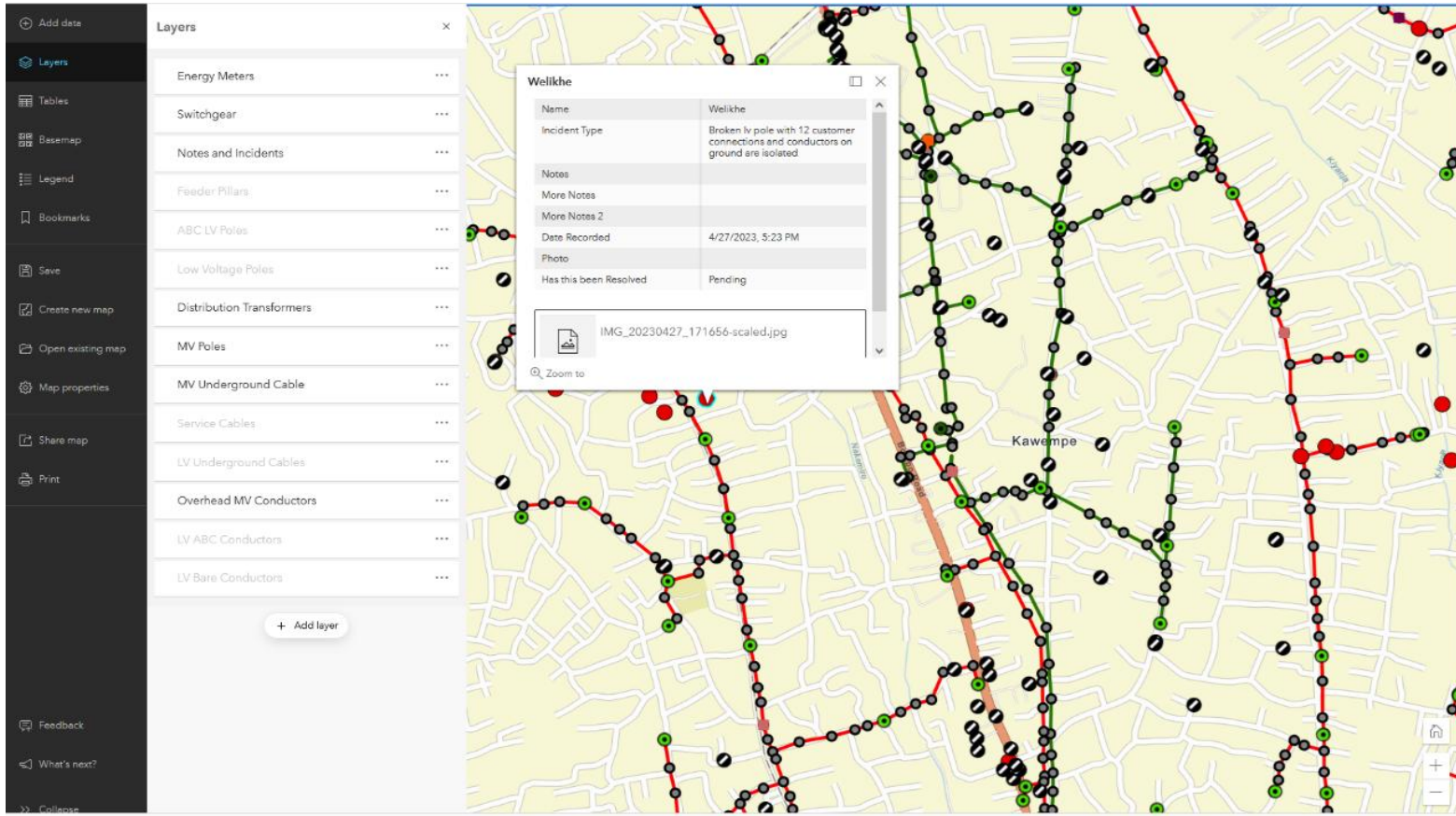
Interventions in Grid Modernization

Asset Management

- Centralized digital asset registry
- Condition/status monitoring & predictive maintenance
- Optimized maintenance workflows
- Risk-based investment planning
- Loss reduction by vandalism mitigation



