PROJECT PERFORMANCE ASSESSMENT REPORT

TANZANIA

Backbone Transmission Investment Project

Report No. 185410
JUNE 17, 2024

IEG
INDEPENDENT EVALUATION GROUP
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June 17, 2024

Finance, Private Sector, Infrastructure, and Sustainable Development

Independent Evaluation Group

Abbreviations

AfDB	African Development Bank
ASMP	artisanal and small-scale gold mining and processing
BTIP	Backbone Transmission Investment Project
BTL	Backbone Transmission Line
EAPP	Eastern Africa Power Pool
EIB	European Investment Bank
EPP	emergency power producers
JICA	Japan International Cooperation Agency
JNHPP	Julius Nyerere Hydroelectric Power Plant
REA	Rural Energy Agency
SAPP	Southern African Power Pool
TANESCO	Tanzania Electric Supply Company
VRE	variable renewable energy

All dollar amounts are US dollars unless otherwise indicated.

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This report was prepared by Joel J. Maweni and Ihsan Kaler Hurcan, who assessed the project in February and March 2023. The report was peer-reviewed by Arun Sanghvi and panel reviewed by Dileep M. Wagle. Jean-Jacques Ahouansou provided administrative support.

Note: IEG = Independent Evaluation Group; PPAR = Project Performance Assessment Report.

Contents

Figures

Tables

Appendixes

Data

This is a Project Performance Assessment Report by the Independent Evaluation Group of the World Bank Group on the Tanzania Backbone Transmission Investment Project (P111598). This instrument and the methodology for this evaluation are discussed in appendix B.

Following standard Independent Evaluation Group procedure, copies of the draft Project Performance Assessment Report were shared with relevant government officials for their review and comment.

Backbone Transmission Investment Project (P111598)

Basic Data

Country	Tanzania	World Bank financing commitment	US$150.00 million
Global Practice	Energy and Extractives	Actual project cost	US$228.26 million
Project name	Backbone Transmission Investment Project	Expected project total cost	US$468.45 million
Project ID	P111598	Actual amount disbursed	US$65.50 million
Financing instrument	Specific investment loan	Environmental assessment category	A
Financing source	IDA-47980		

Dates

Event	Original Date	Actual Date
Approval		August 26, 2010
Effectiveness	March 4, 2011	March 30, 2011
Restructurings		March 17, 2015 February 16, 2016 December 30, 2016
Mid-Term Review	September 30, 2014	September 24, 2014
Closing	March 31, 2015	December 31, 2016

Key Staff Responsible

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Summary

Background and Description

At the time of the project appraisal in 2010, load shedding and unplanned outages in Tanzania were common because of the overloaded transmission network. The national high-voltage transmission system was overloaded, and unplanned outages were common because of tripping in both the transmission and the distribution networks. The existing north-south single-circuit 220-kilovolt transmission line between Iringa and Shinyanga had insufficient capacity to transmit electricity from the generation centers in the south of the country to the load centers in the north.

Tanzania needed substantial investments in both generation and high-voltage transmission capacities to meet the increasing demand for electricity, increase the electrification rate, and sustain economic growth. A total of approximately 3,100 megawatts of additional generation capacity, including import capacity, was needed within 15 years. The electricity generated at the power centers in the south was to be transmitted to the growing load centers in the north through a new 400-kilovolt double-circuit Backbone Transmission Line (BTL) that would run parallel to the existing 220-kilovolt line.

Objective, Design, and Financing

The objective of the Backbone Transmission Investment Project was "to increase availability, reliability and quality of grid-based power supply to the northern regions of Tanzania" (World Bank 2018a, 5). The project design was based on the premise that the increased electricity transmission capacity resulting from the new 400-kilovolt high-voltage transmission line would reduce the amount of unserved energy and decrease electricity outages, while improving voltage quality. The transmission line was also to serve as the backbone for the connection of the Eastern Africa Power Pool (EAPP) with the Southern African Power Pool via Tanzania.

The project consisted of an investment and a technical assistance component. The investment component included the construction of the Iringa-Shinyanga 667-kilometer BTL and a fiber-optic communication line to be used for the supervisory control and data acquisition system. The technical assistance component consisted of the World Bank's support to the Tanzania Electric Supply Company (TANESCO) for project management, development of a 100-megawatt wind farm investment in Singida by the private sector, and the preparation of a feasibility analysis for the Rumakali Hydroelectric Power Station.

At appraisal, the project cost was overestimated, resulting in significant loan savings during implementation. The total project cost was estimated at $468.45 million including physical and price contingencies. The actual project cost was $228.26 million because of the significantly lower bids offered for the construction of the 400-kilovolt line (World Bank 2017). The World Bank loan savings were allocated to the Tanzania Rural Electrification Expansion Program (P153781). The African Development Bank, the Japan International Cooperation Agency, and the European Investment Bank loan savings were allocated to the upgrading of the four project substations.

What Worked, What Didn't Work, and Why?

Results

The project successfully completed the construction of the BTL by the revised project closing date, resulting in a substantial increase in the electricity transmission capacity and actual transmission of electricity between Iringa and Shinyanga, but the transmission line is currently underused. The number and duration of outages and voltage fluctuations caused by the overloading of the transmission line before the project decreased because of the increased transmission capacity. However, the BTL is currently underused, and load shedding is still common because of insufficient power generation to meet the increasing electricity demand. Conversely, the completion of the BTL accelerated the planning and development of the national transmission grid at 400 kilovolts, the integration of Tanzania's electricity network with the regional power pools, and the development of major infrastructure projects that require high-voltage electricity. The national grid of Tanzania is expected to be connected to the EAPP via Kenya in 2024 by a new 400-kilovolt transmission line extending the BTL from the Singida substation (see chapter 3).

What Worked and Why?

The government's strong ownership of the project during project preparation and implementation contributed to the successful completion of the project activities and the achievement of project outputs. The project was included in the Big Results Now initiative, which aimed at completing infrastructure projects that would have increased economic growth and improved service delivery in the country. This ensured strong government ownership.

Having a large effective coordination project preceding the intervention made preparation easier and targeted. With technical and financial support from the then-ongoing Tanzania Energy Development and Access Expansion Project (P101645), an international consultant had prepared technical specifications and tender documents, and other donors had confirmed funding. The project's implementation preparedness before effectiveness was high.

The involvement of an owner's engineer from preparation through to project closing was critical for the achievement of project outputs and outcomes according to the construction schedule despite initial delays in implementation. The engineering company was fully involved in the design of the BTL and served as a coordinator and quality supervisor of construction and testing in the field. This ensured successful completion of the project activities despite initial project implementation delays because of donor coordination issues.

Regular weekly and monthly reporting by contractors was instrumental for close monitoring of construction progress and processing of payments to contractors. These reports provided information about works completed weighted against the cost of each activity. The information in these reports provided a common understanding among the engineering and procurement teams in TANESCO about the progress of the works and allowed the project implementation unit to process payments corresponding to the works completed (which ensured transparency and accountability).

What Didn't Work and Why?

The project cost was overestimated, resulting in significant loan savings during implementation that could not be effectively used to increase the development impact of the project. The project cost was estimated at the height of the super-commodity cycle of high demand, and the assumptions used for the cost of this first 400-kilovolt transmission line in Tanzania were highly conservative. The actual cost of the project was significantly lower than the cost estimated at appraisal. Only the African Development Bank–Japan International Cooperation Agency loan savings could be successfully used to upgrade the two substations under the second phase of the project. The European Investment Bank canceled the funds for the upgrading of the other two substations because of delay in project preparation, and the World Bank loan savings were allocated to the Tanzania Rural Electrification Expansion Program (P153781). Therefore, the construction of the transmission line and the upgrading of the associated substations under one phase could have been a better alternative in the medium term rather than the two-phase approach the project adopted.

The risk of inadequate donor coordination that was not adequately identified at appraisal led to significant delays because of difficulties encountered in coordinating procurement and joint financing. The project was the first project in the electricity sector in Tanzania that was financed by five international donors including the Economic Development Cooperation Fund. The joint donor missions were ineffective in improving donor coordination. The bidding was conducted using the donors' different procurement procedures and guidelines. The procurement of project contracts could be completed only in 30 months from initiation of prequalification.

The noncompliance of TANESCO with the financial covenants defined in the loan agreement was a major shortcoming of the project. TANESCO failed to comply with the debt service coverage ratio and earnings-before-interest-taxes-depreciation-and-amortization margin requirements because of low tariffs and absence of measures to lower its operating costs. TANESCO maintains some form of financial sustainability through the government's capital injections, but the utility's weak financial viability poses a major risk to the sustainability of project outcomes.

Medium-Term Impacts of the Project

The report assessed the medium-term impacts of the BTL under the four special themes used in fiscal year 2023–24 by the Independent Evaluation Group for Project Performance Assessment Reports on transmission line projects. The themes are (i) power evacuation, (ii) development of variable renewable energy, (iii) integration with regional power pools, and (iv) increase in rural electrification.

Impact on Power Evacuation

The project increased the electricity transmission capacity between Iringa and Shinyanga as planned and paved the way for the development of major infrastructure projects in Tanzania. The BTL has a transmission capacity between 1,200 and 2,200 megawatts, which is sufficient to supply electricity to the load centers in the north of the country and to some major infrastructure projects, such as the standard gauge railroad and the crude oil pipeline from Uganda that are under construction. However, the BTL is underused because of insufficient power generation, and unplanned outages and voltage fluctuations are still frequent in the northern regions because of a dilapidated and fast-expanding distribution network as a result of rural electrification. The utilization rate of the BTL is expected to increase after the commissioning of the 2,115-megawatt Julius Nyerere Hydroelectric Power Plant and the connection of the Tanzanian national grid to the EAPP via Kenya (both scheduled in 2024).

Impact on Variable Renewable Energy

The BTL provides the necessary technical transmission capacity for the integration of variable renewable energy to the grid, but the stalled electricity sector reform and the insufficient enabling environment prevented private sector participation in power generation, including renewable energy. The 2,200-megawatt transmission capacity can facilitate the absorption of new intermittent generation sources, such as solar irradiation and wind power, but the current legal framework and power purchase agreement conditions are not conducive to the private sector investing in power generation. For the same reason, a 100-megawatt wind farm the project tried to develop in Singida stalled because of perceived investment and operation risks and because the investors offered high electricity sale prices and no progress could be achieved in finalizing a bankable power purchase agreement.

Impact on Integration with Regional Power Pools

The BTL functions as the backbone for the connection of the EAPP and the Southern African Power Pool via Tanzania, but TANESCO needs to strengthen its planning, technical, and operational capacity for operational integration with these power pools. The BTL will be physically connected to the EAPP via a new 400-kilovolt line between the Singida substation and Isinya in Kenya, which is expected to be energized in 2024. This will allow Tanzania to import electricity in the medium term and supply electricity to the EAPP in the long term. Another transmission line from the Iringa substation toward Zambia is under construction. The completion of the BTL extensions to Kenya and Zambia will physically connect Tanzania with these two power pools; however, for operational integration, TANESCO needs to strengthen its planning, technical, and operational capacity and install supporting equipment such as protection controls and relays. This will require TANESCO to develop its soft infrastructure capacity, which stands out as a key challenge.

