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Energy Access Review

An era of surplus generation capacity in Eastern Africa

The development witnessed in the electricity sector across East Africa over the last 10 years is remarkable. Rwanda has doubled overall generation capacity from 101 MW in 2010 to 208 MW in just under 6 years[1]. Umeme in Uganda has almost halved electricity losses from a high of 38% in 2009 to about 19% at present[2]. Kenya Power, through the Last Mile Connectivity Program and other initiatives, now boasts of a customer base of more than 5 million up from about 2 million in 2012. The company's operating profit has more than doubled over the last four years topping US$ 169 million in 2016[3]. Programs to connect trading centers and public institutions are now common in most countries in the region. Together with this rapid progress the region is now witnessing an unprecedented expansion of electricity generation capacity which could ultimately result in an overall negative economic impact on these economies. In this review, we discuss the key message informing this expansion: the current low electrification rates in the region are largely due to low generation capacity and therefore the solution is to expand generation. The widespread message that countries in Sub Saharan Africa should double or triple their electricity generation capacity in the immediate term to raise the low electrification rates is incorrect. That these countries should increase their capacity is not in question – it is the pace of expansion that raises concerns.

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Figure 1: The 6,450 MW Grand Ethiopian Renaissance Dam under construction (credits: Salini Impreglio, April 2015)

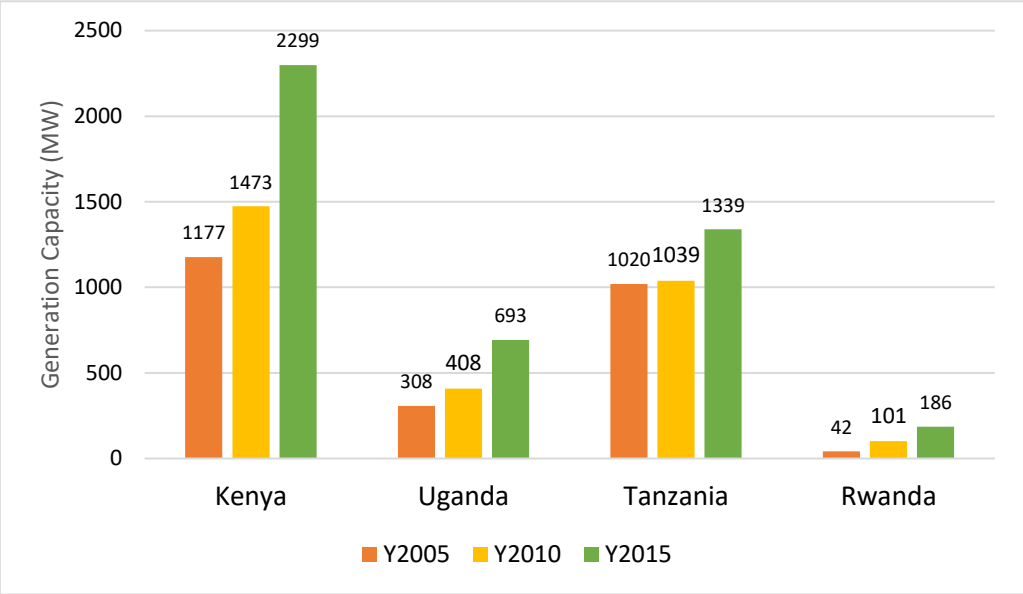
"If it were practical to connect every remaining Kenyan household to the grid today, the country would not need to add a single megawatt to the current installed capacity of 2,341 MW."

- Estimate based on Kenya Power's 2016 Annual Report -

[1] Rwanda Energy Group (2017), Stakeholders' briefing on 16th February 2017, Serena Hotel, Kigali. Retrieved from www.reg.rw on 23rd May 2017.
[2] Umeme Limited (2016), Integrated Annual Report 2016, Rwenzori House, Kampala, Uganda
[3] Kenya Power (2016) KENYA POWER ANNUAL REPORT and Financial Statements for the Year Ended 30 June 2016, NAIROBI

Based on Kenya Power's 2016 Annual Report, for example, we estimate that if it were practical to connect every remaining household to the grid today, the country would not need to add a single megawatt to the current installed capacity of 2,341 MW[1]. Across in Rwanda, the Rural Electrification Strategy of 2016 notes that almost half of the clients connected to the national grid consume less than 20kWh/month[2], meaning that even doubling or tripling the number of customers will not require several hundred megawatts of installed capacity.