Src. UEDCL

Focus

Data gaps, System integrations, skills gaps

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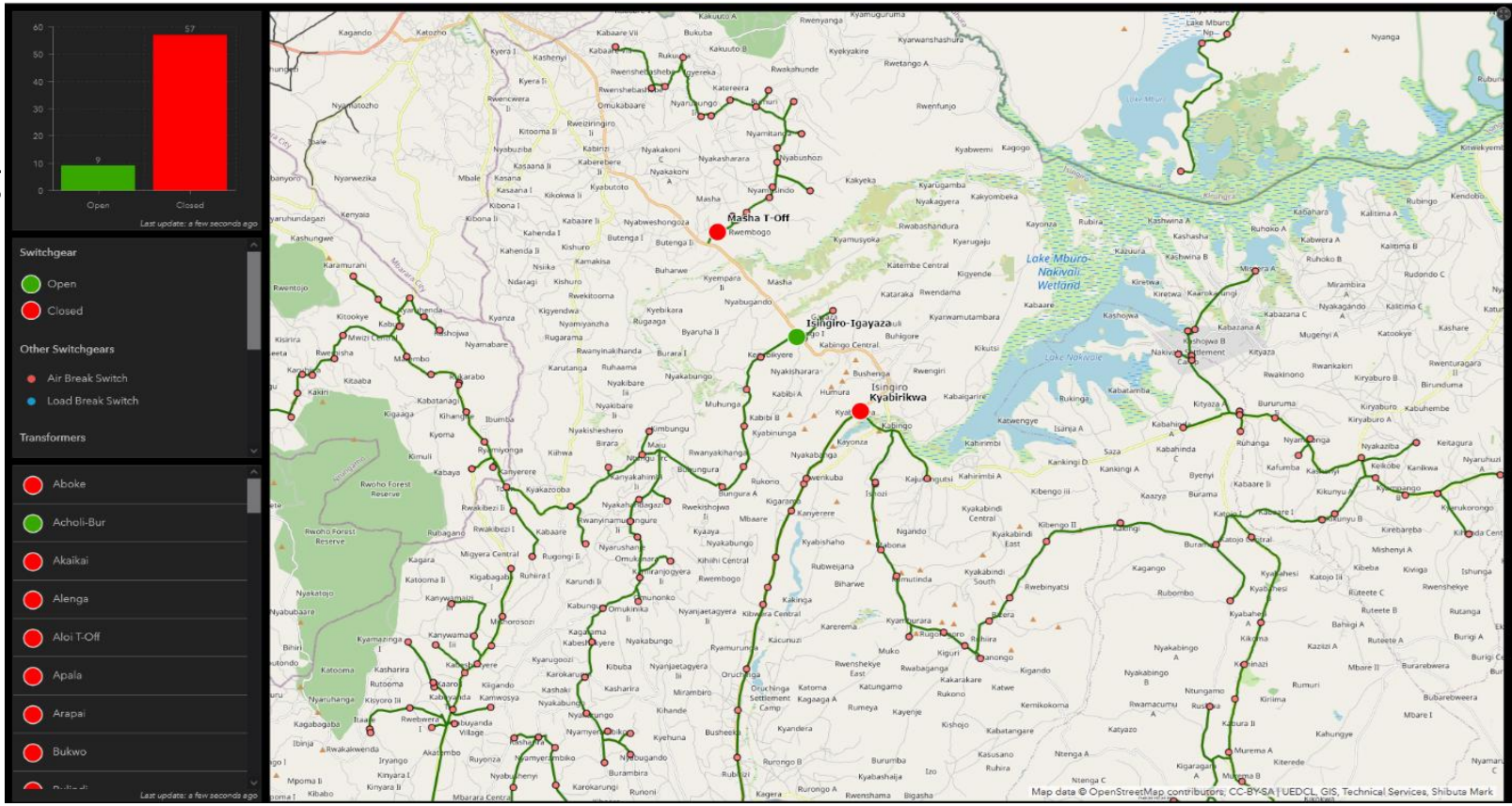
Interventions in Grid Modernization