Impact on Rural Electrification

The BTL established the basis for the expansion of the distribution network for rural electrification, but the sustainability of these efforts depends on the availability and quality of electricity. Despite a rapid increase in the nationwide electrification rate in Tanzania during the past decade, a large gap remains between urban and rural areas. After the completion of the BTL, the Rural Energy Agency started expanding the distribution network. The World Bank supports the Rural Energy Agency through the Tanzania Rural Electrification Expansion Program (P153781). In addition, the Backbone Transmission Investment Project facilitated the electrification of a limited number of villages along the transmission line, improving the inhabitants’ socioeconomic welfare through increased economic activity and improvement in education and health services. After the partial increase in the availability of electricity, artisanal and small-scale gold mining and processing flourished because of increased availability of electricity, but the methods used in mining and processing pose a high risk to the health and safety of workers and the environment in this unregulated sector.

Lessons

This assessment offers the following lessons:

- All factors central to a project's outcome should be either internalized in the design of the project or addressed through measures outside the project. In this project, the objective of improving the availability, reliability, and quality of power supply was dependent on the adequacy of generation and the robustness of the distribution network, neither of which were realized as planned. Hence, the transmission line is underused.

- Organizing the financing of large infrastructure projects implemented in phases in a programmatic manner can be critical in avoiding implementation delays for subsequent phases. Although the economic analysis favored a phased approach for the construction and upgrading of the BTL, a programmatic financing approach could have appropriately linked the second phase to demand conditions and provided the financing up front, which would have prevented delays in the upgrading of the substations.

- Expanding distribution networks to the villages beyond the immediate transmission project areas can increase the development impact of such projects on access to electricity. Some villages that were not covered by the electrification program under the project remained unserved even though they are located a short distance from the electrified villages. A significant potential exists for expanding electricity access to these villages by addressing both demand-side (cost barriers and awareness of the potential benefits of access to electricity) and supply-side (technical standards) constraints.

- Large transmission projects can be ineffective in facilitating the development of variable renewable energy without an adequate policy framework and enabling environment to attract private sector investors. The BTL provides a robust transmission capacity for the integration of intermittent electricity supply from wind and solar sources, but attempts to develop renewable energy projects under a power purchase agreement failed because of the investors' high perceived investment and operation risks. The stalled sector reform is a barrier to attract private sector investments in generation, including renewable energy.

- Funding from multiple donors is both necessary and desirable for large infrastructure investment projects, but inadequate coordination among donors can adversely affect project implementation, resulting in delays and risking the achievement of the project objectives. Five international donors that financed the project had their own procurement procedures with which TANESCO had to comply. This complicated the coordination of procurement reviews and approvals and resulted in delayed awards of four important contracts by 30 months.

- Without technical assistance support for productive uses of electricity, electrification of rural settlements with subsistence-level economies can have limited positive impact on the socioeconomic welfare of the inhabitants, especially women. The households with subsistence-level economic activity either did not connect to electricity or used it only for lighting. The main benefit of access to electricity for women was a reduction in time required to fetch water or grind grains, but women did not receive any support on how to use the time saved from those activities to generate income for their households with or without the use of electricity. The impact of electricity on their socioeconomic welfare, hence, was limited.

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1. Background, Context, and Design

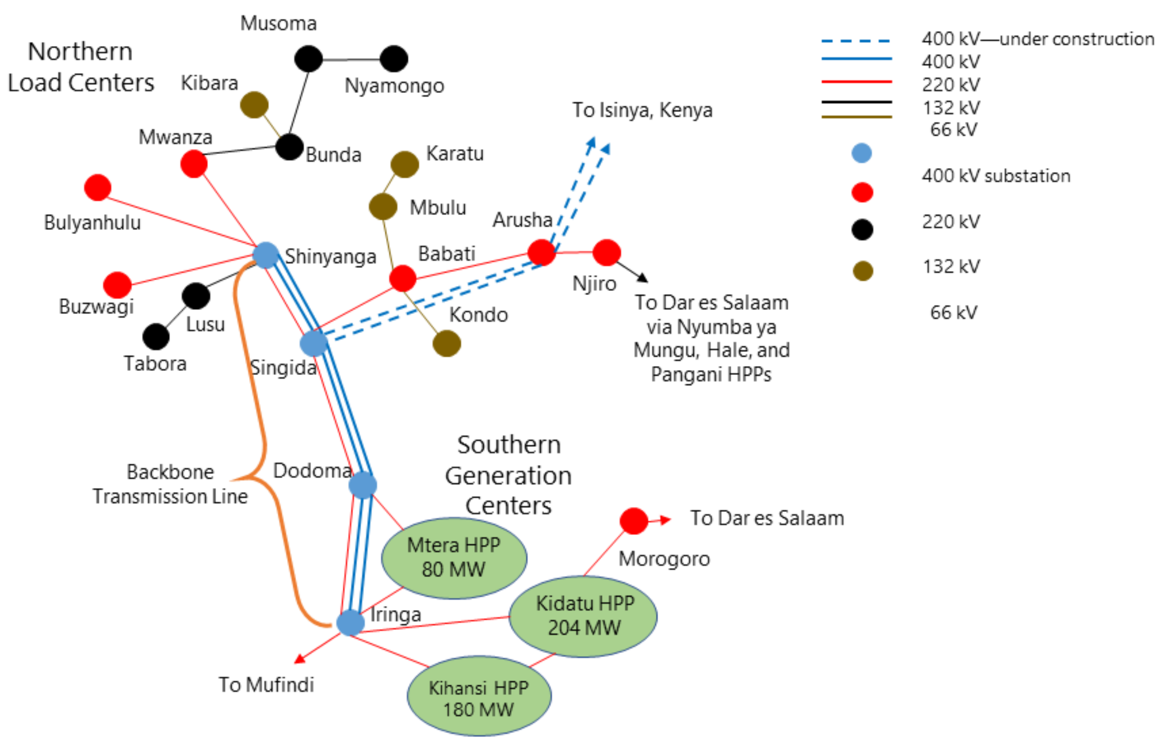
Background and Context

1.1 In 2010, Tanzania was classified as a low-income country with high population and economic growth rates that resulted in steadily increasing demand for electricity. At the time of the appraisal of the Backbone Transmission Investment Project (BTIP) in 2010, Tanzania had an estimated population of 42.5 million increasing at 2.9 percent annually, and the economy had been growing by an average of 7 percent per year since 2000. Per capita income increased from $399 in 2000 to $731 in 2010. The rapid population growth and sustained economic expansion resulted in electricity demand increasing at a rate between 8 and 10 percent annually. Despite these upward trends in income and electricity demand, per capita electricity consumption was still a mere 61 kilowatt-hours, the nationwide electrification rate was only 14 percent (3 percent in rural areas), and approximately 34 percent of the population were still poor.[1]

1.2 Load shedding and unplanned outages were common because of insufficient electricity generation and the overloaded electricity transmission and distribution networks.[2] Total installed generation capacity was 1,140 megawatts. Fifty percent of the capacity was hydropower based, which was vulnerable to frequent droughts causing prolonged load shedding during peak demand periods. The national high-voltage transmission system was overloaded, and unplanned outages were common because of tripping in both the transmission and the distribution networks. The existing north-south single-circuit 220-kilovolt transmission line from Iringa to Shinyanga (passing through the capital of Dodoma) had insufficient capacity to transmit electricity from the generation centers in the south of the country to the load centers in the north where cities had been growing quickly and the number of mines had been increasing.

1.3 Tanzania needed substantial investments in generation and high-voltage transmission capacities to meet the increasing demand for electricity, increase the electrification rate, and sustain economic growth. According to the Power System Master Plan 2008 prepared by the Tanzania Electric Supply Company (TANESCO),[3] an additional 3,100-megawatt generation capacity was needed by 2025, including import capacity. The domestic generation expansion was to be through hydropower, wind, and gas resources located in the southern and southeastern regions of the country. The electricity generated at these power centers was to be transmitted to the growing load centers in the north through a new double-circuit 400-kilovolt Backbone Transmission Line (BTL) that would run parallel to the existing overloaded 220-kilovolt line between Iringa and Shinyanga (figure 1.1).

Figure 1.1. The Backbone Transmission Line



Sources: Tanzania, Ministry of Energy 2018, 2020.
Note: HPP = hydroelectric power plant; kV = kilovolt; MW = megawatt; NYM = Nyumba ya Mungu.

1.4 The new 400-kilovolt BTL was also to play a critical power highway role between the Eastern Africa Power Pool (EAPP) and the Southern African Power Pool (SAPP). Tanzania is a member of both the EAPP and the SAPP, but its electricity grid was not connected to these power pools in 2010. The construction of the BTL was to allow the northeast extension of the transmission line from Singida to Isinya in Kenya, connecting the Tanzanian transmission grid to the Kenya-Ethiopia transmission system. Similarly, the extension of the BTL from Iringa in the south to Nakonde, Zambia, was to establish a connection with the SAPP. These extensions were to be undertaken as separate projects. Once connected to these two power pools, Tanzania would be able to import electricity during dry seasons and export electricity during wet seasons.

Objective, Design, and Financing

1.5 As a development partner of Tanzania in the energy sector since the mid-2000s, the World Bank played a key role in the preparation of the BTIP and its financing by convening other key international donors. The World Bank had been supporting the Tanzanian government in its efforts to establish enabling conditions for sustainable development and reliable energy provisions for economic growth and poverty alleviation since the mid-2000s. The World Bank–financed Tanzania Energy Development and Access Expansion Project (P101645) provided financial and technical support for the preparation of the BTIP. In project preparation and financing, the World Bank closely collaborated with the African Development Bank (AfDB), the European Investment Bank (EIB), Japan International Cooperation Agency (JICA), and the Republic of Korea's Economic Development Cooperation Fund.

1.6 The project objective was "to increase availability, reliability and quality of grid-based power supply to the northern regions of Tanzania" (World Bank 2018a, 5), and the project consisted of one investment component and one technical assistance component. Under the investment component, the World Bank financed the construction of the 225-kilometer Iringa-Dodoma section of the BTL and a fiber-optic communication line to be used for the supervisory control and data acquisition system. AfDB and JICA financed the construction of the 217-kilometer Dodoma-Singida section, and EIB financed the 225-kilometer Singida-Shinyanga section. The Economic Development Cooperation Fund financed the upgrading of the existing four 220-kilovolt substations associated with the high-voltage transmission line. Under the technical assistance component, the World Bank supported TANESCO in project management, including fiduciary aspects and social and environmental safeguards and the preparation of a power purchase agreement with a private consortium for a 100-megawatt wind farm investment in Singida, which did not materialize. This component was to also finance the preparation of a feasibility analysis for the 222-megawatt Rumakali Hydroelectric Power Station, but this activity was canceled because TANESCO decided to finance this feasibility study using its own funding outside of the project.

1.7 The project's theory of change was robust, and the project activities and outputs would have been expected to lead to the achievement of the project outcomes and objectives. The project's expanded theory of change is provided in appendix A. The causal links from project activities to the achievement of project outputs and outcomes were direct and valid, and the achievement of the project objective could be attributed to the project's intervention, but the indicators in the results framework (discussed in chapter 2) did not sufficiently capture the achievement of the outcomes.

