



Tanzania

Improving Sustainability of the Power Sector and Accelerating Electricity Access: A Proposed WBG Roadmap

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**Improving Sustainability of the Power Sector and
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A Proposed WBG Roadmap
May 2024**

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Improving Sustainability of the Power Sector and Accelerating Electricity Access in Tanzania: A Proposed WBG Roadmap April 2024

Introduction

The United Republic of Tanzania (URT) is a country in Eastern Africa with a population estimated at 61.75 million, inclusive of 1.89 million in Zanzibar¹. Tanzania has expanded the power grid to reach nearly 100% of villages in the country, and electricity access in Tanzania has increased from 14% in 2011 to 46% in 2022². Nevertheless, more than half the population remains in the dark. Similarly, Tanzania's domestic low-cost resources provide conditions for affordable electricity, but remain mostly underdeveloped.

Those who do have an electricity connection in Tanzania experience poor reliability and quality of service provision due to a deteriorating network and limited O&M, and TANESCO's financial sustainability and viability are precarious with tariffs that require revision. At the same time, power infrastructure is inadequate to meet growing demand, public funding is inadequate for improvement and expansion of infrastructure, and the enabling environment for private investment is limited.

Overall, the Government needs a clear vision and practical implementation plan(s) to achieve its objectives. This high-level policy note serves as the foundation for the WBG strategic engagement in Tanzania's electricity sector. It describes in detail the status of the sector and highlights the reform areas that need to be addressed to place it on a financially and operationally sustainable path while accelerating access to electricity.

Country Context

Tanzania is formed by the union between mainland Tanzania and Zanzibar Islands. It extends over 947,303 km² (30th largest in the world), with population estimated at 61.75 million, inclusive of 1.89 million in Zanzibar³. Tanzania is a lower-middle-income country with a per capita gross national income (GNI) of US\$1,253 in 2022. The population is young with a median age of 18 years and is growing at about 3 % annually, putting Tanzania among the countries with the fastest population growth rates globally, driven partly by the high total fertility rate and the reduction in childhood mortality. The Human Capital Index (HCI) for Tanzania in 2020, which quantifies the contribution of health and education to the productivity of the next generation of workforce was estimated at 0.39. This figure is similar to that of Burundi, but just below the figure for Malawi (0.41) and Zambia (0.40), and much below that of Kenya (0.55). Tanzania holds position 152 of 174 in HCI ranking among countries.

Zanzibar is a semi-autonomous region of Tanzania, having its own legislative assembly, judicial system, and an executive power - the Revolutionary Government of Zanzibar (RGoZ) - headed by the President. The Zanzibar archipelago consists of two main islands, Unguja and Pemba, which are located roughly 35 km from the coast of mainland Tanzania and are surrounded by a group of approximately 50 islets. Total area is around 2,500 km². Zanzibar's population was 1.89 million in 2022, with about 70 % in Unguja and the rest in Pemba. Over 60 % of the inhabitants live in urban areas. The population density of Zanzibar is

1 Administrative units Population Distribution Report Tanzania December 2022

2 Tracking SDG7 Report

3 Administrative units Population Distribution Report Tanzania December 2022

more than ten times higher than on mainland Tanzania and its urbanization rate is twice as much as the national average (33%).

Sector Overview

Institutions on Mainland

The Ministry of Energy (MoE) is responsible for overall coordination, planning, and policy in the energy sector in mainland Tanzania. The Energy and Water Utilities Regulatory Authority (EWURA) undertakes technical and economic regulatory functions in the electricity sector, including oversight of performance of licensed operating companies. TANESCO, the state owned vertically integrated utility, is the largest operating company in the sector, conducting generation, transmission, distribution, supply, and cross border trade, and has roughly 3.78 million customers. Apart from TANESCO and during the period 2021-2022:

- Eight other entities were involved in power generation activities using a variety of primary resources (natural gas, hydropower, biomass, bagasse, solar, and wind).
- One additional company (Mwenga Power Services Limited (MPSL)) was involved in distribution serving 5,621 customers.
- Six companies were licensed mini-grid operators serving 17,000 customers using solar PV.
- There were fourteen licensed entities generating electricity for their own use.
- There were three registered entities generated electricity for sale in bulk to TANESCO.

Institutions in Zanzibar

The power sector in Zanzibar comprises three key institutions. The Ministry of Water, Energy and Minerals (MoWEM) of RGoZ is responsible for overall sector coordination, planning, and policy. The vertically integrated utility Zanzibar Electricity Corporation (ZECO), owned by RGoZ, is responsible for generation, transmission, distribution, and supply of electricity to roughly 180,000 customers in both Unguja and Pemba islands. The Zanzibar Utilities Regulatory Authority (ZURA) is responsible for technical and economic regulation in the water and energy sectors.

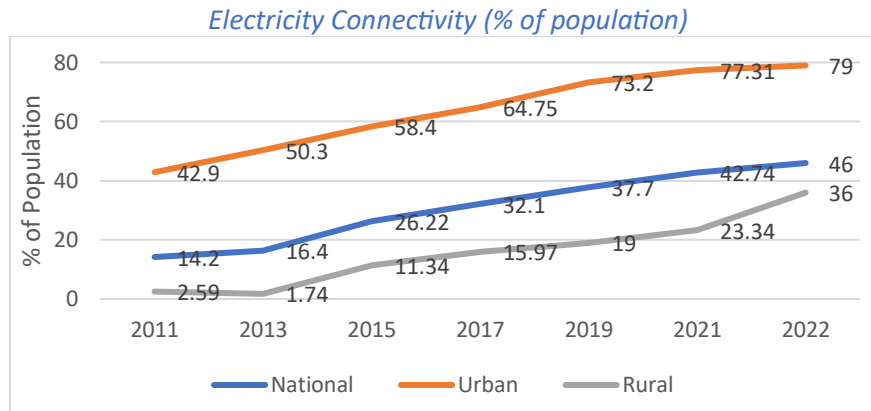
Electricity Access

Approximately two-thirds of the population in mainland Tanzania remains without access to electricity service. A large disparity exists between electricity access rates in urban areas (79 %) and rural areas (36 %) and between national grid coverage (>90 %) and overall access/connectivity rate (46 %)⁴. This disparity exists because of the historical emphasis on backbone grid extensions, which has resulted in the national grid reaching most villages in the country but most households in those villages are not connected to receive electricity service. GoURT set objective of achieving universal access (100 % villages connected) and 75 % of metered connections in mainland Tanzania by 2030. A Rural Electrification Master Plan (REMP) with a Supply Plan (RESP) for the territory was prepared in August 2022.