Grid Automation

- “Digital Twin”
- Real-Time Situational Awareness
- Optimizing Automated Switching & Self-Healing
- Enhancing Voltage & Load Management
- Integrating Distributed Energy Resources (DERs)
- Automating field workforce operations



Focus

Data accuracy, system integrations, skills gap, cost

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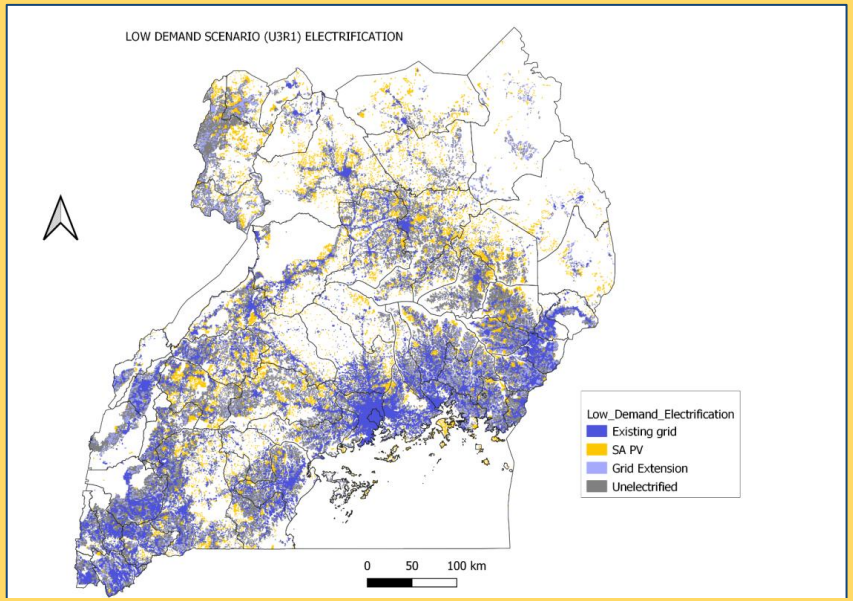
Src. UEDCL

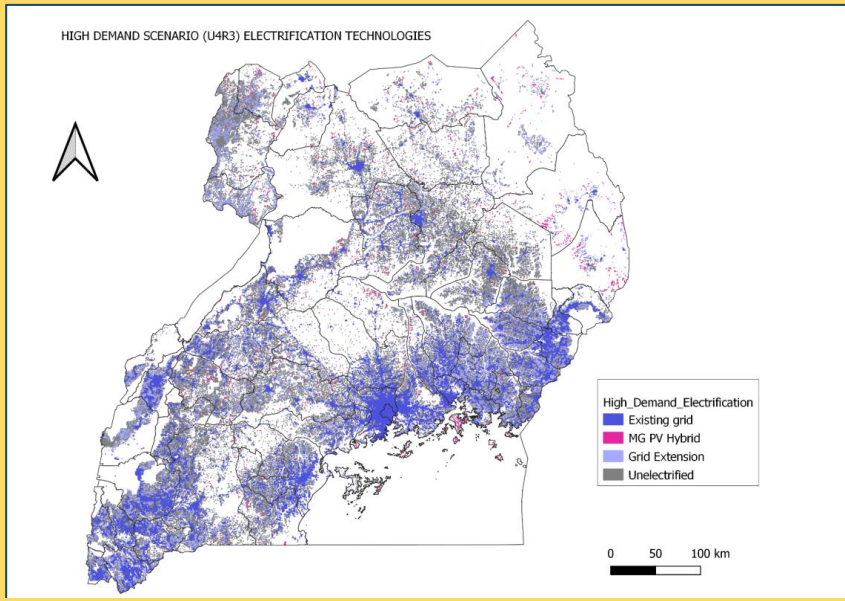
Interventions in Grid Modernization

Least Cost Electrification Modeling

Modelling variables

- Proximity
- Solar radiance
- Wind potential
- Terrain and environments
- Mobility
- Generation options