1.8 At appraisal, the project cost was overestimated, which resulted in significant loan savings during implementation. The total project cost was estimated at $468.45 million including physical and price contingencies of $60.78 million. The actual project cost was $228.26 million because of the significantly lower bids offered for the construction of the 400-kilovolt line (World Bank 2017). The World Bank loan savings were canceled and allocated to the Tanzania Rural Electrification Expansion Program (P153781). The AfDB, JICA, and EIB loan savings were allocated to the upgrading of the four project substations from 220 kilovolts to 400 kilovolts.

2. What Worked, What Didn't Work, and Why?

Results

2.1 The project successfully completed the construction of the BTL by the revised project closing date, resulting in a substantial increase in the electricity transmission capacity and actual transmission of electricity between Iringa and Shinyanga. When the project closed on December 31, 2016 (21 months later than the original closing date because of initial implementation delays), the BTL had already been commissioned. The transmission capacity between Iringa and Shinyanga increased from 200 megawatts to 1,200 megawatts, creating a robust backbone transmission infrastructure. This allowed the transmission of a higher amount of electricity to the load centers in the north. For example, the transmission line supplied sufficient electricity to meet the electricity demand in Shinyanga located at the north end of the transmission line, which increased from a baseline of 252 gigawatt-hours to 483 gigawatt-hours at project closing.

2.2 The number and duration of outages and voltage fluctuations caused by the overloading of the transmission line before the project decreased because of the increased transmission capacity. The number of unscheduled outages because of the overloading of the transmission line and other technical issues decreased from 30 to 3, and the duration of outages from 7 days to 4 days. These results have further improved since project closing, and TANESCO reported that the electricity network did not experience any major unplanned outage caused by a malfunctioning in the BTL. The increased transmission capacity also stabilized the electricity voltage at 220 kilovolts along the transmission line and at the substations without any major fluctuations.

2.3 However, the BTL is currently underused, and load shedding is still common because of insufficient power generation to meet the increasing electricity demand. The World Bank supported the preparation of the least-cost generation plan and the development of gas infrastructure to ensure the continuity of electricity supply and allocated resources under various projects to support TANESCO and the government of Tanzania to develop private sector generation initiatives. However, the installed generation capacity in Tanzania increased incrementally through only public investments because of insufficient government commitment to private sector participation in power generation. Inadequate power generation is the main reason for the underutilization of the BTL and load shedding in the project area, but the increased transmission capacity will allow more electricity to be transmitted to the northern regions after the expected commissioning of the 2,115-megawatt Julius Nyerere Hydroelectric Power Plant (JNHPP) in 2024 (see the Impact on Power Evacuation section in chapter 3).

2.4 The completion of the BTL accelerated the planning and development of the national transmission grid at 400 kilovolts, the integration of the Tanzania's electricity network with the regional power pools, and the development of major infrastructure projects that require high-voltage electricity. The completion of the BTL was the major milestone for the development of the national transmission network at 400 kilovolts. Some parts of the 400-kilovolt transmission network that are under construction will connect JNHPP and Dar es Salaam to the high-voltage transmission network. A new 400-kilovolt transmission line under construction is expected to connect the BTL to the EAPP via Kenya in 2024, establishing the first high-voltage transmission connection with a regional power pool. The expansion of the 400-kilovolt transmission grid will also allow Tanzania to connect with the SAPP via Zambia (see the Impact on Integration with Regional Power Pools section in chapter 3). In addition, the availability of a robust 400-kilovolt transmission system supported the development of the first high-speed standard gauge railroad from Dar es Salaam to Mwanza and the Uganda-Tanzania crude oil pipeline, both of which require high-voltage electricity to operate.

What Worked and Why?

2.5 The government's strong ownership of the project during project preparation and implementation because of the inclusion of the BTL in the Big Results Now initiative contributed to the successful completion of the project activities and the achievement of project outputs. The construction of the BTL was a part of TANESCO's Capital Investment Plan and included in the Big Results Now initiative of the government, which aimed at completing infrastructure projects that would have increased economic growth and improved service delivery in the country. Because of the BTL's direct impact on economic growth and improvement of electricity service delivery, the government's ownership of the project was strong during preparation and implementation. The government's strong ownership was critical in successfully completing the project activities despite some initial delays in safeguards implementation because of slow budgetary processes.

2.6 Having a large effective coordination project preceding the intervention made preparation easier and targeted. The Tanzania Energy Development and Access Expansion Project (P101645) financially and technically supported the preparation of the BTIP. At the time of the project approval in August 2010, the detailed economic analyses of technical alternatives had already been completed and the technical design had been chosen for the BTIP. An international consultant hired under the Tanzania Energy Development Project had prepared technical specifications, bill of quantities, and bid documentation. Tender documents were ready to start implementation immediately after effectiveness. The funding from multiple donors (AfDB, EIB, JICA, and the

Economic Development Cooperation Fund) had already been confirmed. The project's implementation preparedness before effectiveness was high.

2.7 The involvement of an owner's engineer from preparation through project closing was critical for the achievement of project outputs and outcomes according to the construction schedule and cost savings despite initial delays in implementation. The engineering company was fully involved in the design of the BTL. It served as a coordinator and quality supervisor of construction and testing in the field. The engineer significantly helped TANESCO in finding a solution for the completion of construction works of the line section from Dodoma to Singida when the main contractor declared bankruptcy. An additional $5.3 million was saved because of the revisions made to the types of transmission tower foundations because of the soil tests requested by the owner's engineer for each tower. The involvement of a global engineering firm experienced in managing large complex projects allowed knowledge transfer to TANESCO's staff and also contributed to TANESCO's capacity building.

2.8 Regular weekly and monthly reporting by contractors was instrumental for close monitoring of construction progress and processing of payments to contractors for the works completed. With the assistance of the owner's engineer, the project implementation unit in TANESCO required all contractors to submit weekly and monthly reports. These reports provided information about works completed weighted against the cost of each activity. The information in these reports provided a common understanding among the engineering and procurement teams in TANESCO about the progress of the works and allowed them to appropriately intervene when potential delays were identified. These reports also allowed the project implementation unit to process payments corresponding to the works completed, which ensured transparency and accountability.

2.9 TANESCO's increased safeguards implementation capacity ensured the project's compliance with the World Bank's safeguards requirements despite some initial unavailability of counterpart funds for the compensation payments to project-affected people. As a result of the capacity development assistance provided by the project, TANESCO upgraded its environmental unit to a department headed by a manager. The findings of a study financed by the project led to the design change of towers closer to Singida to minimize the project's impact on migratory bird routes. The project also successfully relocated some graves found on the right-of-way of the transmission line in coordination with the local communities and in accordance with the religious requirements. However, the availability of counterpart funds for the payment of compensation to project-affected people was delayed because of slow budgetary processes. Despite this delay, all 2,389 people affected by the project were appropriately compensated before works started, and there was no outstanding payment at project closing. TANESCO's increased project implementation capacity ensured project's compliance with safeguard policies and successful completion of the project activities.

What Didn't Work and Why?

2.10 At appraisal, the project cost was overestimated, resulting in significant loan savings during implementation that could not be effectively used to increase the development impact of the project. The BTL was the first 400-kilovolt line to be constructed in Tanzania. Therefore, the assumptions used to estimate the project cost were conservative. Additionally, the project cost was estimated at the height of the super-commodity cycle of high demand generated by China's economic expansion. At appraisal, the total cost of the transmission line was estimated at $348.17 million, but the actual cost was $178.52 million. Only the savings from AfDB-JICA funds could be successfully used to upgrade the Dodoma and Singida substations to 400 kilovolts. EIB canceled the funds for the upgrading of the Iringa and Shinyanga substations because of a delay in project preparation. The World Bank loan savings could not be used to build a dedicated line for the development of a 100-megawatt wind farm in Singida. These funds were consequently allocated to the Tanzania Rural Electrification Expansion Program (P153781).

2.11 The construction of the transmission line and the upgrading of the associated substations to 400 kilovolts under one phase could have been a better alternative in the medium term rather than the two-phase approach the project adopted. Economic analyses conducted at appraisal indicated that the two-phase approach for the construction of the BTL and upgrading of its associated substations would be the most economically viable alternative.[4] This approach was appropriate with the assumption that the full transmission capacity would not be needed in the short run and upgrading of the substations to 400 kilovolts could be postponed until the electricity demand increased to the level that would justify the additional investment cost. As previously discussed, the Iringa and Shinyanga substations could not be upgraded because of EIB's cancellation of the funds (TANESCO is in the process of securing funds from other donors). The delay in upgrading these two substations on the BTL could create a bottleneck for the transmission of electricity through the Tanzania-Kenya 400-kilovolt interconnector, which is expected to be energized in 2024. The two-phase approach created inefficiencies in the completion of the 400-kilovolt BTL. As a lesson learned, TANESCO now tenders all 400-kilovolt transmission line investments as one phase, including the construction or upgrading of substations.

2.12 Despite the high-level preparedness of the project, the risk of inadequate donor coordination that was not adequately identified at appraisal but materialized during implementation led to significant delays because of difficulties encountered in coordinating procurement and joint financing. It was the first project in the electricity sector in Tanzania that was financed by five international donors. The project implementation arrangements included joint donor supervision missions, but these missions were ineffective in improving donor coordination. The project did not establish a separate donor coordination body. As each donor had different fiduciary conditions, TANESCO was required to complete the internal approval processes of each donor for the procurement of contracts. The bidding was conducted using the relevant institution's procurement procedures and guidelines for each line segment and the substations. The procurement of four contracts (three for three-line segments and one for the substations) could be completed only in 30 months from initiation of prequalification in November 2010 to the awarding of contracts in August 2013.

2.13 The monitoring and evaluation system as designed and implemented was insufficient to capture all outcomes expected from the project's intervention. The results framework included useful intermediate indicators that were mostly sufficient to capture the achievement of the project outputs. The project objective-level indicators captured the reduction in transmission losses, duration, and frequency of outages in the BTL. However, the results framework lacked indicators to capture the other two outcomes expected from the project (that is, increase the availability and improve the quality of electricity supply). The indicators were restricted to the improvement in the BTL. The results framework did not capture the impact of the project on end users. It was assumed that the distribution network would have sufficient capacity to reliably supply electricity to the end users. In addition, it was assumed that there would be sufficient power generation to meet growing demand in the project areas. These two assumptions did not fully materialize.

2.14 The noncompliance of TANESCO with the financial covenants defined in the loan agreement was a major shortcoming of the project. To improve the financial viability of TANESCO, the loan agreement included financial covenants that TANESCO had to comply with. These were a debt service coverage ratio equal to or greater than 1.3 and an earnings-before-interest-taxes-depreciation-and-amortization margin equal to or greater than 20 percent. TANESCO failed to comply with these covenants because of low tariffs and the absence of measures to lower its operating costs. TANESCO is still in a financially precarious situation. Although TANESCO maintains some form of financial sustainability through government's capital injections, the utility's weak financial viability poses a major risk to the sustainability of project outcomes and further development of the transmission and distribution networks in the country.