In Zanzibar alone, 57% of the population has access to electricity service. Like in mainland Tanzania, at present the grid infrastructure covers about 82 % of the settlements/villages in the islands. About 25 % of the population live almost “under the grid” but are not connected. RGoZ set objective of having universal

⁴ Tracking SDG7 Report

access to electricity service in Zanzibar by 2032. RGoZ is currently implementing through ZECO an Electrification Master Plan (EMP) approved in 2018.



Domestic Energy Resources

Tanzania is endowed with low-cost domestic energy resources. They include:

- **Hydropower:** Tanzania has a large hydropower potential of around 4,700 MW, of which only 837.77MW have been exploited—the small hydro potential of not more than 10MW is estimated at 331MW.
- **Solar:** Tanzania has between 2,800 and 3,500 hours of sun a year, creating a solar energy potential ranging from solar irradiation levels of 1800 to 2400 kWh per square meter per year. It is estimated that between 25 and 30 MW of solar PV have been installed in Tanzania, mostly in off-grid areas and mini-grids.
- **Wind:** Tanzania has wind energy potential areas with average speeds of over eight m/s. The variable renewable energy analysis conducted in 2023 shows that the central and western regions have good wind resources, with some areas experiencing wind speeds of more than ten m/s.
- **Geothermal:** The Rift Valley offers potential for geothermal development. Assessment studies on geothermal resources indicate an estimated potential of over 5,000 megawatts (MW) for both direct and indirect uses. Despite this substantial potential, it has remained untapped.
- **Natural Gas:** Tanzania has the resources to become a major natural gas producer in Africa, with estimated reserves of 57 trillion cubic feet.
- **Biomass:** Tanzania is endowed with abundant biomass energy resources. Biomass energy accounts for over 80% of the total energy consumption in Tanzania. Charcoal and firewood are the widely used bio-energy sources for cooking in Tanzania.
- **Coal:** Conservative estimates place reserves at 1.9 billion tons with 25% proven reserves, though many estimates place potential as high as 5 billion tons.

These resources remain largely untapped.

Existing Infrastructure

As of June 2022, the total installed capacity in mainland Tanzania for entities carrying out electricity activities for sale was 1,740.43 MW, of which 1,694.55 MW (97.36 %) was from the national interconnected system (main grid) and 45.878 MW (2.64 %) from off-grid systems⁵. The main grid's peak demand in the period was 1,340.68 MW and reached 1,431.59 MW in May 2023. The generation mix (MWh produced) in the main grid consisted of natural gas 68.44%, hydropower 31.37%, liquid fuel 0.19%.

Three large generation projects are currently under construction, with total installed capacity of 2,326.7 MW: Julius Nyerere Hydro Power Project (2,115 MW), Kinyerezi I Extension Gas Power Project (185 MW), and Rusumo Hydro Power Project (26.7 MW for Tanzania out of total 80 MW installed capacity). Commissioning of those projects, which is expected to commence early 2024⁶, and will allow mainland Tanzania to have excess generation capacity and a robust energy mix with low operating costs combining hydropower and firm thermal production based on domestic natural gas.

Total Installed Capacity by energy source in 2021/22 (MW)

Energy Source	Main Grid	Off grid	Total	Main Grid	Off grid	Total
	In MW			In %		
Biomass	11		11	0.6		0.6
Gas Oil	18	35	54	1.1	82.6	3.1
HFO	70		70	4.2		4.1
Hydro	575		575	33.9		33.1
Natural Gas	1,021		1,021	60.2		58.8
Solar		7.4	7.4		11.7	0.3
Wind		2.2	2.2		5.6	0.1
Total	1,695	45	1,740	100	100	100

TANESCO is the only entity licensed to carry out electricity transmission activities. It operates transmission lines at voltage levels of 66 kV, 132 kV, 220 kV and 400 kV. As of June 30, 2022, the transmission network comprised of 6,110 km of transmission lines and 61 grid substations with a total capacity of 6,872 MVA (including generation substations).

The licensed entities carrying out distribution and supply activities on Mainland own roughly 160,811 km of distribution lines: 160,367 km operated by TANESCO, and 444 km by Mwenga Power Services Limited. Electricity connections serve only 46% of the population while the rest of the population in mainland Tanzania remain without access to electricity service.

Unguja is connected to mainland Tanzania power grid through a 100MW capacity 132kV submarine cable, whose capacity is expected to be surpassed by peak demand in the near future. Likewise, the sister island

⁵ "Electricity Sub-Sector Regulatory Performance Report for Financial Year 2021-2022" published by EWURA in March 2023 (most recent report publicly available).

⁶ Since the time this report was prepared, one turbine (235MW) at Julius Nyerere Hydro Power Project was commissioned. Rusumo Hydro Project was also commissioned, offering Tanzania 27MW of additional generation capacity.

of Pemba is connected through a 20MW 33kV submarine cable from Tanga (mainland Tanzania). The lack of supply redundancy to both islands results in a continued risk of supply outages.

The existing backbone network on Unguja and Pemba comprises 33kV and 11kV radial distribution lines. Under the Bank-funded ZESTA project, a 132 kV backbone transmission line will be constructed on Unguja. In Zanzibar, 57% of the population has access to electricity service.