- SA PV alternative solution identified for low demand scenario and MG PV Hybrid solution identified for High Demand Scenario
- Grid extension solution most viable solution to increase access and meet the set Targets

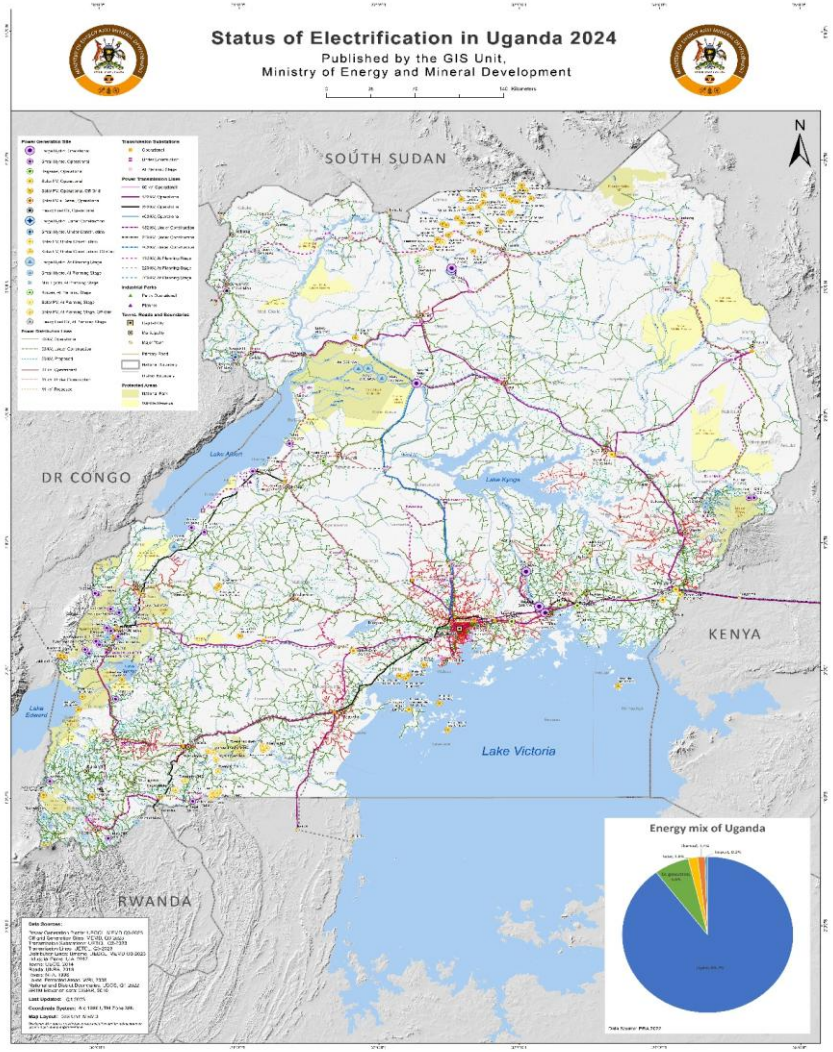
Interventions in Grid Modernization

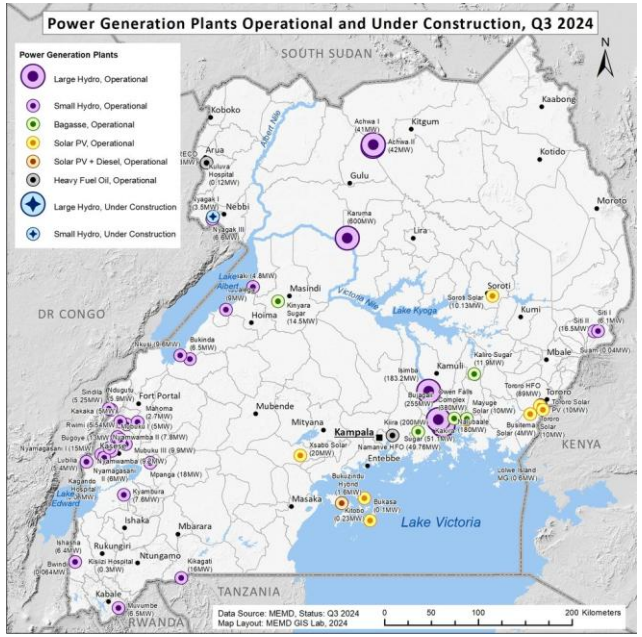
Inter agency collaboration

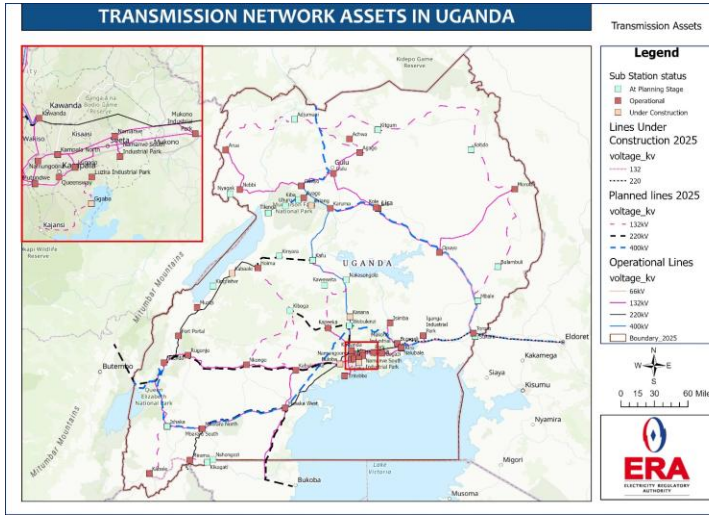
- Supporting Policy & Regulation
- Streamlining Planning
- Monitoring projects, schemes and interventions
- Enhancing Transparency & Coordination

Considerations

- Adoption of SDI for standardization
- Data availability and quality
- Intergratability of data and systems
- Effective ICT infrastructure
- Institutional buy-in







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Case Study/Demo

Energy Levelized cost of electrification for Uganda using GIS--2023

Context and Challenges

	Indicator	2020	2025	2030
1	Area	241,038 sq Km	-	-
2	Population	41,583,600 (Urban 27%, Rural 73%)	52,294,280	59,437,920
3	Access Rate	42.1% (urban 70%,Rural 33%		
4	NDP III Targets Electricity Access	24%	60%	75%
	Per capita electricity consumption	100 kWh	145kWh	578 kWh

Challenges

1. >50% of the population has no access to electricity

1. High cost of power generation and grid extension versus the domestic economic value of electricity generated

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Research Questions & Scenarios

???

- ❑ What are the most feasible technologies for electrification?
- ❑ What are the associated investment costs for each technology?
- ❑ Population with access by the end of the NDP III(2030)

Tool used: OnSSET tool

General Assumptions and considerations

- ➢ Population threshold- 50 people
- ➢ Productive use in Education and Health Facilities
- ➢ Uncapped rollout plan, Forced grid within 2km buffer& least cost approach outside of the buffer zone

Scenario Label	Scenario Description	Key Assumptions
Low Demand	Top- Down Demand target-Low	Urban demand-Tier 3 (803 kWh/hh/yr) and Rural Demand- Tier 1(38.7 kWh/hh/yr) by 2030
High Demand	Top- Down Demand target-High	Urban demand-Tier 4 (2117 kWh/hh/yr) & Rural Demand- Tier 3(803 kWh/hh/yr) by 2030