3. Medium-Term Impacts of the Project

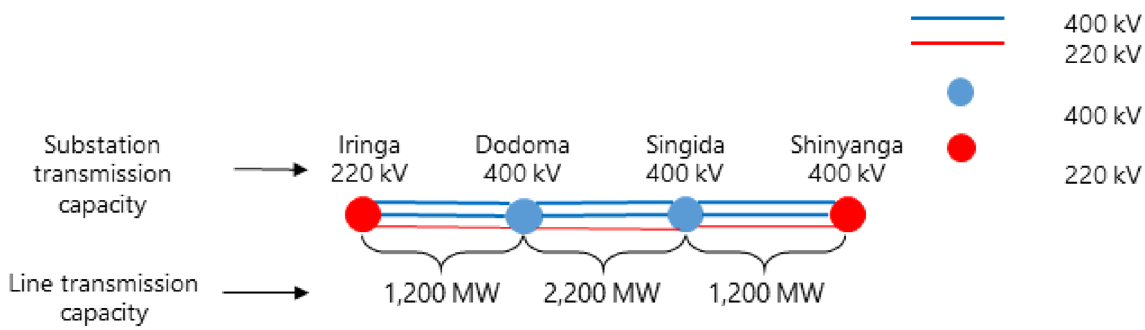
3.1 In this chapter, the report assesses the medium-term impacts of the BTL under the four special themes used in fiscal year 2023–24 by the Independent Evaluation Group for Project Performance Assessment Reports on transmission line investment projects. The themes are (i) power evacuation, (ii) development of variable renewable energy (VRE), (iii) integration with regional power pools, and (iv) increase in rural electrification. The assessment of results and impacts on rural electrification also includes a summary of a beneficiary survey conducted at 6 villages sampled out of 122 villages that were electrified after the completion of the BTL under the project funded by the governments of Norway and Sweden. The survey assessed the impact of electricity on socioeconomic welfare of the villagers. The findings from a site visit to a mining area in Shinyanga where local miners operate artisanal mines to extract gold are also presented.

Impact on Power Evacuation

3.2 The project increased the electricity transmission capacity between Iringa and Shinyanga as planned and paved the way for the development of major infrastructure projects in Tanzania. However, the BTL is underused because of insufficient power generation, and unplanned outages and voltage fluctuations are still frequent in the northern regions because of a dilapidated and fast-expanding distribution network.

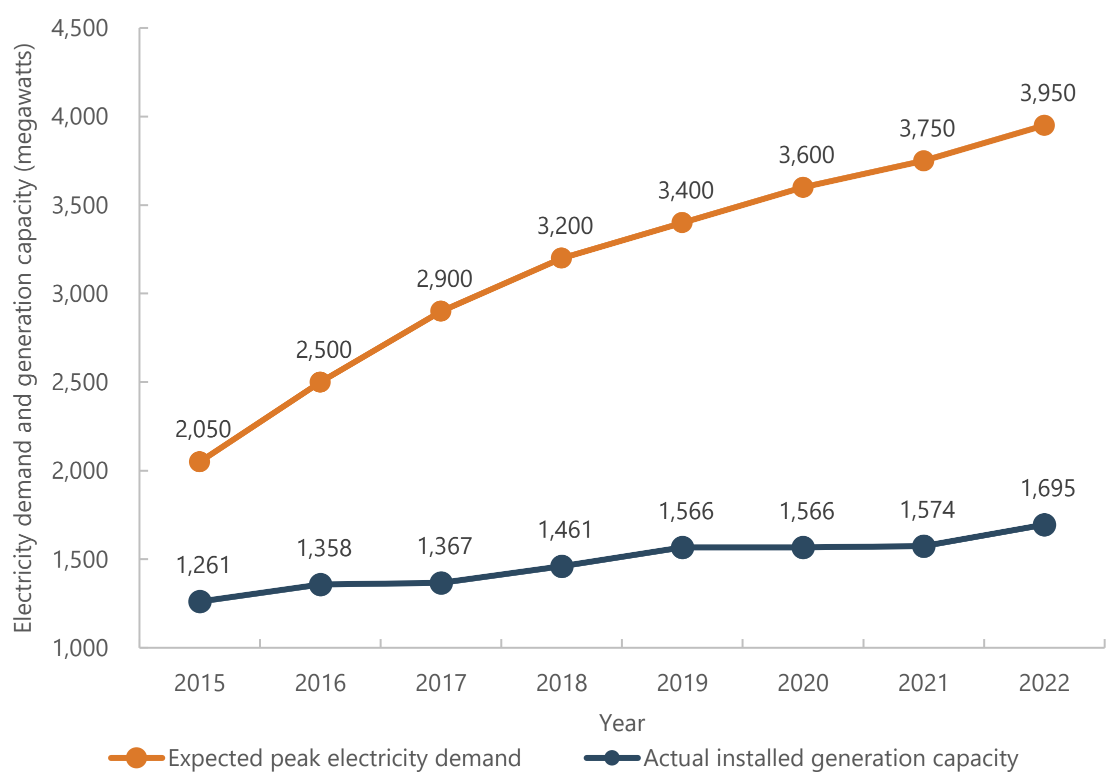
3.3 The project increased the electricity transmission capacity between Iringa and Shinyanga as planned, but the line's utilization rate is significantly lower than expected because of insufficient electricity generation; therefore, the project's impact on increasing the availability of grid-based electricity supply has been moderate. The current daily maximum electricity arriving at Singida to be distributed to the northern regions is approximately 300 megawatts, which is higher than the 220 megawatts that was transmitted before the project but significantly lower than the current transmission capacity of the line at 1,200 megawatts (figure 3.1). The low electricity generation capacity in the country is the main reason for the underutilization of the BTL. According to the Power System Master Plan 2012 Update, an additional 2,500-megawatt generation capacity would have been needed by 2020 to meet the estimated peak electricity demand of 3,600 megawatts (Ministry of Energy and Minerals of Tanzania 2013b). However, between June 2015 and June 2022, the installed generation capacity increased by a mere 434 megawatts (mostly gas-fired generation) from 1,261 megawatts to 1,695 megawatts (figure 3.2). The net available capacity is much lower because of frequent droughts adversely affecting generation at hydroelectric power plants and technical issues at thermal power plants. TANESCO still implements load shedding in the northern regions mostly between October and March because of insufficient hydroelectric power generation. Although load shedding is expected to be significantly shortened or even eliminated after the expected commissioning of the 2,115-megawatt JNHPP in 2024, Tanzania needs additional investments in power generation to meet increasing electricity demand and to sustain economic growth.

Figure 3.1. Transmission Capacity between Iringa and Shinyanga (March 2023)



Source: Independent Evaluation Group.
Note: kV = kilovolt; MW = megawatt.

Figure 3.2. Expected Peak Electricity Demand and Actual Installed Generation Capacity, 2015–22



Sources: Energy and Water Utilities Regulatory Authority 2015–22.

3.4 Despite the capacity increase in the BTL, unplanned outages and voltage fluctuations are still frequent in the northern regions because of a dilapidated and rapidly expanding distribution network. The three high-voltage lines connecting four substations on the BTL satisfy the N-2 contingency criterion.[5] Therefore, the high-voltage transmission system has not caused any outages because of overheating or overloading, which were common before the completion of the BTL. The strengthening of the transmission network was expected to lead to an improvement in the reliability and quality of electricity supply, but outages are still frequent (table 3.1). The outages and voltage fluctuations experienced at the distribution level are due to the dilapidated condition of the distribution network and its rapid expansion. TANESCO's financial constraints result in suboptimal spending on maintenance and upgrading of the network leading to distribution system overloading and increased losses, outages, and voltage fluctuations. The rapid expansion of the distribution network to increase rural electrification increases the stress on the already overloaded distribution system and stretches TANESCO's limited financial and institutional capacity for operation and maintenance. The three indexes that the Energy and Water Utilities Regulatory Authority uses show that the reliability of electricity is significantly lower than the targets set in the power quality standards of the Tanzania Bureau of Standards (table 3.2).[6]

Table 3.1. Load Shedding and Unserved Energy because of Outages

(Gigawatt-hour)

Year	Load Shedding	Unserved Energy
2010	53.94	107.06
2011	444.02	605.14
2012	66.34	148.42
2013	75.06	159.84
2014	57.79	136.81
2015	273.02	369.94
2016	17.80	109.41
2017	59.09	131.32
2018	15.62	128.67
2019	10.72	74.31
2020	16.11	82.20
2021	52.08	128.64
2022	301.57	422.94

Sources: Energy and Water Utilities Regulatory Authority 2010–22.

Table 3.2. System Average Interruption Frequency Index, System Average Interruption Duration Index, and Customer Average Interruption Duration Index, 2019–21

Index[a]	Index Target	2019	2020	2021
SAIFI (frequency per customer)	3	46	218	48
SAIDI (minutes per customer)	650	2,784	10,560	22,380
CAIDI (minutes per interruption)	4	61	48	466

Source: Energy and Water Utilities Regulatory Authority 2019–21.
Note: CAIDI = Customer Average Interruption Duration Index; SAIDI = System Average Interruption Duration Index; SAIFI = System Average Interruption Frequency Index.
a. Data are not available before 2019 because of lack of boundary energy measurement.

3.5 The capacity increase in the high-voltage transmission network paved the way for the development of major infrastructure projects in Tanzania. Tanzania is constructing a single-lane standard gauge railroad for electrical trains in six phases starting from Dar es Salaam to Mwanza and Kigoma. Once completed, the railroad will transport passengers and freight with electrical locomotives running at 160 kilometers per hour and establish a crucial freight transport link between the Port of Dar es Salaam and landlocked countries of Burundi, Rwanda, and the Democratic Republic of Congo. The BTL will supply power to energize a 225-kilovolt dedicated transmission line for the railroads. The increased availability of electricity through the BTL also supports the development of the 1,443-kilometer East African Crude Oil Pipeline from Uganda to Tanzania, which requires high-voltage electricity to heat the waxed oil to flow through the pipeline. The availability of electricity also supported the rapid development and urbanization of the capital city of Dodoma and the construction of a modern international airport that will serve the capital and central Tanzania.