Figure 2: Expanding Generation Capacity (Y2005 - Y2015)



Sources of data: Kenya Power (2006*). Kenya Power and Lightning Company Limited Annual Report and Accounts 2005 – 2006;* Kenya Power (2010). *Kenya Power and Lightning Company Limited Annual Report and Financial Statements for the Year Ended 30 June 2010;* Kenya Power (2015). *Kenya Power and Lightning Company Limited Annual Report and Financial Statements 2014/2015;* IFC (2011). *Uganda: Bujagali Hydropower Project. A Case Study on Risk Mitigation through PPP Structuring*; ERA (2016). *Electricity Regulatory Authority: Electricity Generation KPIs;* ERA (2016). *Electricity Regulatory Authority: Electricity Generation KPIs;* EWURA (2007). *Energy and Water Utilities Regulatory Authority Annual Report 2006/2007;* EWURA (2010). *Energy and Water Utilities Regulatory Authority Annual Report the Year Ended 30th June, 2010*; EWURA (2015). *Energy and Water Utilities Regulatory Authority Annual Report the Year Ended 30th June, 2015*; Rwanda Energy Group (2017); EnDev (2016) Status of the Hydropower Sector in Rwanda; World Bank (2012). *Project Information Document (PID) Appraisal Stage Burundi – Energy Efficiency Project*

At 25%, Ethiopia's grid electrification rate is dismally low by any standards. With a population estimated at over a hundred million and a rapidly growing economy clocking an average expansion rate of 10% per annum each year over the last 10 years, Ethiopia is now the largest economy in the region in terms of GDP. The county also has the largest generation capacity at 4,284 MW – 89% of which is from hydro resources[3]. With only 25 million out of the 100 million connected to the national grid, it may seem reasonable to focus on rapid expansion of the generation capacity. This has been the headline reason across most of the countries in Eastern Africa with the key question being asked by governments, "how do we ensure that most of our population have access to modern energy?"

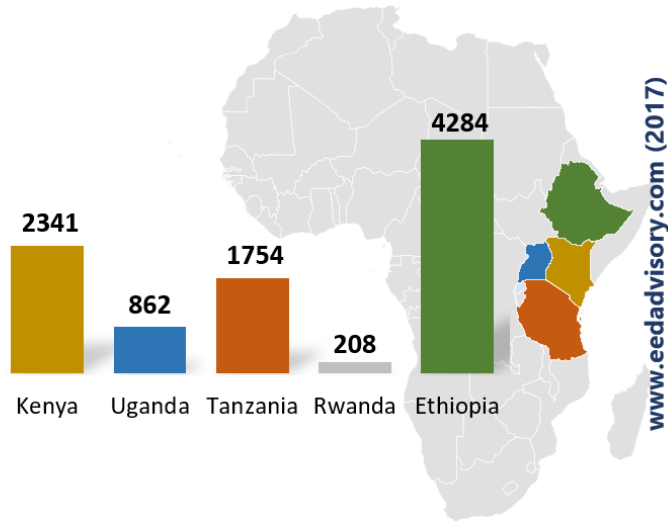
[1] Installed capacity reported in the Kenya Power (2016) KENYA POWER ANNUAL REPORT and Financial Statements for the Year Ended 30 June 2016, NAIROBI

[2] Ministry of Infrastructure (2016), Rural Electrification Strategy, Government of Rwanda, Kigali.

[3] Federal Democratic Republic of Ethiopia (2017), The Ethiopian Power Sector – A Renewable Future, Berlin Energy Transition Dialogue, Power Point Presentation.

The 2016 Umeme Integrated Annual Report estimates that only 16% of Uganda's households are connected to the grid. Although these forms 91% of Umeme's customers, their combined consumption was only 23% of the total sales in 2016[4]. Likewise, Kenya Power received only 29% of their 2016 sales from their domestic clients who constitute 93% of the client base. These numbers not only show that demand from domestic customers will remain marginal in the immediate term but that this alone cannot be a basis for the planned rapid expansion. Also, it should be expected that the average demand and electricity consumption per household from additional customers yet to be connected will be less than the current average because those that are currently connected tend to be urban dwellers and the rural middle to upper classes. These segments do consume more electricity than the expected average consumption of the unconnected. This explains why the peak demand in Kenya reported in 2016 stood at 1,586 MW even after a rapid electrification blitz that has resulted in a customer base of more than 5 million (see figure 4 below).