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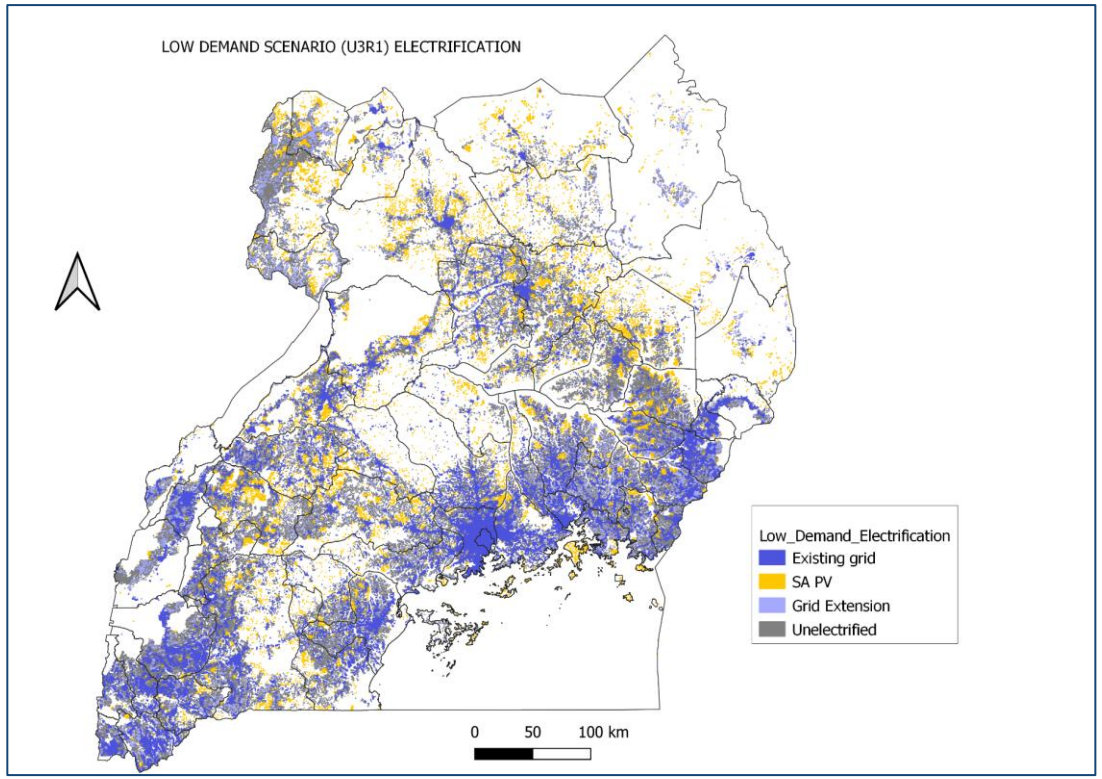
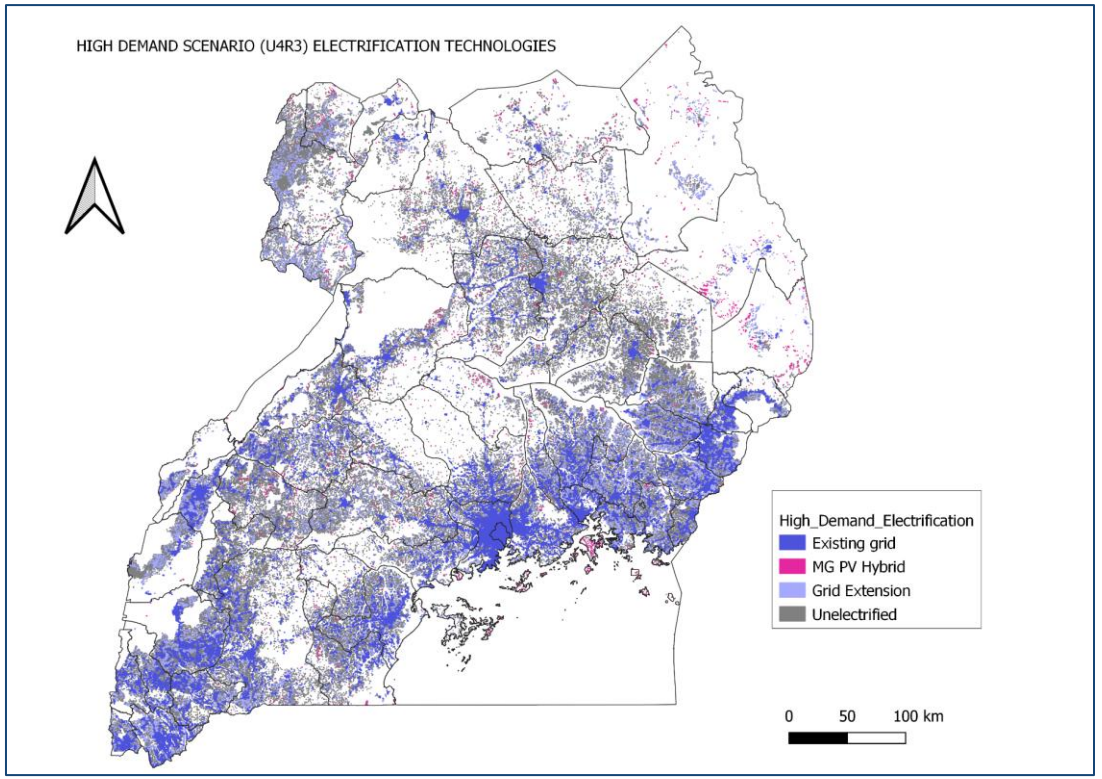
Results