Tanzania Power Sector Map



Source: TANESCO 2023

Regional Interconnectors

Regional transmission interconnections are set to change the landscape of the electricity sector in Tanzania over the next few years, given Tanzania’s strategic location at the boundary of the East African Power Pool (EAPP) and the Southern African Power Pool (SAPP). Accessing these markets will open vast opportunities for power trade that will improve the reliability, resilience, and security of power supply in Tanzania, and the country could accrue substantial benefits from the diversification of power supply and lower cost

power generation. This high voltage transmission enables the country to make greater use of its domestic renewable energy resources and also tap renewable resources in the broader region if needed. Interconnectors that have recently been commissioned, are under construction, or are planned are shown in the table below.

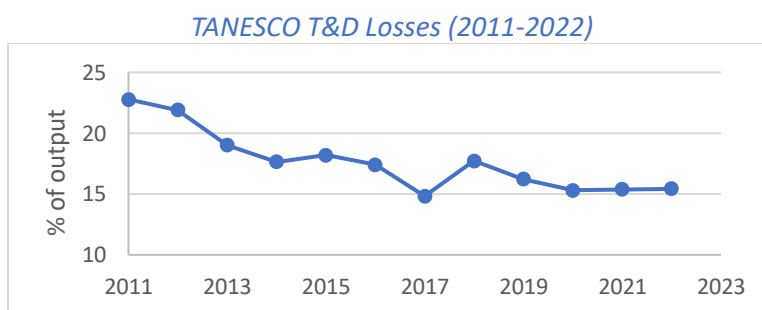
Existing & Planned Interconnectors

From	To	Voltage level	Commissioning
Isinya (Kenya)	Arusha (Tanzania)	400kV	Commissioned 2023
Rilima (Rwanda)	Rusumo (Tanzania)	220kV	Commissioned 2024
Muyinga (Burundi)	Rusumo (Tanzania)	220kV	Commissioned 2024
Sumbawanga (Zambia)	Iringa (Tanzania)	400 kV	Planned for 2026
Masaka (Uganda)	Kyaka (Tanzania)	400kV	Planned for 2028

Operational & Financial Performance

EWURA’s “Report on Electricity Sub-Sector Performance for the July 2021-June 2022 Period” is the most recent publicly available document on performance of the power sector in mainland Tanzania.

TANESCO’s transmission losses in Financial Year 2021-2022 were 6.68%. The values of Key Performance Indicators (KPI) used to evaluate reliability in transmission infrastructure was within regulatory allowance, showing adequate performance of TANESCO in operations in the segment.



TANESCO distributed 7,854.39 GWh and sold 7,167.31 GWh in the period, with total system losses of 8.75%. Mwenga had losses of 6%. While current losses in distribution and supply are not high in any of the two utilities, the quality of electricity service provided to customers is a major issue, and substantial improvements are needed.

Power system reliability indices were assessed based on the Tanzania Standard TZS 1374:2011 (Power quality – Quality of service and reliability). During the period under review, both utilities recorded values for all quality indicators substantially higher than the standards allow. TANESCO’s performance⁷ is reflected below:

- SAIFI: number of interruptions per customer per year: 11 (of a maximum level of 3)
- SAIDI: hours of interruption per customer per year: 26,820 (of a maximum allowed level of 650)
- CAIDI: minutes per interruption event per year: 2,438.18 (of a maximum allowed level of 4).

⁷ Electricity Sub – Sector Regulatory Performance Report for the Financial Year 2021/22 by EWURA

Also, Mwenga had a SAIFI of 14 instead of 3 interruptions per customer per year required by the standard, SAIDI of 1,380 instead of 650 minutes per customer per year required by the standard, and CAIDI of 98.57 instead of 4 minutes per interruption event per year.

In 2020, ZECO sold 371 GWh, with total losses of 16 % of amounts of energy distributed.

While detailed financial information is not readily available, TANESCO’s Annual Report 2021/22 and 10 Year Corporate Strategic Plan (CSP) 2024/25 – 2034/35 indicate that, in 2022, the bill collection rate was 96%, the debt/asset ratio was 0.36, and operating plus debt-service cost recovery stood at 96%. It is evident that, without significant budget support from the Government, the power sector would not be whole.

Power Sector Targets

Tanzania’s power sector targets are largely aligned with Sustainable Development Goal 7 (SDG7), which calls for “affordable, reliable, sustainable and modern energy for all” by 2030. The table below summarizes each target and corresponding status.

Tanzania Energy Sector Targets

INDICATOR	Source Target	2019/20 (BASELINE)	TARGET	Target year	Current level	Source for current level
Installed generation capacity	NFYDP	1,602 MW	4,915 MW	2025/26	1,738 MW 2021/22	EWURA
Length of national grid length	NFYDP	5,896 km	9,351 km	2025/26	6,139 km 2021/22	EWURA
Electricity per capita consumption	NFYDP	137 kWh	220 kWh	2025/26	148 kWh 2021/22	JESR
Total grid loss	NFYDP	16.2%	12.3%	2025/26	14.5%	EWURA
Access to electricity	NFYDP, REMP	78.4%	100%	2030	82% (2021/22)	EWURA
Connectivity to electricity	NFYDP, REMP	39.9%	75%	2030	46% (2022)	ESMAP
Access to modern cooking solutions	REMP, CCS	< 7%	80%	2034	7% (2023)	CCS

Note: NFYDP=National Five-Year Development Plan; REMP=Rural Electrification Master Plan; EWURA=Energy Water and Utilities Regulatory Agency; NDC=Nationally Determined Contributions; SE4All=Sustainable Energy for All; JESR=Joint Energy Sector Review