Impact on Variable Renewable Energy

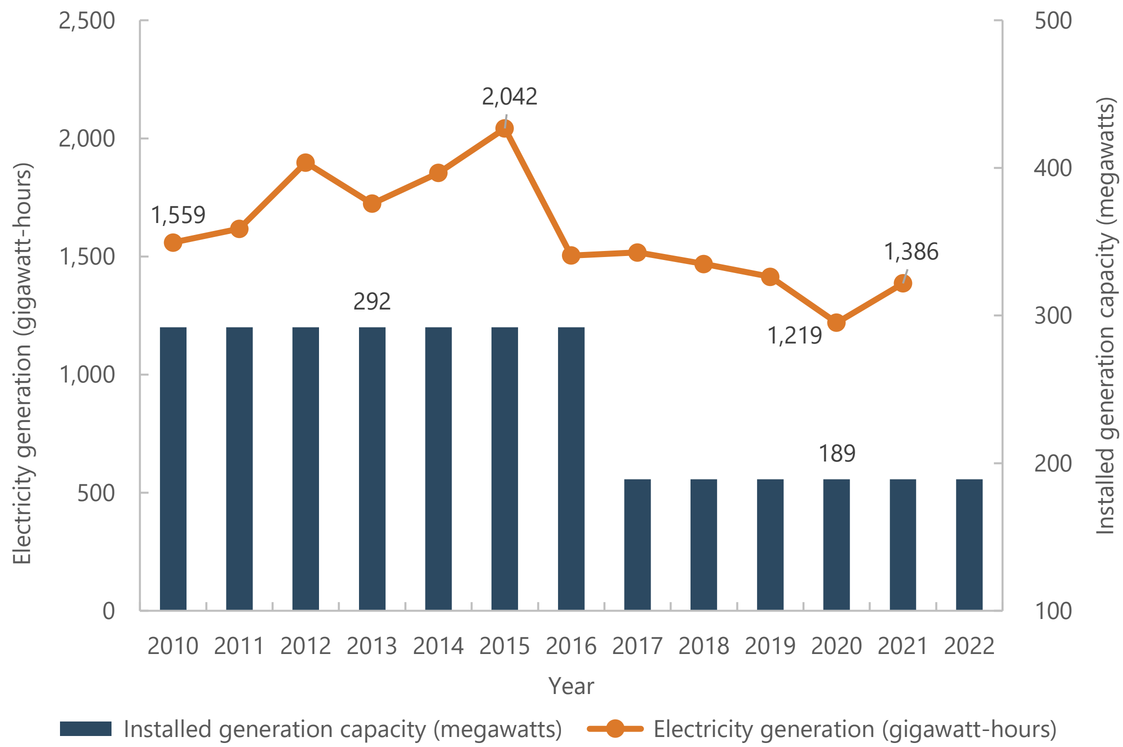
3.6 The BTL provides the necessary technical transmission capacity for the integration of VRE into the grid in Tanzania, where solar and wind resources are abundant to generate electricity. However, the stalled electricity sector reform and the insufficient enabling environment prevented private sector participation in power generation, including renewable energy. Although the BTIP supported the development of a 100-megawatt wind farm in Singida, the wind farm project stalled because of high electricity sale prices and no progress in finalizing a bankable power purchase agreement.

3.7 The BTL provides necessary excess capacity for the integration of VRE to the grid, but Tanzania has not yet developed any grid-connected large-scale VRE, despite the availability of abundant solar and wind resources.[7] Tanzania has up to 3,500 hours of sunshine per year with a global horizontal radiation of 4–7 kilowatt-hours per square meter per day. This is comparable to the solar resource in Morocco, where solar generation capacity is approximately 800 megawatts.[8] Tanzania's solar power potential is estimated to be approximately 1,000 megawatts in relation to the BTL. Wind speeds around Singida alone are sufficient for the development of a wind farm of at least 100 megawatts. The country's total wind power potential is estimated to be approximately 1,500 megawatts. Despite low electricity prices offered at a bidding for 350-megawatt wind and solar power plant development in 2018 (approximately $0.04 per kilowatt-hour), the process did not result in any investment mostly because of the absence of a capacity charge or TANESCO's commitment to a minimum offtake in the power purchase agreement in addition to the absence of a provision for international arbitration and government guarantee to mitigate TANESCO's offtaker risk.

3.8 The BTIP supported the development of a 100-megawatt wind farm in Singida, but the project stalled because of high electricity sale prices and no progress in finalizing a bankable power purchase agreement. The BTIP provided technical assistance for the preparation of a power purchase agreement between the consortium that was to develop the 100-megawatt wind farm and TANESCO and considered using the loan savings to finance the construction of a dedicated high-voltage transmission line to connect the power plant to the BTL. The cost of power at $0.11–0.12 per kilowatt-hour from the wind farm was higher than the cost of power generated by using domestic gas at $0.06–0.07 per kilowatt-hour (Eberhard et al. 2016). With the expectation of more gas-fired power plants to be commissioned in the mid-2010s, TANESCO did not consider wind power as competitive. The government and TANESCO, therefore, did not prioritize the wind farm project among the new power generation investments, and the power purchase agreement did not progress as expected.

3.9 The stalled electricity sector reform and the insufficient enabling environment prevented the private sector participation in power generation, including VRE. Despite the provisions in the 2008 Electricity Act for the unbundling of TANESCO and private sector–led electricity market development, the electricity sector reform did not progress as planned because of vested political interests, general suspicion about the private sector, and negative past experiences with private sector participation in the sector.[9] TANESCO still heavily dominates the sector as the single buyer and distributor of electricity in the country excluding a few small areas where independent power producers operate. TANESCO's share in power generation has been increasing steadily, whereas the share of private sector has remained the same since 2017 when contracts with emergency power producers ended (figure 3.3). Currently, Songas is the only large power plant developed under a public-private partnership model with an installed generation capacity of 189 megawatts supplying electricity to the national grid.[10] Weak financial viability of TANESCO requires regular government interventions as equity injections. Although the market regulator provides some transparency in the sector, the regulator's mandate is frequently undermined by political interference. With its VRE, geothermal, and hydropower potential and high-voltage transmission connections to the EAPP and the SAPP (see the Impact on Integration with Regional Power Pools section in chapter 3), Tanzania can become a source and highway for clean energy in the region if the sector reform moves forward to establish a transparent electricity market operating on market rules and platforms.

Figure 3.3. Private Sector Participation in Power Generation, 2010–22



Source: Energy and Water Utilities Regulatory Authority 2010–21.

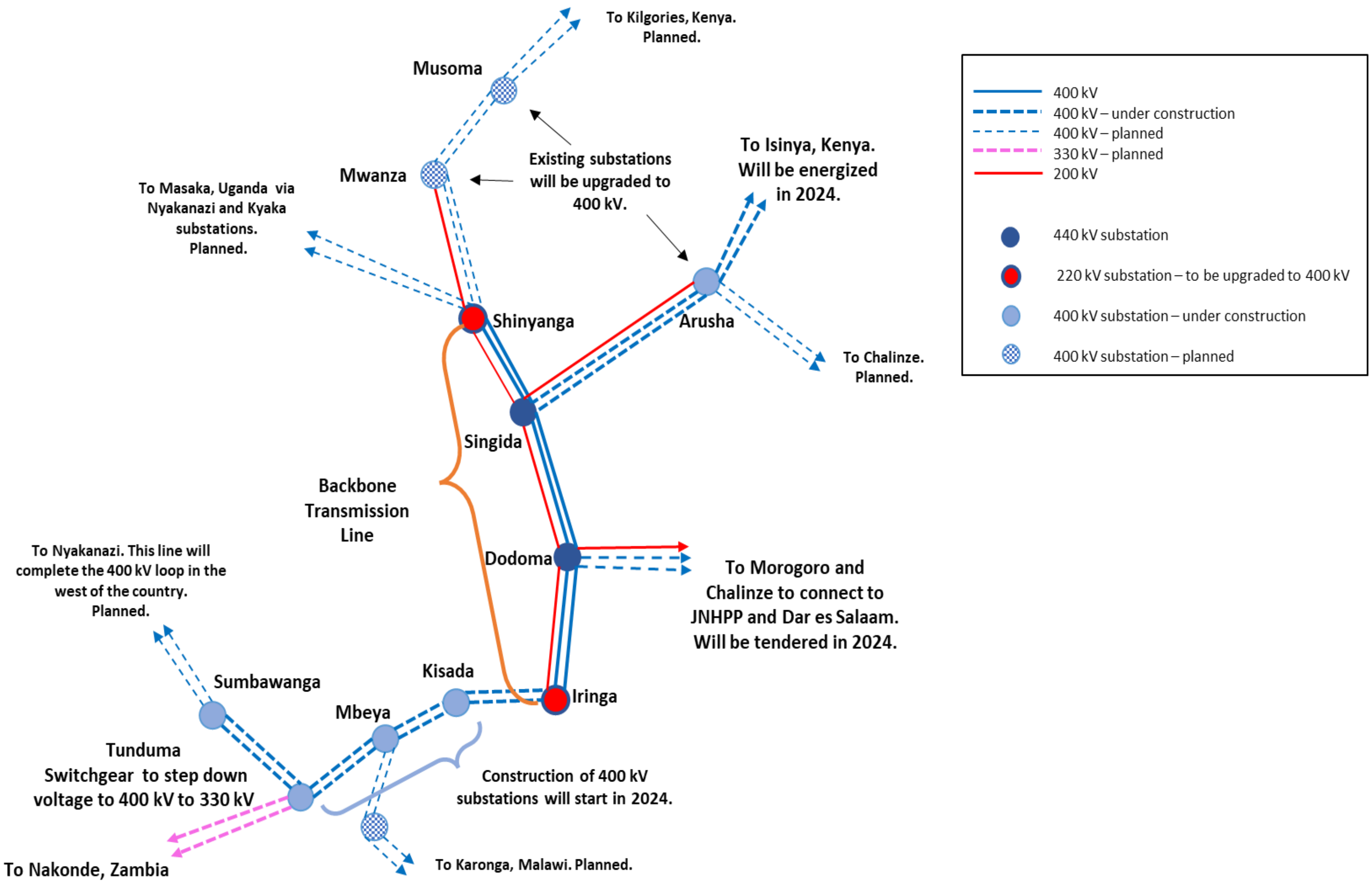
Impact on Integration with Regional Power Pools

3.10 In addition to accelerating the expansion of the high-voltage national transmission network, the BTL also functions as the backbone for the connection of the EAPP and the SAPP. The BTL is expected to be connected to the EAPP via a new 400-kilovolt line between Singida and Isinya in Kenya expected to be energized in 2024. Another transmission line from Iringa substation toward Zambia is under construction. The completion of the BTL extensions to Kenya and Zambia will physically connect Tanzania with these two power pools, but for operational integration, TANESCO needs to strengthen its planning, technical, and operational capacity.

3.11 The BTL paved the way for the further expansion of the 400-kilovolt transmission lines domestically and across borders and is expected to connect Tanzania with the EAPP in 2024. Tanzania plays a critical role for the physical connection of the EAPP and the SAPP and serves as the backbone for the connection of these two power pools via Tanzania. Funded by AfDB and JICA, TANESCO is about to complete the construction of the 400-kilovolt transmission line extension from Singida through Arusha in northeast Tanzania to Isinya, Kenya, and plans to energize the line in 2024 (figure 3.4). This line will initially allow Tanzania to import 200 megawatts from Kenya to balance the electricity supply coming from the southern generation sites and reduce load shedding. Although this will initially be a bilateral trade between Tanzania and Kenya, as the EAPP evolves into a market-based power trading pool Tanzania will be able to import and export electricity to the utilities in the EAPP (see further discussion in this section).

3.12 TANESCO is in the process of extending the BTL from Iringa substation toward its border with Zambia, which will complete the physical infrastructure on the Tanzania side for the ultimate connection of the EAPP and the SAPP. The World Bank and the French Development Agency–financed Tanzania-Zambia Transmission Interconnector (P163752) finances the construction of a 616-kilometer double-circuit 400-kilovolt transmission line and its associated substations between Iringa and Sumbawanga, which will later connect the BTL with the SAPP at Nakonde in Zambia (figure 3.4). Despite significant implementation delays because of slow procurement processes, TANESCO signed the main contracts for the construction of the transmission line in November 2023 and the associated substations in April 2024.