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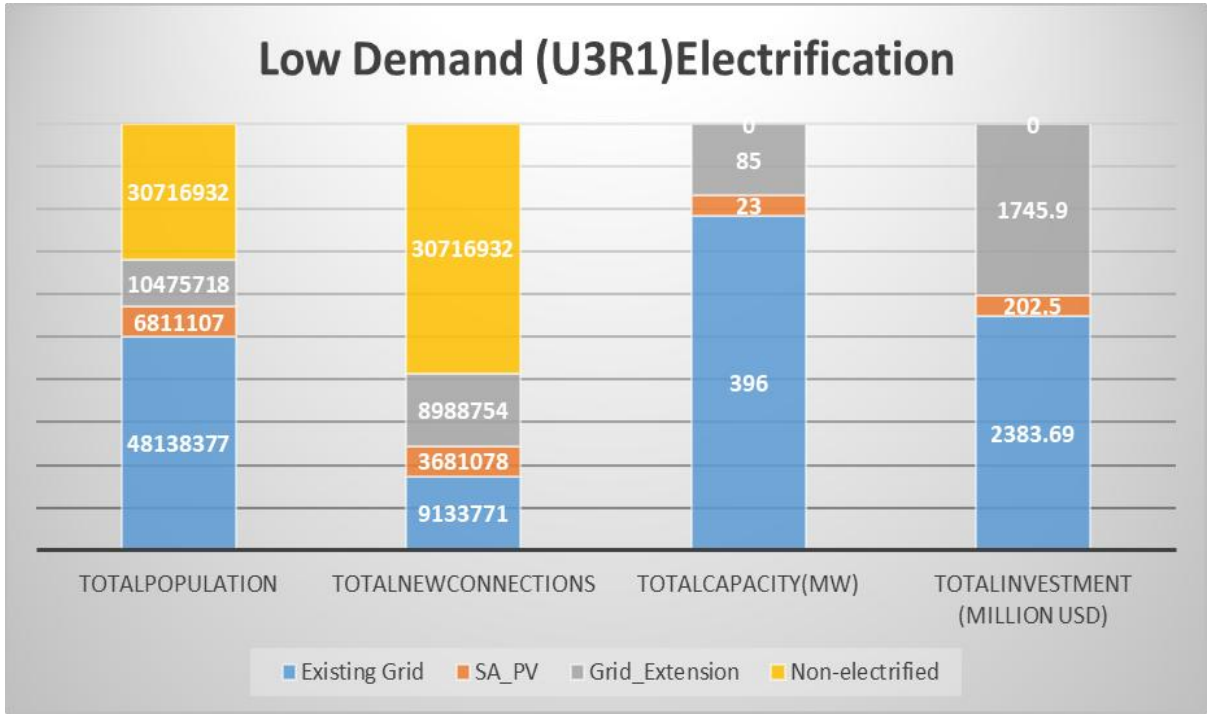
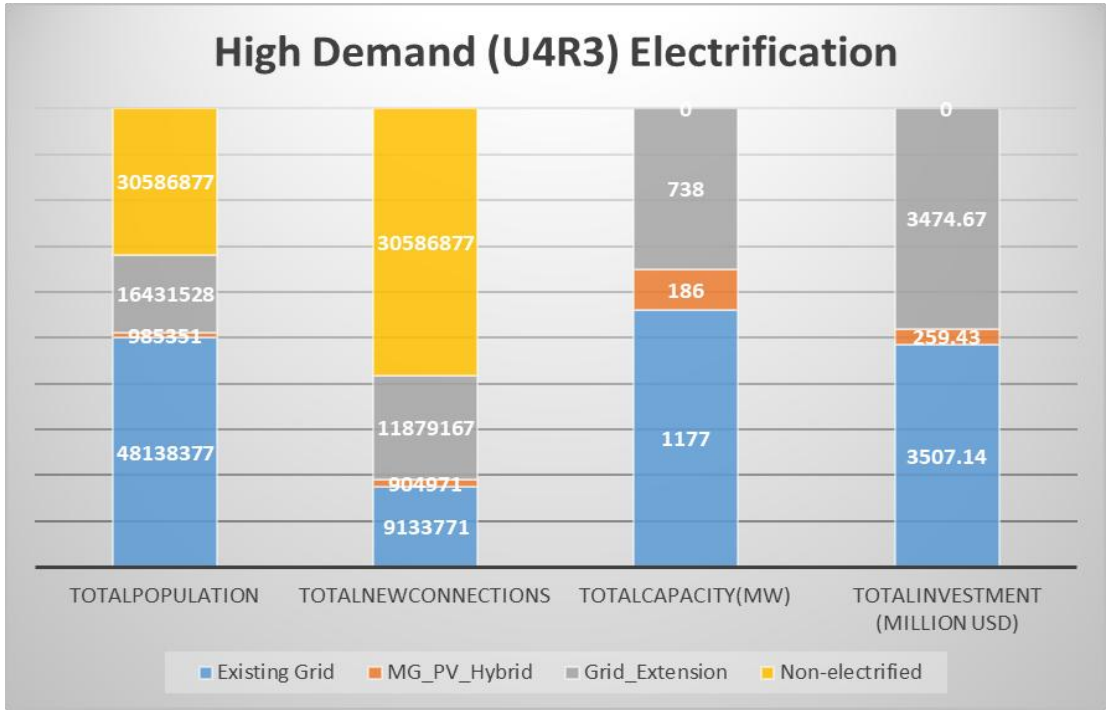
Results





- Population connected by Grid extension- 10,474,718 @1,746m USD
- Population connected by SA PV 681,1107 @ 202.5m USD

Population connected by Grid extension- 16,431,528 @3,474.67m USD

Population connected by MG PV Hybrid 985,351 @ 259.43m USD

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Conclusions and Policy Insights

Conclusion and Policy Insights

- Grid Intensification contributes the majority share of the 75% set Target by 2030
- Need to include or increase other technologies like solar PVs and Hybrid Minigrid to achieve the access targets
- Reliance on evidence based decision making(modelled scenarios) to inform policies on electricity access

Future Work

- Update of datasets and Inclusion of other productive uses of energy like Agriculture,etc..in the model
- Align the model with the Energy Transition Plan (ETP) currently under develoment in Uganda aimed at attaining zero carbon emissions
    - ❖ The ETP was finalized and launched at COP 28 in Dubai, Dec 2023. Plans to update the model are underway updated datasets

Thank You

Pay us a visit at the Exhibition Booth!!