Key Sector Challenges

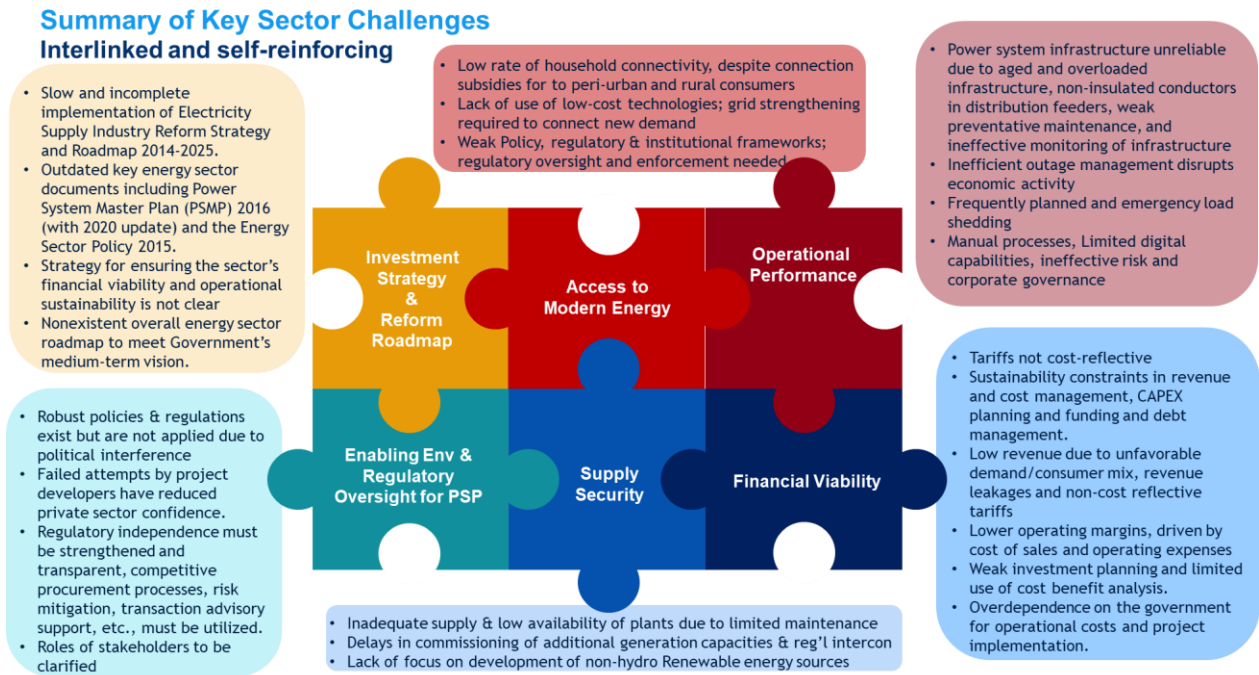
Overarching challenges facing the electricity sector in Tanzania (in both mainland and Zanzibar) include:

- (i) The service provided by TANESCO and ZECO to their customers’ needs substantial improvements to comply with applicable national standards, including the Tanzania Standard on quality⁸ in a sustainable manner.
- (ii) Electrification rate needs to be accelerated to support economic development and improve quality of life of the population. The situation of high number of villages connected to the grid

⁸ TZS 1374:2011 Power quality - Quality of service and reliability

but low connectivity rate faced at present in both territories provides an opportunity to achieve significant increases in the electrification rate with moderate unit cost per new connection, provided the barriers to connectivity are addressed.

- (iii) Current electricity tariffs are not sufficient to recover cost of efficient service provision, resulting in very limited O&M (further deteriorating the network) and inability to undertake necessary investments to improve and expand service.
- (iv) Private sector investment continues to be low across the value chain, limiting the much needed growth in the sector.



Developing a Sustainable Power Sector in Tanzania

The following sections highlight how to address challenges currently faced by electricity sector of Tanzania.

Three Key Pillars of Sustainability

In order to achieve sustainable development, the country must consistently address three key areas ("pillars"):

Pillars of Ensuring Sustainable Power Sector in Tanzania



Pillar I: Security of Supply

In Zanzibar, sole reliance on the limited submarine transmission capacity from mainland Tanzania (without redundancy in supply) severely compromises security of electricity supply to Zanzibar. RGoZ is addressing this risk through development of generation based on renewable resources available in the islands. The Zanzibar Energy Sector Transformation and Access Project (ZESTA) financed by the World Bank, currently under execution, includes a public investment in a park with an 18 MW solar PV plant and a stand-alone Battery Energy Storage System (BESS) to mitigate that risk through in-island generation and supply.

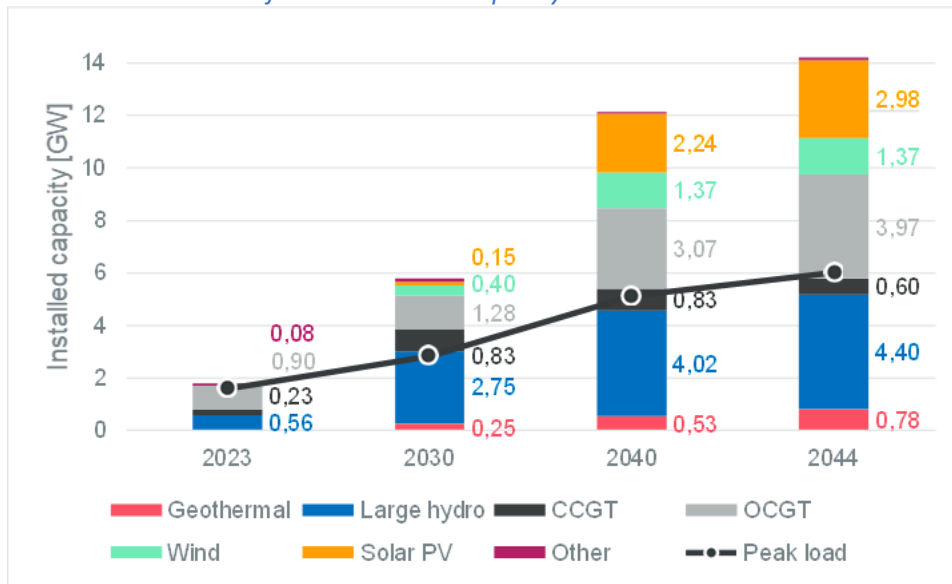
To further improve energy security, Tanzania should increase efforts on scaling up regional electricity trade and integration. The Tanzania – Kenya interconnector project was recently commissioned at the end of 2023 and will enable Tanzania to become an operational member of the Eastern Africa Power Pool (EAPP). The Tanzania–Zambia (TAZA) interconnector project is already under construction and its finalization will enable Tanzania to become an operational member of the Southern Africa Power Pool (SAPP) with full access to its trading platforms. The Uganda – Tanzania interconnector project (UTIP) is at the preparatory stage and the Mozambique-Tanzania interconnector (MOTA) is at a conceptual stage. Tanzania should evaluate how it can further benefit from regional integration and power trade.