Figure 3.4. Extension of the 400-Kilovolt Backbone Transmission Line



Sources: Tanzania, Ministry of Energy 2018, 2020.
Note: JNHPP = Julius Nyerere Hydroelectric Power Plant; kV = kilovolt.

3.13 The completion of the BTL extensions to Kenya and Zambia will physically connect Tanzania with these two power pools, but for operational integration, TANESCO needs to strengthen its planning, technical, and operational capacity. Integration of power pools can be divided into two parts: (i) hard infrastructure physically connecting national transmission grids and (ii) soft infrastructure consisting of planning and investment coordination, technical harmonization, commercial trading and market design, and institutional architecture. The impact of the BTL on the integration and synchronization of the two regional power pools cannot be fully achieved unless TANESCO develops its soft infrastructure capacity, which currently stands out as a key challenge along with the installation of other necessary equipment such as protection controls, automated generation controls, and protection relays. Political commitment and coordination among related parties are a prerequisite to address this challenge. The Tanzania-Zambia Transmission Interconnector project supports TANESCO in capacity development for compliance with the requirements of regional power integration, such as power system stability, operational ancillary enabling services, frequency synchronization, tie-line control, protection, and metering. The project also supports the EAPP in moving from bilateral power trade agreements to market operating rules and platforms so that national utilities in the EAPP, including TANESCO, can trade power in a regional market. The SAPP has already established necessary market rules and platforms for power trading.

Impact on Electrification

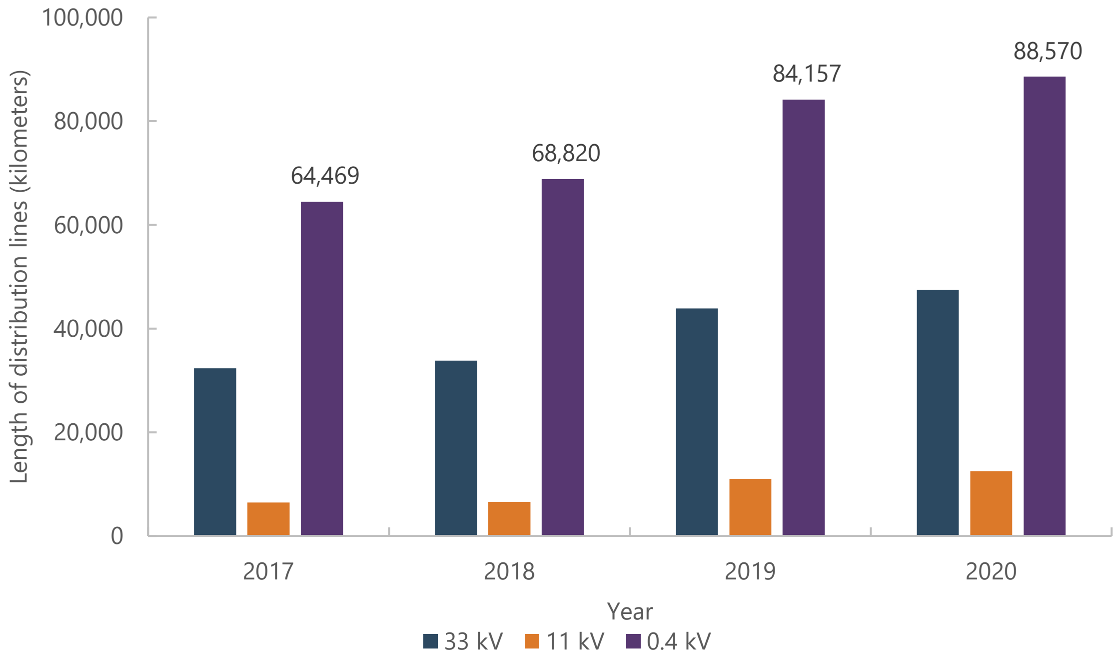
3.14 During the past decade, the nationwide electrification rate increased in Tanzania, but a large gap remains between urban and rural areas. The BTL established the basis for the Rural Energy Agency (REA) to expand the distribution network for rural electrification, but the sustainability of these efforts depends on the availability of electricity. The project facilitated the electrification of a limited number of villages along the transmission line, improving the inhabitants' socioeconomic welfare. In addition, artisanal and small-scale gold mining and processing (ASMP) flourished because of increased availability of electricity; however, the sector is unregulated, and the methods pose a high risk to the health and safety of workers and the environment.

3.15 During the past decade, Tanzania has rapidly increased its electrification rate, but large gaps remain in electrification between urban and rural areas. The electrification rate of 14 percent in 2011 increased to 38 percent in 2020, which was one of the fastest electrification increases in Sub-Saharan Africa, but the rural electrification rate is much lower than the urban electrification rate. As of 2020, the electrification rate in urban areas was 73.2 percent, whereas electrification rate in rural areas was only

24.5 percent despite a grid coverage rate of 78.4 percent in mainland Tanzania.[1] With an urban population rate of 35 percent of the total population (estimated at 65 million), approximately 6 million people in urban areas do not have access to electricity. The number of people who do not have access to electricity in rural areas is a staggering 32 million people.

3.16 The increased availability of electricity after the completion of the BTL established the basis for REA to expand the distribution network for rural electrification, but the sustainability of these efforts depends on the increased availability and quality of electricity through domestic generation and imports from the regional power pools. REA is an autonomous governmental body with the mandate to promote and facilitate improved access to modern energy services in rural areas of mainland Tanzania. Starting in 2018, REA embarked on an aggressive expansion of rural electrification program supported by the World Bank–financed Tanzania Rural Electrification Expansion Program (P153781). According to the information received from the REA and TANESCO officials, the increased availability of electricity immediately after the construction of the BTL facilitated the expansion of rural electrification. The increase in the length of the distribution lines is attributed to REA's efforts in expanding rural and semiurban electrification starting in 2019 (figure 3.5). Tanzania has set a target to achieve universal access to electricity by 2030, but the sustainability of the rural electrification efforts depends on the increased availability of electricity generated domestically (such from JNHPP expected to be energized in 2024 and other generation plants in the pipeline) and imported from the EAPP and the SAPP.

Figure 3.5. Length of Distribution Lines on Mainland Tanzania, 2017–20



Source: Energy and Water Utilities Regulatory Authority 2017–21.
Note: kV= kilovolt.

Impact of Electrification on Socioeconomic Welfare of Villagers in the Project Area

3.17 The electrification of villages along the BTL had a limited but positive impact with a strong upward potential on the socioeconomic welfare of the residents. The Village Electrification Project (financed by the Norwegian Agency for Development Cooperation and the Swedish International Development Cooperation Agency) extended the 33-kilovolt distribution lines to 122 villages along the transmission line between Iringa and Shinyanga (these villages were originally to have access to electricity through a shield wire system that would tap electricity directly from the transmission line, but it was later decided to expand the 33-kilovolt distribution line to avoid numerous shield wire system connections to the high-voltage transmission grid). A survey conducted at 6 villages (Ntondo, Mgongoro, Makomero, Mbutu, Negezi, and Mwaweja) showed that access to electricity had a limited but positive impact on the socioeconomic lives of the inhabitants with electrical equipment, productive uses of electricity, and improvements in the quality of education and health services. Access to electricity is expected to further increase the socioeconomic welfare of the villagers as electricity reliability improves, productive uses of electricity diversify, and other infrastructures are improved (such as access to road and water). The main findings of the survey are summarized as follows:[2]

- **Access to electricity and service quality.** Eighty-one percent of the respondents have electricity at their households, which is higher than the national access rate of 38 percent. This high access rate of the survey can be partly explained by limitations in sampling and partly by the proximity of the villages to main roads, which increases economic activity—hence, higher income to pay for the connection fee. The main electrical equipment used at households is television and radio. Eighty-six percent of the respondents with access to electricity are satisfied with the reliability of electricity supply despite planned load shedding and frequent unplanned outages. The findings show that the households with access to electricity can be classified mostly in Tier 2 and some in Tier 3 of the Muti-Tier Framework for measuring access to electricity.[3] Some villagers commented that high connection costs and long distance to the nearest distribution pole were the main constraints in accessing electricity.

- **Productive uses of electricity.** About one-third of the respondents used electricity for money-earning activities, and 90 percent of these respondents reported that their income increased because of the use of electricity in their businesses. Extended business hours after sunset was the main impact of electricity use through lighting. Some businesses use refrigerators to sell cold soft drinks and ice cream. Other businesses that benefited from electricity are barbershops and hair salons; television saloons; and carpentry, welding, milling, and oil pressing shops.

- **Impact on public services.** The majority of the respondents reported that education and health services had improved after access to electricity. The impact on education was through extended study hours in the evenings. The schools are electrified, but it is used only for lighting if there are study sessions in the evenings. No school had computers or any other electrical equipment that could be used for teaching. Health centers and pharmacies provide services after sunset when needed because of electricity. All health centers are equipped with a refrigerator for vaccine and medication storage. Public water supply services (sometimes through local churches or mosques) improved because of the installation of electrical pumps.

- **Impact on gender.** The impact of electrification on gender has been through the reduction in time to fetch water because of electrical water pumps and to grind grains because of the availability of electrical milling machines. However, the opportunities to use time saved for money-earning activities are limited because of the subsistence-level economy in most of the households. There is a significant technical assistance need to increase the women's capacity to engage in money-earning activities with or without the use of electricity.

Impact on Artisanal and Small-Scale Gold Mining and Processing

3.18 ASMP flourished in the northwest region of the country because of increased availability of electricity through the BTL, but the absence of appropriate environmental and social regulations raises concerns about the health and safety of workers, contamination of underground water resources, and general aesthetics. In addition to large gold mining and processing companies, there are more than 500 sites scattered in the northwest of Tanzania where ASMP takes place. Switching from diesel crushers to electrical ones almost triples the amount of material processed by ASMP businesses. The operating cost of an electricity crusher is approximately 25 percent cheaper than the operating cost of a diesel crusher. The ASMP business owners interviewed commented that their profits had increased significantly because of the impact of electricity on processing. However, the sector is not adequately regulated. The workers in these sites are not equipped with any personal protection equipment, such as headsets for hearing protection, goggles, gloves, or protective boots. The use of liquid mercury by bare hand without any protection to separate gold particles from crushed material poses a high risk to the health of the workers and contamination of underground water through the ponds used for gold processing. The sites are not properly equipped with sanitation facilities. Overall, ASMP is a major income source for many residents in the rural settlements of northwest Tanzania, and electricity had a significant impact on the production and profitability of this business; however, long-term sustainability of this economic activity will depend on how well the sector is regulated.

4. Lessons

4.1 All factors central to a project's outcome should be either internalized in the design of the project or addressed through measures outside the project. The BTIP's objective of improving the availability, reliability, and quality of power supply in the northern parts of Tanzania was dependent on two critical factors: the availability of enough generation in the southern parts of the country and the robustness of the distribution system network to reliably distribute electricity in the northern parts of the country. New generation capacity built during project implementation and to the present turned out to be significantly below TANESCO's plan. The project's support for development of a hydropower plant (222 megawatts at Rumakali) and a wind farm project (100 megawatts at Singida) did not result in new generation capacity. The shortage of generation capacity resulted in a transmission line capacity underutilization—it ran at approximately 25 percent capacity in 2023—a situation that is expected to continue until JNHPP enters operation in 2024. The degraded condition of the distribution system and its expansion through the rural electrification program resulted in the distribution of additional electricity to more customers, but the service was not provided reliably with acceptable voltages and outages.