Figure 3: Installed Capacity in MW (2017 estimates)



Sources of Data: *As in Figure 2 above*

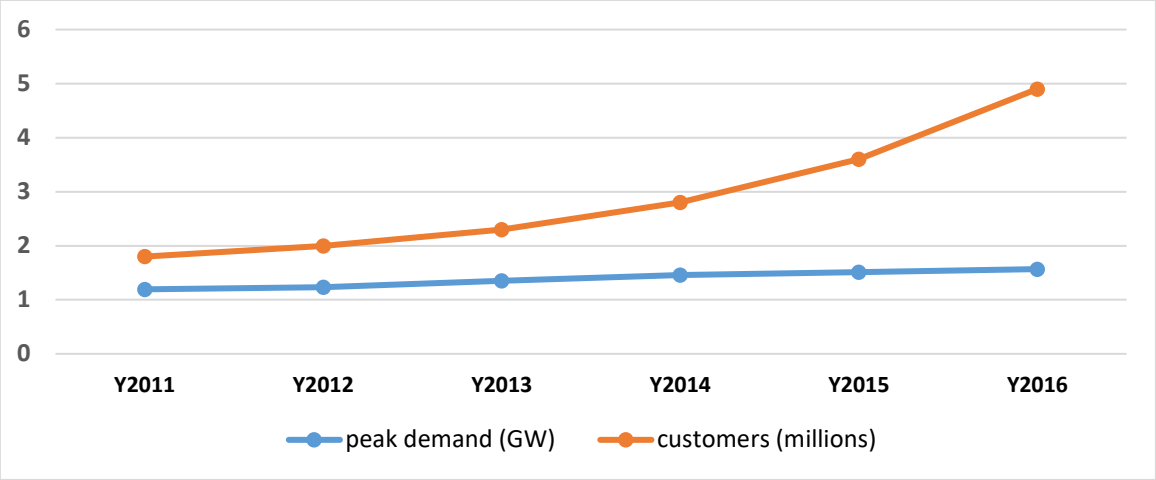
all with projects that will require sufficient and stable electricity supply. Also, many of these countries aspire to be net exporters of electricity. Kenya, for example, has plans to export electricity to Rwanda but at the same time imports from Uganda and plans to import more power from Ethiopia and Tanzania. All this cross

> **"These numbers not only show that demand from domestic customers will remain marginal in the immediate term but that this alone cannot be a basis for the planned rapid expansion."**

Even though the low electrification rate is often fronted as the justification for the rapid expansion of generation capacity, it is incomplete to say that this is the only reason given. Most countries have ambitious industrialization and economic expansion plans including Rwanda Vision 2020, Kenya Vision 2030, Tanzania Development Vision 2025, Uganda Vision 2025 – supply and demand of power in the region is good as it reduces vulnerability, especially in countries that rely heavily on weather sensitive resources like hydropower. However, if we take apart the current and projected demand driving expansion: rapid domestic electrification, anticipated industrial growth, major socio-economic projects and exports – there remains a

[4] Umeme Limited (2016), Integrated Annual Report 2016, Rwenzori House, Kampala, Uganda

Figure 4: Divergence of peak demand and number of connections (Data from Kenya Power 2016 Annual Report)



wide divergence between the realistic demand and projected expansion. In 2014, we argued [5] that Kenya's rapid expansion plan of 5,000 MW in 40 months was overly ambitious - not in terms of generation capacity but its implementation time. The plan would mean an annual increase in generation capacity of 1500MW per year which was staggering when compared against a recorded 10% annual increase in demand. It was expected that some of the capacity would power the Vision 2030 projects but even accounting for that still leaves unreasonably high excess capacity. Even the Least Cost Power Development Plan (LCPDP), which is an inter-government agency initiative led by the Energy Regulatory Commission (ERC), did not anticipate such a rapid increase in demand. The same is to be expected in other countries in the region. While Kenya marches forward towards its target of adding 5,000 MW, Uganda's current effective capacity is expected to nearly double when the Karuma (600 MW) and Isimba (183 MW) hydroelectric dam projects are completed.