Overall, mainland Tanzania is in a good situation regarding least cost power system planning. The Power System Master Plan 2020 (PSMP 2020) is the most recent initiative in the topic, following PSMP of 2008 and its subsequent updates in 2009, 2012 and 2016. The most recent update was prepared by a joint team of experts from inter-governmental institutions, led and coordinated by MoE, and including representatives of Ministry of Finance and Planning, TANESCO, National Bureau of Standards (NBS), Rural Energy Authority (REA), Tanzania Petroleum Development Corporation and the electricity and water regulator EWURA. One of the key recommendations made by the team led by MoE to GoURT is to prepare a comprehensive Power System Master Plan in 2025 as the last was conducted in 2008 and updated several times (2009, 2012, 2016 and 2020). The Government is currently preparing a new PSMP. The expected completion date is unknown. RGoZ is also preparing an Integrated Resource Plan; the expected completion date is February 2025.

A least-cost capacity expansion exercise was undertaken to assess needed generation capacity and the magnitude of investment requirements through 2044. The peak demand is expected to increase from 1,350 MW in 2022 to 6,000 MW in 2044. The study shows 4.4GW of large hydro, 4GW of OCGT, almost 3GW of solar PV, 1.37 GW of wind, and 800MW of geothermal must be installed to meet growing demand. Given that public funding will not be sufficient to develop this infrastructure, the private sector has an important role to play in efficiently achieving development objectives (in generation, transmission, and distribution) and meeting expected growth in Tanzania.

Controversies surrounding past IPPs/SPPs throw a shade on new prospects for private investment, and bankability issues have been a barrier to international investors and financiers. For example, many MoUs have been signed between the Ministry of Energy and private sector to develop renewable energy generation; however, the majority of project never reach financial close. Challenges include, among others, unwillingness of the Government of Tanzania to provide the required government backstopping of projects (in particular, TANESCO termination payment backstop).

Projected least-cost capacity mix 2023-2044



Source: World Bank 2024

Pillar II: Improving the Operational Performance of the Power Sector

Losses in distribution and supply do not appear as a major issue for any of the two utilities on Mainland. Since 2009 TANESCO has been using remote metering tools (initially one-way communication automated meter reading (AMR) and more recently Advanced Metering Infrastructure (AMI)) for consumption recording and monitoring of its largest customers (those supplied at high and medium voltage levels). Results achieved in terms of sustainable reduction of commercial losses were positive. However, as described above, the quality of electricity service provided to customers by TANESCO and MWENGA requires substantial improvements. Quality performance indicators in distribution (SAIFI, SAIDI, CAIDI) have been substantially higher than allowances established in applicable regulations.

In Zanzibar, the existing backbone network on Unguja and Pemba comprises 33kV and 11kV radial distribution lines. These lines extend over long distances and are not adequately maintained or configured to isolate and localize faults to prevent widespread supply interruptions. Due to this configuration, the network is fraught with high technical losses, reliability, and power quality issues. Many of ZECO's transformers are overloaded and have distribution network feeders that are often longer than industry good practice recommendations. Due to supply reliability issues in the outlying areas, large power users such as hotels have installed backup diesel generators. Quality of electricity service provided to customers is a major issue that must be addressed without delays. While ZECO has been successful in reducing commercial losses, technical losses remain high.

Improvements in quality of electricity service provided to customers and reduction of technical losses require investments in network rehabilitation, reinforcement, and upgrade, including incorporation of switchgear and digital technologies to enhance operational flexibility. The ongoing ZESTA project in Zanzibar includes investments of this type executed by ZECO. It's also necessary to optimize processes for management of outages and other incidents in electricity supply, supported by state-of-art information systems and reliable corporate customers and networks databases.

At present TANESCO is executing a contract financed by World Bank to incorporate cooperate management systems (CMS) to support execution of operations in key business areas: electricity supply to customers

(including management of outages and other incidents), commercial functions, management of corporate resources. The situation of ZECO on this matter is not fully clear. Currently, the World Bank is supporting development of a digitalization strategy for electricity utilities in Tanzania and, so far, the utility is in the process to incorporate a SCADA for system operation (in the scope of ZESTA project) and has also undertaken specific initiatives regarding metering consumption of customers, including massive deployment of prepayment for small and medium consumers; use of AMI to manage consumption of large customers.

Even assuming both utilities already have or will have in place state-of-art information systems to support operations in key business areas, it's crucial to ensure those powerful tools are systematically used to improve efficiency, transparency, and accountability in its operations in all business areas in a sustainable manner, with a strong focus on good customer service. This requires reengineering of processes and activities (P&A) in key business areas to adequately use functionalities of the MIS, and strict enforcement of reengineered P&A by an empowered management team showing clear leadership.

Pillar III: Financial Sustainability of the Sector

In a lower-middle-income country like Tanzania with access to concessional financing for investments in the electricity sector, in the short- and medium-term financial sustainability means setting and periodically adjusting tariff revenues to ensure permanent recovery of operating costs (including cost of debts) incurred for efficient service delivery in all segments of the value chain. This should be achieved by meeting two key principles: (i) protecting low-income/vulnerable consumers through a “social tariff” category defined (monthly consumption and rate) based on their affordability; (ii) applying rates in all other tariff categories allowing recovery of costs incurred to efficiently serve consumers in the category. Each category should include fixed, demand and energy charges with values set to respectively recover fixed, demand related, and energy related costs incurred across the entire value chain. Funds to subsidize consumers in the social category should be provided by wealthy consumers in other categories (tariff cross-subsidization).