4.2 Organizing the financing of large infrastructure projects (which may require implementation in phases aligned with demand increases to optimize economic returns) in a programmatic manner can be critical in avoiding implementation delays for subsequent phases. For the BTIP, the second phase to upgrade four substations from 220 kilovolts to 400 kilovolts was to be completed within seven years of the completion of the project. Two of the substations have been completed, whereas the other two have been delayed because of the lack of financing. Although the economic analysis favored a phased approach, a programmatic financing approach could have appropriately linked the second phase to demand conditions and provided the financing up front, especially because the larger project, including both phases, had robust economic rates of return.

4.3 Expanding distribution networks to the villages beyond the immediate project areas along high-voltage transmission lines can increase the development impact of such projects on increasing access to electricity. Along the Dodoma-Singida-Shinyanga road corridor, it was evident that some villages that were not covered by the Norwegian-Swedish village electrification program remained unserved, even though they are located a short distance from the electrified villages. A significant potential exists for expanding electricity access to these villages by addressing both demand-side (cost barriers and awareness of the potential benefits of access to electricity) and supply-side (technical standards) constraints. The World Bank–financed large transmission projects in Sub-Saharan Africa include limited activity to electrify villages along the routes of the transmission lines as a social responsibility activity, mostly with shield wire systems. This results in a limited number of villages benefiting from the availability of electricity and restricts the development impact of these projects on increasing access to electricity.

4.4 Large transmission projects can be ineffective in facilitating the development of VRE without an adequate policy framework and enabling environment to attract private sector investors. The BTL provides sufficiently robust transmission capacity for the integration of intermittent electricity supply from wind and solar sources, but TANESCO's attempts to develop renewable energy projects by private sector under a power purchase agreement failed because of the investors' high perceived investment and operation risks. The stalled sector reforms are a constraint to investors who are concerned about TANESCO's payment risks in the absence of government and third-party credit enhancement measures, termination risks, and open access to the transmission network, among other issues. Currently, TANESCO dominates the electricity market, and a resumption of the market reform could be effective in attracting private companies to invest in power generation projects, including renewable energy.

4.5 Funding from multiple donors is both necessary and desirable for large infrastructure investment projects, but inadequate coordination among donors can adversely affect project implementation, resulting in delays and risking the achievement of the project objectives. Five international donors financed the project. Each donor had its own procurement procedures with which TANESCO had to comply (which complicated the coordination of procurement reviews and approvals and resulted in delayed awards of four important contracts). This led to a 30-month delay in project implementation and a 21-month extension of the project closing date. The absence of a donor coordination mechanism was a shortcoming of project design. In the absence of such a mechanism, parallel (instead of joint) financing arrangements could be an option to avoid the problem of coordinating multidonor procurement reviews and approvals of contract packages.

4.6 Without technical assistance support for productive uses of electricity, electrification of the rural settlements with subsistence-level economies can have limited positive impact on the socioeconomic welfare of the inhabitants, especially women. According to the results of the survey conducted at six villages electrified by the project that are located near main roads (hence, having more economic activity), the project's impact on increasing the income of inhabitants using electricity for money-earning activities has been substantial, but this was restricted to a small portion of the population in the villages. Most of the households that gained access to electricity can be classified at Tier 2 according to the Multi-Tier Framework for measuring access to electricity and a small portion at Tier 3. The households with subsistence-level economic activity did not have access to electricity or used it only for lighting, which would be classified as Tier 1. According to the survey findings, the main benefit of access to electricity for women was a reduction in time required to fetch water or grind grains, but women did not receive any support on how to use the time saved from those activities to generate income for their households with or without the use of electricity. The impact of electricity on their socioeconomic welfare, hence, was limited. Therefore, technical assistance support on productive uses of electricity could be an effective way to increase the development impact of access to electricity.

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[1] In 2010, 61-kilowatt-hour per capita electricity consumption in Tanzania was significantly lower than the average 291 kilowatt-hours in low-income countries and 542 kilowatt-hours in Sub-Saharan Africa. Similarly, at 14 percent, Tanzania had one of the lowest electrification rates in Sub-Saharan Africa, where the average electrification rate was 29 percent and 26 percent among low-income countries.

[2] Load shedding means planned electricity supply interruptions because of insufficient electricity generation to meet the demand.

[3] Tanzania Electric Supply Company (TANESCO) is a vertically integrated national power utility on mainland Tanzania. In 2010, the company had monopoly over transmission and distribution of electricity and owned approximately 63 percent of the generation capacity (others were emergency power plants operated by private companies). Following the retirement of the emergency power plants in 2017 and new investments by TANESCO, the utility's share in generation gradually increased to 88 percent of the 1,695 megawatts in June 2022 (Songas is the other major player in the generation sector with 189-megawatt installed capacity in which TANESCO has a 9.56 percent share). In addition to TANESCO, three small independent power producers provide distribution services around their generation plants. TANESCO has a monopoly over the electricity transmission in the country.

[4] Under the first phase, the project was to build the transmission line with both 400-kilovolt lines strung and the substations upgraded to accommodate additional power at 220 kilovolts. However, only one circuit was to be energized at 220 kilovolts. Under the second phase, which was to be financed separately, the substations were to be upgraded to 400 kilovolts and both circuits were to be energized at 400 kilovolts in line with the increase in electricity demand within seven years after project closing.

[5] The N-2 contingency criterion is defined as the capability of delivering electricity from one point to another—that is, from a generation site to a substation or from one substation to another without any load loss in case of a failure in one of multiple transmission lines between those two points.

[6] These indexes are the System Average Interruption Frequency Index, the System Average Interruption Duration Index, and the Customer Average Interruption Duration Index. The System Average Interruption Frequency Index is the measurement of average number of supply interruptions per customer per year; the System Average Interruption Duration Index measures the average duration of supply interruptions per customer in minutes. The Customer Average Interruption Duration Index is the ratio between the System Average Interruption Duration Index and the System Average Interruption Frequency Index, which measures average duration of each supply interruptions per customer per year in minutes.

[7] The Rift Valley Energy Group, an independent power producer, has been operating a 2.4-megawatt wind power plant in Mwenga since June 2020. This plant is connected to the national grid, but it distributes electricity to the customers in its region. There are numerous independent power producers operating small off-grid solar plants under the Small Power Producer Program in Tanzania; see https://www.ewura.go.tz/small-power-projects.

[8] Morocco has between 2,700 and 3,500 hours of sunshine per year and approximately 5.8 kilowatt-hours per square meter per day of global horizontal solar radiation.

[9] To address electricity shortages, TANESCO contracted emergency power producers (EPPs) starting from 1994. However, after 2002, these EPPs started generating electricity permanently. The high cost of the electricity that these diesel-fueled EPPs generated financially burdened

TANESCO and became an important barrier to the development of the sector because of long-term power purchase agreements. Technical and financial issues with these EPPs resulted in lengthy and costly international arbitration processes. Overall, Tanzania's experience with EPPs was significantly a bitter one and had an adverse impact on the development of private sector power generation.

[10] The shareholders of Songas are Globeleq (54.1 percent), Tanzania Petroleum Development Corporation (28.69 percent), TANESCO (9.56 percent), and Tanzania Development Finance Company (7.65 percent).

[1] The Ministry of Energy officials provided these electrification rates, which were also reported in the World Bank feature story titled "Changing Lives and Livelihoods in Tanzania, One Electricity Connection at a Time" (World Bank 2022).

[2] For survey details and methodology, see appendix B.

[3] The Energy Sector Management Assistance Program launched the Multi-Tier Framework for measuring access to electricity in 2015 to redefine the way access to electricity is measured—not restricted to the traditional binary measure of "connected or not connected." The framework consists of six tiers from Tier 0 (no electricity or less than 4 hours per day) to Tier 5 (at least 23 hours of electricity per day). For a detailed explanation of the Multi-Tier Framework, see https://mtfenergyaccess.esmap.org/methodology/electricity.

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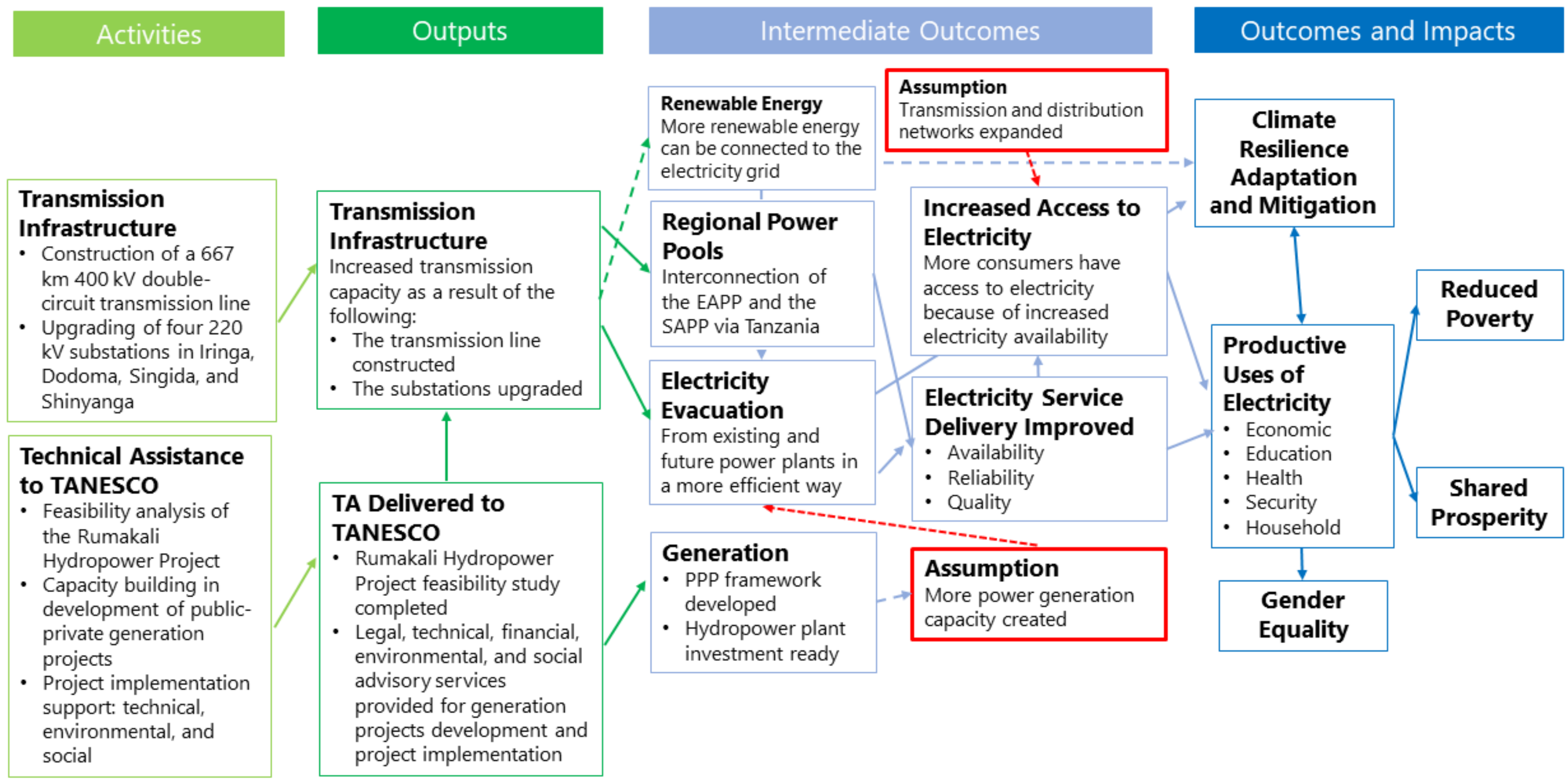
Appendix A. Theory of Change



Source: Independent Evaluation Group.
Note: EAPP = Eastern Africa Power Pool; km = kilometer; kV = kilovolt; PPP = public-private partnership; SAPP = Southern African Power Pool; TA = technical assistance; TANESCO = Tanzania Electric Supply Company.