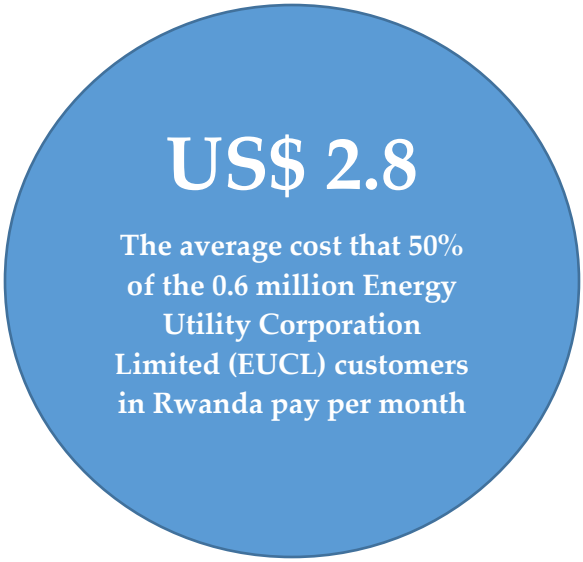
To electrify domestic customers, the bigger issue will always be the cost of distributing the power rather than the installed capacity. In Rwanda for example, 0.3 million of the 0.6 million Energy Utility Corporation Limited (EUCL) customers pay less than $2.8 per month. This is based on Rwanda Utilities Regulatory Authority (RURA) electricity tariffs[6] and estimates that less than half of the utility's customers use less than 20kWh/month. It is because of this and other factors that the 2016 Rwanda Electrification Strategy acknowledges that "a consumer would need to use approximately 130 kWh/month in order to fund the cost of their own connection". When discussing the cost of electrification, there are two averages that are often used interchangeably – the average cost of connecting a household and the average cost of connecting an additional household. The two are very different. One distinction is that the second can change within a geographic boundary (e.g. country or province) but the first will always be single number within such boundaries. For

[5] EED Advisory (2014) *Energy Access Review*, Energy, Environment and Development Advisory, Publication number; 14-Q1EA, Nairobi, Kenya

[6] RURA Board Decision No. 05/BD/ER-LER/RURA/2016 effecting new tariffs from January 1st, 2017

example, the cost of an additional connection in Morogoro region in Tanzania could vary in Kilosa district compared to Gairo. Even within Kilosa, this number could vary. However, the average cost of a connection in Morogoro will always be the total cost of all connections divided by the number of connections. Either way, the cost of connecting households remains a big barrier to electrification.

If raising the low electrification rate remains the main motivation for the rapid capacity expansion, then East Africa's power sector will soon enter an era of significant uncertainty as the excess capacity reaches unprecedented levels and surpasses the projected demand. Utilities and institutions responsible for the electricity sector need to depend more on careful projections such as those done through Least Cost Modelling approaches rather than ambitious development goals to avoid a situation where the electricity sector is all dressed up and has nowhere to go.



Summary of the Performance of Select Water Utilities in Africa

Universal and equitable access to safe and affordable drinking water alongside access to adequate sanitation and hygiene for all by 2030 are targets that fall under SDG#6 (Sustainable Development Goals). Access to piped water in Sub-Saharan Africa has been increasing steadily from the start of the millennium to date. By 2015 however, access to piped water on premises as a primary source of supply was at 33%, a definite decline from 40% in 2000. One of the reasons cited for this was a rapidly expanding urban population.

A study was carried out to investigate the performance of water utilities in Africa making use of data from 120 utilities across 14 low and lower-middle income countries from the years 2000 to 2015. Table 1 below highlights the performance of case study utilities across different indices in select countries namely Kenya, Uganda, Burkina Faso, Senegal and Côte d'Ivoire. The final report notably outlines the challenges of a lack of agreement on what good performance for utilities constitutes, a seemingly illusive balance between offering sustainable and affordable water services, and among others. It is also noted that the utility performance is given within its service area.