In May 2021 EWURA issued “The Electricity and Natural Gas Tariff Application and Rate Setting Rules, 2021” to set Revenue Requirement of regulated companies in the electricity sector of mainland Tanzania. The Rules set a methodology for determination and periodic adjustment of Revenue Requirement of regulated companies adopting a multi-year tariff regime, with 3-year price control periods, and incentives for efficiency in operations (Performance Based Regulation). Rules also describe the regulatory process to be followed for application of the methodology, which includes public consultation (a positive feature that deserves to be highlighted). Technical contents of the Rules are robust and seem adequate for the current situation and expected evolution of the power sector of Tanzania. However, having passed two years since the date Rules were issued, the regulatory process for its initial application is yet to be carried out. This situation is negatively impacting the financial sustainability of regulated companies in mainland Tanzania and the whole power sector in the territory. EWURA must proceed to carry out initial application of methodology and process set in the Rules.

The existing approach for tariff setting in Zanzibar needs to be reviewed and improved, and institutional capacity of sector regulator ZURA strengthened to ensure systematic application of enhanced tariff regulations. It's recommended to adopt rules similar to those approved by EWURA in 2021.

In addition to the application of adequate rules for determining and periodically adjusting Revenue Requirement of regulated companies, it's necessary to review and improve retail electricity tariff structures applied by EWURA and ZURA. Improved tariff structures should include fixed, demand related and energy related charges in all tariff categories with rates that respectively provide end users with right signals on fixed, demand related, and energy related operating costs incurred for service delivery. This condition is key to ensure development of distributed generation (where convenient from country's

perspective) in a level playing field, without creating undue financial burden to service utilities and small and medium consumers unable to access this option.

Once the initial application of the rate setting rules is carried out, a politically and socially acceptable trajectory (“glide path”) should be defined and implemented to move over a transition period towards charging cost-reflective tariff rates to all consumers able to pay them, while at the same time protecting low-income/vulnerable consumers.

Being a public utility, TANESCO generates most of its revenue from sales of electricity. A preliminary analysis of the market served by TANESCO (data from EWURA’s “Report on Electricity Sub-Sector Performance for the July 2021-June 2022 Period”) shows the sales made to general usage customers (T1) contributed to 50%, High voltage supply customers (T3) 38%, whilst low voltage supply (T2) and Domestic low usage (D1) customers amounted to 10% and 2% of the total electricity sales revenue, respectively. *The financial viability of TANESCO depends on charging cost-reflective tariff rates to customers in T2, T3 and largest in T1 categories. Consumers in those categories can afford to pay the rates and should not be subsidized.* Subsidized low-income consumers in D1 create just 5 % of sales and 2 % of revenues. Even if their number is expected to significantly go up as electrification plans are executed, and this increases average cost-reflective tariff (\$ per MWh sold), this impact will be limited if investments in electrification are financed out of tariff revenues (through loans from development partners and/or charges applied to existing consumers).

Actions to Achieve a Sustainable Power Sector

Based on the current assessment of power sector performance described above, the following actions are proposed in each of the three key pillars:

Pillar I: Strengthen institutional arrangements to systematize update of PSMP in mainland Tanzania led by MoE. Define and put in place institutional arrangements to systematize power system planning in Zanzibar through preparation and periodic update of a LCEP led by MOWEM. Strengthen enabling regulations to attract private investment.

While current institutional arrangements for system planning in mainland Tanzania seem adequate, GoURT should assess the convenience of strengthening them to systematize the execution of the planning process led by MoE, through implementation of periodic (annual or every two years) updates of PSMP, which should include public consultation on the draft of the updated plan that GoURT intends to approve. An eventual review and optimization of the methodological approach adopted for preparation of PSRP could also be analysed.

Within the framework of its autonomy, RGoZ should adopt institutional arrangements to systematize power sector planning in the archipelago, led by MoWEM. Supply from mainland Tanzania is likely to continue having a very important role in energy security and reliability in Zanzibar, considering current situation and expected evolution of electricity generation in the continent. Under ZESTA, ZECO is building a 132 kV transmission backbone for Unguja that will increase its ability to supply loads in the North and South of the island efficiently and reliably. The 132 kV line will connect the growing loads in the North and South of the island with the Mtoni substation and the 132 kV line from the mainland. The transmission backbone will help relieve the pressure on the overloaded distribution system, contribute to significantly reduce technical losses, and improve supply efficiency. While these are very positive developments, they make a thorough assessment focused on optimization of reliability of transmission infrastructure connecting mainland Tanzania and Zanzibar Islands an indispensable task, which should be carried out within the framework of the planning process.

GoURT and RGoZ should decide on investments in the PSMP to be undertaken by the public sector and those reserved for the private sector, according to their policies. Transparent competitive processes should be followed by timely implementation of all projects resulting from the PSMP, including private investments such as generation plants or transmission lines to be built and operated by private companies.

In parallel, it is imperative to (1) Review and propose updates to the energy policy and relevant acts and laws; (2) Review the ongoing private sector engagements/initiatives; (3) Identify barriers for private sector participation; and (4) define and put in place recommendations for the improvement or development of regulations and guidelines which will address bankability challenges and attract private sector participation along the entire power sector value chain.

Pillar II: Prepare and implement Action Plans to improve quality of service provided to customers and efficiency, transparency, and accountability in operations of TANESCO and ZECO in key business areas.