Appendix B. Methods and Evidence

This report is a Project Performance Assessment Report. This instrument and its methodology are described at https://ieg.worldbankgroup.org/methodology/PPAR.

Overview

This Project Performance Assessment Report followed a mixed method and is based on evidence gathered through the following: (i) key project documents and data from the World Bank, Tanzania Electric Supply Company (TANESCO), Energy and Water Utilities Regulatory Authority, and the Rural Energy Agency and other sector-specific documents; (ii) semistructured interviews with World Bank staff, government counterparts, representatives of TANESCO, chamber of commerce and industry, private companies, key development partners active in the energy sector (the African Development Bank and the Japan International Cooperation Agency), and beneficiaries; (iii) site visits to Singida and Shinyanga substations; and (iv) beneficiary surveys in 6 out of 122 villages that were electrified in the project area.

Semistructured Interviews

During the meetings, key informant interviews were conducted using semistructured interviews. These interviews qualitatively assessed the project interventions and implementation results in line with the theory of change and the points of inquiry. Semistructured interviews include the following:

1. Impact of the project and sustainability of development outcomes:

    a. How is the current utilization level of the backbone transmission system? What are the issues related to the optimal use of the transmission line?

    b. What has been the impact of the project on power evacuation to the northern regions? Did the reliability and quality of electricity supply improve?

    c. What has been the impact of the project on the expansion of the transmission and distribution lines in the country? Did these expansions lead to increased electrification in the rural areas?

    d. What has been the impact of the project on the integration of the Tanzanian transmission grid with the Eastern Africa Power Pool and the Southern African Power Pool?

e. How has the project supported the development of variable renewable energy, if any, in Tanzania? What are the barriers for the development of renewable energy in the country?

f. What has been the socioeconomic impact of the project? Has there been an increased industrial and business activity in the project area? What has been the impact of the project on the big and small mining industry? What has been the impact of electricity on the villages electrified by the project? (This was further assessed by a beneficiary survey explained below.)

g. What are the risks to the sustainability of development outcomes the project achieved? What should be done to increase the impact of the project and ensure the sustainability of the outcomes?

2. Policy and regulatory framework governing power sector:

   a. What has been the progress in electricity market opening (2017–22) and other market reforms, such as the enabling environment to increase private sector investments in power generation, privatization of distribution sector, and the framework to trade power with neighboring countries?

   b. Do tariffs reflect a cost recovery level? How financially sustainable is TANESCO?

   c. What is the level of the private sector's involvement in the power sector (that is, generation, transmission, and distribution)? Do independent power producers have open access to transmission and distribution networks? What is the government plan to unbundle TANESCO and privatize transmission and distribution networks?

3. Relevance of the project objectives and design:

   a. How relevant were the project objectives to the country context and the electricity sector development objectives of the country?

   b. How relevant was the project design in achieving the project objectives? Were there any shortcomings in the project design that could have increased the efficacy and efficiency of the project in achieving the project objectives?

4. Project implementation, Bank performance, and borrower performance:

   a. Key factors during project preparation and implementation that led to implementation issues and delays

b. Monitoring and evaluation design, implementation, and utilization

c. Implementation of safeguards

d. Financial management and procurement

e. Relevance and effectiveness of the World Bank's support and assessment of Bank performance

f. Assessment of borrower performance

5. Lessons learned and applied to other projects in the sector

Beneficiary Survey

A beneficiary survey is a qualitative research tool to assess the impact of a project's intervention by conducting a survey to collect data and gain the views of project beneficiaries. Therefore, to assess the socioeconomic impact of the Tanzania Backbone Transmission Investment Project on the residents of the villages along the transmission line that were electrified after the completion of the project, the mission conducted a beneficiary survey in 6 selected villages out of 122 villages that were connected to the TANESCO grid under a project financed by Norway and Sweden. The data about the 6 villages are given in table B.1.

Table B.1. Population and Electrification Data for Six Beneficiary Survey Villages

Village	Households (no.)	Households with Electricity (no.)	Electrification Rate (%)	Total Population	Female Population	Male Population
Ntondo	566	250	44	5,587	3,139	2,448
Mgongoro	507	149	29	—	—	—
Makomero	419	154	37	—	—	—
Mbutu	520	111	21	3,600	2,000	1,600
Negezi	423	190	45	2,622	1,329	1,293
Mwaweja	339	149	44	1,834	915	919
Total	2,774	1,003	36	—	—	—

Source: Independent Evaluation Group.
Note: — = not available.

The survey was designed to capture the immediate impact of having access to electricity at home. The questions were formulated to be easily translated from English to Swahili and to be understood. The survey consisted of the questions provided in table B.2. One shortcoming of the survey was that it insufficiently captured the reliability and quality of electricity supply in the villages, and data were limited to adequately assess the level of access to electricity according to the Multi-Tier Framework for measuring access to electricity.[1]

Table B.2. Survey Questions and Responses

No.	Question	Response
1	Do you have electricity at home?	Yes or No
2	If no, why is your house not connected to the electricity?	Text
3	If yes, which year were you connected to the electricity?	Year
4	Are you satisfied with reliability of electricity service at your house?	Yes or No
5	Which electrical equipment do you have in your house?	Text
6	Do you use electricity to help you earn money?	Yes or No
7	If yes, what do you do with electricity to earn money?	Text
8	Has your household income increased because of using electricity?	Yes or No
9	Has electricity improved the quality of public and commercial services you receive?	Text
10	Has using electricity eased the burden of your daily chores?	Yes or No
11	If yes, what are the improvements?	Text

Source: Independent Evaluation Group.

The six villages were selected to include households with different socioeconomic activities as much as possible. Four villages located by a tarmac road and two villages located further from a tarmac road were selected. Village locations were chosen to include long and short distances from larger towns and cities (table B.3). The impact of tarmac role on socioeconomic activity was less visible than the closeness of the villages to larger towns or cities. Socioeconomic welfare was positively affected by the level of agricultural activity in the villages. For example, Mgongoro has subsistence-level economic activity; although it is located next to the tarmac road connecting two big cities of Singida and Shinyanga, it is further away from the nearest large town of Igunga (23 kilometers). Conversely, although Negezi is accessible only by a stabilized road and is 33 kilometers away from the large city of Shinyanga, the village is located in a cluster of villages, and cotton is the main crop produced in that area. The sampled villages were sufficient to cover respondents with different socioeconomic wealth, but the overall wealth difference between villages was not wide. One limitation of the sampling was that all villages are located along the transmission line between Singida and Shinyanga. The villages to the south of Singida toward Dodoma and Iringa could not be sampled because of limited time and the itinerary of the mission.

[1] See https://mtfenergyaccess.esmap.org/methodology/electricity.

Table B.3. Village Locations and Economic Activity

Village	Road Pavement	Nearby Large City or Town	Distance from Large Town (km)	Part of a Village Cluster	Economic Activity
Ntondo	Tarmac	Iguguno (town)	4	No	Diverse
Mgongoro	Tarmac	Igunga (town)	23	No	Not diverse
Makomero	Tarmac	Igunga (town)	12	No	Not diverse
Mbutu	Tarmac	Igunga (town)	7	No	Diverse
Negezi	Stabilized	Shinyanga (city)	33	Yes	Diverse
Mwaweja	Stabilized	Shinyanga (city)	42	No	Half-diverse

Source: Independent Evaluation Group.
Note: km = kilometer.

In six villages, 112 people were surveyed. The sample size was 4 percent of the number of households in all six villages. Sixty respondents were female (54 percent of the sample size) and 52 were male (46 percent of the sample size). These ratios did not correspond to the female and male population ratios in the six villages for which population data based on gender were available (65 percent female and 35 percent male). Therefore, the men were overrepresented in the sample size. Conversely, as each person belonged to a different household, the survey was unbiased in assessing the impact of electricity on households except the impact of electricity on easing the burden of daily chores. As women bear the burden of daily household chores disproportionately to men, the survey did not capture the impact on gender sufficiently because of the higher percentage of men in the sampling size compared with their percentage in village populations. The breakdown of respondents based on gender per village is given in table B.4.

Table B.4. Survey Respondents by Gender per Village

Village	Female Respondents	Male Respondents	Total
Ntondo	17	11	28
Mgongoro	9	8	17
Makomero	6	9	15
Mbutu	13	4	17
Negezi	9	12	21
Mwaweja	6	8	14
Total	60	52	112

Source: Independent Evaluation Group.

The surveys were conducted starting from the center of each village where the village commercial centers are located closer to the road. Houses around the commercial centers are mostly electrified. Therefore, the access rate measured by the surveys (81 percent) was much higher than the actual overall electrification in these six villages (36 percent). Although the survey was skewed toward households with access to electricity and did not adequately reflect the number of households without access to electricity, this nevertheless provided sufficient data to assess the impact of electricity on households and arrive at statistically significant conclusions, since responses of the villagers surveyed started to converge around similar findings, with rare outlier data after 30 surveys.

The surveys were conducted by six different people who had limited experience in conducting such surveys. Before conducting the surveys, each surveyor filled in the survey five times with hypothetical villages in mind, and survey design was revised to increase its implementation efficiency. To support the surveyors, the sample size in Ntondo, the first village where the surveys were conducted, was selected to be higher than the sample sizes in other villages because Ntondo was selected as a pilot. A few implementation issues that were faced during conducting the first survey were addressed in the following surveys, such as further clarification of what was meant by household chores and how to fill in the "Other" option in a couple of questions.

The online platform Google Sheets was used to conduct the survey. This proved to be an efficient way of gathering data and compiling them in an Excel sheet. However, in two villages, mobile phone service coverage was insufficient; therefore, paper-based surveys were used.

Overall, the survey produced statistically meaningful findings about the socioeconomic impacts of access to electricity in rural areas in the selected 6 villages (but these cannot be extrapolated to the 122 villages electrified by the project because the sample size is small; the results can best be interpreted as indicative rather than representative for all 122 villages). This was facilitated by the sufficiently diverse selection of villages to reflect different socioeconomic backgrounds of households in the sample and sufficient size of the sample of respondents. The survey had some limitations, as explained in this appendix, but these limitations did not result in findings that contradict the theory of change of having access to electricity that was widely explored in similar development projects and academic literature.