Table 1: Summary of Performance of Case Study Utilities

Indicator	Global benchmark	Africa benchmark	Kenya, NCWSC (2014)	Uganda, NWSC (2013)	Burkina Faso, ONEA (2014)	Senegal, SDE/SONES (2013)	Côte d'Ivoire SODECI (2014)
Non-Revenue Water (m3/connection/ day)	0.121	0.205	0.697	0.265	0.135	0.159	0.174
Non-Revenue Water, NRW (%)	—	30.3	39	35	19	20	24
Metering (%)	100	100	94	100	97	96	98
Staff-efficiency	4.27	4.21	2.10	4.34	3.04	5.24	5.83
Staff per 1,000 connections	—	5.0	5.0	5.4	3.2	2.4	2.9
OCCR*	1.38	1.19	1.01	1.30	1.13	1.33	1.06
Collection ratio (%)	—	91.3	91	96	97	94	86
People per connection	3.0	8.3	9.6	9.4	12.9	10.8	14.9
Reliability (hours of supply)	24	21.6	18	20	23	23	20
Affordability (%)	0.5	1.22	2.14	3.40	2.53	2.16	0.96
Water consumption per capita/day	—	77.1	110	52	47	59	39
Water coverage (%)	100	77	75	78	86	98	69
Water coverage in people served in utility (2013), millions	n.a.	n.a.	2.9	3.0	3.9	5.8	11.7
Pop. in service area of utility (2013), millions	n.a.	n.a.	3.9	3.8	4.8	5.9	17.0
Pop. according to JMP with piped water on premises (2015), millions	n.a.	n.a.	10.1	2.0	1.4	7.9	9.1
Ranking	n.a.	n.a.	42	4	5	1	12

Note: the OCCR from the data collected through the Task Team Leaders and the annual reports show some discrepancy for Burkina Faso and Uganda. This may be linked to a different interpretation of the costs (including some financing costs). — = not available; n.a. = not applicable

Abbreviations: OCCR - Operating Cost Coverage Ratio; JMP - UNICEF-WHO Joint Monitoring Programme; NCWSC - Nairobi City Water and Sewerage Company (KE) NWSC - National Water and Sewerage Corporation (UG); ONEA - Office National de l'Eau et de l'Assainissement (Burkina Faso); SDE - Sénégalaise des Eaux (Senegal); SONES - Société Nationale des Eaux du Sénégal; SODECI - Société de Distribution d'Eau de la Côte d'Ivoire

Source of data: Van den Berg, Caroline, and Alexander Danilenko (2017), *Performance of Water Utilities in Africa*, World Bank, Washington, DC

First Quarter 2017 Energy Access News Highlights

- **AfDB support for Tanzania's off-grid energy plans -** The African Development Bank has approved a US$ 870,000 grant to promote off-grid electricity generation to the East African state. The grant is funded by the governments of Denmark, UK, US and Italy. It was announced in January under the Sustainable Energy for Africa facility. The resources will fund private sector clean energy projects, in a bid to improve access to electricity in rural areas of the country.
- **Tanzania's President sacks managing director of TANESCO (Tanzania Electric Supply Company) over electricity tariff hike** - President John Magufuli in January sacked Mr Felchesmi Mramba who was the head of the state-run electricity company after the firm hiked tariffs by 8.53%. Dr Magufuli said the raised rates would stymie his plans to industrialize the country and went on to rescind the price increase. However, the tariff increase, according to the power firm, was to address their losses and clear debts to independent power producers and fuel suppliers. Tito Esau Mwinuka, a Senior Lecturer of Mechanical Engineering at the University of Dar es Salaam, is the acting managing director of TANESCO.
- **U.S. firm seeks US$ 561 million from Tanzania in power supply dispute –** Symbion Power is accusing TANESCO of a breach of contract and seeks US$ 561 million as a result, the US firm said in March. Symbion's spokesperson Julie Foster said it sued TANESCO at the International Chamber of Commerce's International Court of Arbitration in Paris in March, saying it had failed to honour a 15-year agreement. Symbion owns a 120 megawatts (MW) thermal power plant in Tanzania's commercial capital Dar es Salaam and is one of the independent producers that sell power to TANESCO.