It's proposed to tackle improvement of quality of service provided by TANESCO and ZECO to their customers and efficiency in operations of both companies through the preparation and implementation of specific Action Plans focused on: (i) investments in network rehabilitation, reinforcement, and upgrade (including incorporation of switchgear and other equipment to enhance operational flexibility); (ii) optimization of processes for management of outages and other incidents in electricity supply, supported by a state-of-art outage management system (OMS) and reliable corporate customers and networks databases; (c) reengineering of processes and activities (P&A) in key business areas to use functionalities of management information systems (in the case of TANESCO currently being incorporated through ongoing project financed by World Bank) to improve efficiency, transparency and accountability in operations, and strict enforcement of those P&A by a management team showing clear leadership.

Given the excellent results achieved in previous phases, and, considering declining prices of technology, Action Plans could also include a new phase of deployment of Advanced Metering Infrastructure (AMI), focused on largest consumers in the low-voltage segment (T1 tariff category of TANESCO; largest pre-payment ZECO's customers).

Pillar III: Apply multi-year incentive-based tariff regime approved by EWURA in 2021 for regulated utilities and mini-grids in mainland Tanzania. Adopt and apply similar regime in Zanzibar. Review and improve retail electricity tariff structure and the regulatory process.

EWURA must proceed to carry out initial application of methodology and process set in the "The Electricity and Natural Gas Tariff Application and Rate Setting Rules, 2021" approved by the agency in May 2021. Existing approach for tariff setting in Zanzibar must be reviewed and improved, and institutional capacity of sector regulator ZURA strengthened to ensure systematic application of enhanced tariff regulations. It's recommended to adopt rules similar to those approved by EWURA in 2021.

In addition to the application of adequate rules for determining and periodically adjusting Revenue Requirement of regulated companies, it's necessary to review and improve retail electricity tariff structures applied by EWURA and ZURA. Improved retail tariff structure should incorporate fixed, demand and energy charges in all tariff categories (except social tariffs applied to low-income / vulnerable consumers) to allow recovery of related costs incurred for efficient service delivery across the entire value chain. This is key to create a "level playing field" and enable penetration of distributed energy resources (DER) when convenient for the country without creating unfair negative financial impacts on service utilities, mini-grid operators and small consumers. The regulatory process should be improved to include public consultation on draft decision that regulator intends to adopt on Revenue Requirement of each regulated company based on analysis of submitted tariff application.

Once the initial application of the rate setting rules is carried out, a politically and socially acceptable trajectory (“glide path”) should be defined and implemented to move over a transition period towards charging cost-reflective tariff rates to all consumers able to pay them, while at the same time protecting low-income/vulnerable consumers.

Achieving Universal Access to Electricity

Mainland Electrification

The Rural Energy Agency (REA) is an autonomous body under the MoE of the GoURT. Its main role is to promote and facilitate improved access to modern energy services in rural areas of mainland Tanzania. REA became operational in October 2007. At present REA is the implementing entity of publicly funded (Government, development partners, etc.) rural electrification programs through grid extension in mainland Tanzania. Once construction works are completed network infrastructure is transferred to TANESCO for operation and maintenance needed to provide electricity service to new customers supplied using those assets. REA and TANESCO coordinate handover of network infrastructure upon commissioning, and the utility becomes responsible for connection of new users, hiring them as regular customers and permanent service delivery.

Investment programs carried out in the last decade and ongoing ones were successful to extend electricity networks to reach many villages, but lower priority was allocated to connect all households and other structures in the electrified villages. While building network infrastructure is a necessary condition for electrification, it has the risk to become an unproductive investment if the construction works do not include service connections to most households in the area (or at least are immediately followed by those connection works) and service utility does not register all connected structures as regular customers and start providing electricity service. Electrification should be understood as sustainable delivery of electricity service to consumers.

Discussions with senior management of REA yielded the following observation from ongoing grid extension rural electrification projects:

- (i) as internal wiring and connection charges are significant barriers to connect low-income households (vast majority in rural areas), service connections are built gradually as new users reach the conditions to connect, thus losing ability to achieve economies of scale (i.e., significantly increasing construction costs compared to massive construction at the same time the area gets electrified).
- (ii) unclear technical rationale for not utilizing the available low-cost technologies. For example, the view that two-phase lines do not allow to provide 3-phase services is technically incorrect. This is done in many countries using inverters at the appliance level (single phase supply is converted to direct current, which in turn is converted to 3-phase alternate current supply). While this is expensive for 3-phase consumers, from a country’s perspective it’s much cheaper than building 3-phase medium and low voltage networks to serve areas where 90% or more of new users require single phase service. TANESCO/REA decision to not utilize this lower-cost solution should be further discussed and analyzed.

Another example is one of the contactors building rural electrification networks for REA (i.e., STEG – the national public electric utility of Tunisia). All rural electrification networks of Tunisia, whose per capita income is above US\$ 3,800 (more than tripling that of Tanzania), were built by STEG in the 1990s and beginning of this century using two-phase medium

voltage lines (technology is known as “MALT”, acronym for the French name “mise a la terre”). However, STEG seems to be building significantly more expensive network infrastructure for the same purpose in Tanzania. Successful international experience shows that in no country the utilities and / or rural electrification agencies are allowed to decide on their own on technical standards for network design and construction. This is done by the Government and/or regulator. Hence, REA should review its policies to ensure the key driver of investments in electrification: minimize unit (per connection) cost (or maximize the number of connections per \$ spent).

- (iii) TANESCO is responsible to carry out works to connect new users in already electrified urban and peri-urban areas, through densification / intensification programs, involving mainly extension of low-voltage networks and service connections. Understandably, those initiatives do not have high priority for the utility. TANESCO’s main mandate and responsibility is to serve existing customers complying with applicable standards on service quality. The funding arrangements for TANESCO’s implementation of densification/intensification needs to be strengthened.

Zanzibar Electrification

The RGoZ has set the target for universal electricity access by 2032. Considering the high population density of Zanzibar, together with the fact that backbone infrastructure has been built in many areas without connecting households in those areas (25 % of households “under the grid” but not having access to electricity service), it’s highly likely that grid electrification will be the least cost option for most of the population in the archipelago. Therefore, the public utility ZECO will continue to be the implementing entity of most projects in the ongoing EMP until its completion. Scope of one of the components of the ZESTA project financed by World Bank is grid extension and intensification works, including the procurement of the necessary connection materials. Some of the activities are undertaken in-house by ZECO, while those that require capacity exceeding that available at the utility are outsourced to contractors. Scope of MV/LV extensions and intensification contracts includes all customers’ connections in the respective areas.

As per the information available, and, similarly to RESP, EMP for Zanzibar does not contemplate the application of low-cost technologies for electrification in medium and low-density areas.

Connection charges present a significant barrier to increasing access in Zanzibar, even where the electricity grid is available (probably this is the key factor explaining the 25 % of unelectrified households “under the grid”). In recognition of this barrier, ZECO has implemented some initiatives that include adopting a scheme to allow customers to pay for connection fees in installments over time and (ii) reducing the connection charge to TZS200,000 (approximately US\$ 90) in January 2021. However, a holistic approach is needed to address this issue and internal wiring of low-income households, and eliminate them as barriers to electrification.

Actions to Successfully Scale-Up Electricity Access

To achieve objectives on electrification respectively set by GoURT and RGoZ, actions proposed above for achieving a sustainable power sector in Tanzania must be complemented by others focused on reviewing and optimizing current arrangements for electrification in mainland Tanzania and Zanzibar.

Action 1: An Action Plan led by MoE is needed to analyze and put in place recommendations made in the Final Report of RESP on policy, regulatory and institutional actions to be adopted for improved framework

conditions for RESP implementation. Although RESP was prepared for mainland Tanzania, MoWEM should review those recommendations and their applicability in the context of Zanzibar.

Action 2: Seek opportunities to accelerate electrification, taking advantage of current advanced development of network infrastructure in many areas, including:





- **TANESCO and ZECO defining and implementing action plans to complete electrification of urban and peri-urban areas through “densification”** with adequate financing arrangements, taking advantage of the fact that the expensive backbone infrastructure (high and medium voltage distribution networks) has been already built in many areas in mainland Tanzania and almost everywhere in Zanzibar.
- **Reviewing the Distribution Code** to identify opportunities to optimize cost-effectiveness of investments in distribution networks for expanding electrification and meeting applicable standards on quality of service in areas of all types (particularly in rural ones).
- **Optimizing procurement arrangements for execution of electrification through “densification”**, whose scope should include service connections of all households and other structures located in areas where network infrastructure is built. Many successful cases in international experience in emerging countries in all regions (including ongoing projects financed by World Bank) show that execution of electrification projects with separate massive procurement of main network equipment and materials (transformers, poles, cables and conductors and customers meters) and of construction works for medium and low voltage distribution grids can create very significant savings. This may improve per-connection cost effectiveness compared to implementation through engineering-procurement-construction (EPC) or turnkey contracts. This is because separate procurement arrangements make possible to carry out highly competitive processes involving the direct vendors of each item and take advantage of economies of scale, while at the same time develop a pool of local companies for construction works, which are directly hired by the implementing entity of the electrification projects, rather than by EPC contractors.
- **Optimizing financing arrangements for execution of electrification through “densification”**. Financing of electrification projects through tariff revenues is unrealistic in low and lower-middle income countries like Tanzania with current low connectivity rates. However, countries in this group have wide access to concessional financing from development partners. This should be the main source of funds for investments in grid electrification, until the country reaches a critical mass of wealthy consumers able to provide financial contributions to those investments. This has been the successful history of countries that achieved high electrification rates by gradually moving from financing provided by development partners to funding by existing consumers.
- **Defining and putting in place procedures for massively wiring connected households, particularly in urban and peri-urban areas**, as customers of the service utilities.
- **Addressing barriers to electrification** like high upfront connection fees (no payments made by new users are needed if electrification projects include construction of service connections) and adopting adequate solutions for internal wiring of low-income households (such as supply of ready boards).

Strategic Directions for World Bank Engagement

This note serves as the foundation for the WBG strategic engagement in Tanzania's electricity sector. It highlights the high-level reform areas that need to be addressed to place the sector on a financial and operational sustainable path while accelerating access to electricity. The following Bank supported activities are being proposed in the near-term:

- Review and improve of institutional structure for systematization of power sector expansion planning.
- Strengthen enabling environment to attract private investment, including in generation and transmission.
- Prepare of Action Plans to improve quality of service provided to customers and efficiency in operations of TANESCO and ZECO.
- Undertake relevant analysis to support tariff Reform in mainland Tanzania and Zanzibar
- Review opportunities to improve of cost-effectiveness of RESP in mainland Tanzania and EMP in Zanzibar

The figure below reflects the sector reform roadmap to guide engagement beyond the near-term.

	Short-term	Medium-term	Long-term
 Security of supply	<ul style="list-style-type: none"> • Least-cost plans and institutional capacity • Technical standards and grid code 	<ul style="list-style-type: none"> • Link procurement to least-cost plan • Regulatory and institutional framework for PPPs 	<ul style="list-style-type: none"> • Procure least-cost plan through competitive process (IPPs or EPCs)
 Universal access	<ul style="list-style-type: none"> • Electrification masterplan and prospectus 	<ul style="list-style-type: none"> • Grid densification and subsidy mechanisms • Legal framework and off-grid incentives requisites 	<ul style="list-style-type: none"> • Implement program for off-grid electrification
 Operational competence	<ul style="list-style-type: none"> • Management improvement plan • Set governance standards • Basic level of service 	<ul style="list-style-type: none"> • Improve quality of management and utility performances (performance contracts, etc.) 	<ul style="list-style-type: none"> • Monitor and hold accountable for improvement • Focus on better private-sector participation
 Financial viability	<ul style="list-style-type: none"> • Price-setting methodology • Sector recovery plan, include revenue protection program 	<ul style="list-style-type: none"> • Set trajectory for operating cost recovery • Tariff compensation mechanisms 	<ul style="list-style-type: none"> • Set trajectory for full cost recovery, cost pass-through, and social tariffs • Sustainable debt profile