- **KenGen plans to sell power directly to large consumers –** Kenya Electricity Generating Company (KenGen) intends to supply electricity directly to consumers than it currently does, through the Kenya Power (KPLC). This will cushion KenGen from risks associated with the current single buyer model where KPLC buys all the power generated in the country for resale to retail consumers. The firm awaits the enactment of Energy Bill, currently in Parliament, to cement this plan. The 2015 Bill provides for more players in the wholesale and retail electricity market, giving KenGen an option to sell bulk energy to multiple customers. KenGen intends to work with firms that will operate at its planned industrial park in Olkaria, Naivasha.
- **Four countries sign on Kenya's nuclear energy plans –** Russia, China, South Korea and Slovakia have all signed pacts that will see them assist Kenya to

build capacity to set up its first US$ 5 billion nuclear plant from 2022. The memoranda of understanding will help Kenya wade through plans to establish nuclear power plants. This was the highlight of the Kenya Nuclear Energy Week and Conference in Nairobi in March. It was organized by Kenya Nuclear Electricity Board (KNEB). Various stakeholders deliberated the country's preparedness to venture into nuclear energy generation, the concerns, risks and benefits. Nuclear generating companies from Russia, China and Korea showcased various technologies used to generate nuclear energy with each angling for the USD$ 20 billion power project expected in the next decade in Kenya. The first reactor in the country will have a capacity of 1,000 MW, which is equivalent to 42 per cent of the country's current installed electricity capacity. KNEB plans to put up at least four of this nuke plants with a total output of 4,000 MW by the time of completion.

- **Coal-fired plant gets greenlight from ERC –** The Energy Regulatory Commission (ERC) has approved the construction of Kenya's first coal-fired power plant in Lamu after rejecting objections to the project by a community-based organisation. This means Amu Power Company Limited, a consortium including Centum Investments, is cleared to get a power generation licence that has been withheld since last year following opposition by Save Lamu Natural Justice. ERC says the environmental, technical and economic issues raised by Save Lamu have been reviewed and addressed. On technical matters, the regulator said the plant's location is "appropriate" and that it will supply the coast region with sufficient power while helping to cut energy costs of transmission and technical losses. The regulator added that the project cost will be recovered through the tariff as contained in the power purchase agreement.
- **Kenya signs US$ 67 million loan for electricity connection -** 1.5 million people will access electricity by 2020 after the government signed a US$ 67 million loan towards last mile connectivity project. The loan signed in March with European Investment Bank (EIB) targets universal access to electricity for the Kenyan population in three years. It is part of a European "blended" financing package comprising a US$ 10 million loan from the Agence Française de Développement and a US$ 33 million grant from the European Union. "Thanks to today's signature over 300,000 Kenyan households – up to 1.5 million people - will soon be connected to the electricity grid, a basic condition for further economic growth. Two further projects that we have committed to will improve access to Mombasa harbour and support geothermal energy at Olkaria," said EIB Vice President Pim van Ballekom, responsible for operations in East Africa.

- **Tullow Oil sells Uganda project stake for US$ 900 million -** Tullow Oil in January agreed to sell a stake in a Ugandan oil project to French group, Total, for US$ 900 million. A subsidiary of Total will acquire a 21.6 per cent stake in the Lake Albert Development Project from Tullow Oil. Tullow, the Irish company, headed by chief executive Aidan Heavey, will be left with an 11.8 per cent interest. This will come down to 10 per cent when the Uganda government will formerly exercise a right to take a stake in the project. The deal involves an initial US$ 100 million cash payment, with a further US$ 50 million due when the final investment decision has been made. Another US$ 50 million will be due when oil starts to be pumped.

- **EU announces US$ 327 million for 19 green projects in Africa -** The EU has announced a contribution of US$ 327 million for 19 renewable energy projects in Africa. The investment, which comes as part of the Africa Renewable Energy Initiative (AREI), is expected to leverage around US$ 5.23 billion and add 1.8 gigawatts (GW) of new clean power generation on the continent. It will contribute to the EU's 2020 goals of giving 30 million more people access to sustainable electricity, saving 11 million tonnes of Carbon Dioxide each year and generating 5 GW of new renewable energy in Africa. One of AREI's key objectives is to generate 10 GW of new renewable energy in Africa by 2020 and to unlock the continent's potential to generate as much as 300 GW from renewables by 2030.

In the Next Issues of Energy Access Review

- Carbon Footprinting – Awareness and Innovations
- Electricity Supply Monitoring Initiative (ESMI) – Measuring Electricity Quality
- Regular updates on energy access from Tanzania, Kenya, Uganda and the Africa region

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