PROJECT PERFORMANCE ASSESSMENT REPORT

BURKINA FASO AND GHANA

First Phase of the Inter-Zonal Transmission Hub Project of the West African Power Pool (APL3) Program

Report No. 187586
OCTOBER 30, 2024

IEG Independent Evaluation Group | WORLD BANK GROUP World Bank • IFC • MIGA

Attribution—Please cite the work as follows:

World Bank. 2024. Burkina Faso and Ghana— First Phase of the Inter-Zonal Transmission Hub Project of the West African Power Pool (APL3) Program. Independent Evaluation Group, Project Performance Assessment Report 187586. Washington, DC: World Bank.

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(IDA-49710 and IDA-H7190)

October 30, 2024

Finance, Private Sector, Infrastructure, and Sustainable Development

Independent Evaluation Group

Abbreviations

AFD	Agence Française de Développement
APL	adaptable program loan
BZ	Bolgatanga-Zagtouli (Transmission Line)
ECOWAS	Economic Community of West African States
GRIDCo	Ghana Grid Company
IDA	International Development Association
ITHP	Inter-Zonal Transmission Hub Project
SONABEL	Société Nationale d'électricité du Burkina Faso
WAPP	West African Power Pool

All dollar amounts are US dollars unless otherwise indicated.

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This report was prepared by Joel J. Maweni and Ihsan Kaler Hürcan, who assessed the project in May 2023. The report was peer reviewed by Arun Sanghvi and panel reviewed by Fernando Manibog. Jean-Jacques Ahouansou provided administrative support.

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

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This is a Project Performance Assessment Report by the Independent Evaluation Group of the World Bank Group on the First Phase of the Inter-Zonal Transmission Hub Project of the West Africa Power Pool (Adaptable Program Loan 3) Program (P094919). Appendix B discusses this instrument and the methodology for this evaluation.

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. No comments were received from the borrower.

First Phase of the Inter-Zonal Transmission Hub Project (P094919)

Basic Data

Country	Burkina Faso and Ghana	World Bank financing commitment	$41.90 million
Global Practice	Energy and Extractives	Actual project cost	$109.70 million
Project name	The First Phase of the Inter-Zonal Transmission Hub Project of the WAPP (APL3) Program	Expected project total cost	$111.00 million
Project ID	P094919	Actual amount disbursed	$41.80 million
Financing instrument	Investment project financing	Environmental assessment category	B
Financing source	IDA-49710 and IDA-H7190		

Dates

Event	Original Date	Actual Date
Approval		June 29, 2011
Effectiveness	November 30, 2011	December 14, 2012
Restructurings		November 13, 2015
		March 28, 2016
		December 29, 2017
Mid-Term Review	March 30, 2015	March 30, 2015
Closing	December 31, 2015	December 31, 2018

Key Staff Responsible

Management	Appraisal	Completion
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Summary

Background and Description

In June 2005, the World Bank's Board of Executive Directors endorsed the application of an adaptable program loan instrument to support the West African Power Pool (WAPP) initiative of the Economic Community of West African States. The project's purpose was to develop a robust platform for the WAPP, which consists of four distinct but mutually reinforcing subregional power system infrastructure development projects. The First Phase of the Inter-Zonal Transmission Hub Project (ITHP), the third project in this series, was designed to connect power systems in Ghana and Burkina Faso by building a transmission line between Bolgatanga in Ghana and Zagtouli in Burkina Faso.

The objective of the First Phase of the ITHP was "to reduce the cost and improve the security of electricity supply to Burkina Faso while increasing Ghana's electricity export capacity" (World Bank 2011b, 2012, 7). The availability of cheaper electricity from Ghana through the Bolgatanga-Zagtouli (BZ) Transmission Line was expected to lower the average weighted annual cost of the electricity supply and reduce the annual total duration of outages in Burkina Faso. The project also aimed to increase the annual quantity of power exported from Ghana to Burkina Faso and connect 25 villages along the transmission line's right-of-way in Burkina Faso.

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

Results

By project closing on December 31, 2018, the project had exceeded its operational targets, as defined in the key performance indicators. The power export from Ghana to Burkina Faso through the BZ Transmission Line increased to 222 gigawatt-hours per year compared with the target of 158 gigawatt-hours per year. The weighted annual cost of the electricity supply in Burkina Faso decreased from a baseline of $0.26 per kilowatt-hour to $0.20 per kilowatt-hour, compared with the target of $0.25 per kilowatt-hour. The duration of outages decreased from 130 hours to 8 hours per year as planned.

Most project achievements improved between 2018 and 2022. Power export from Ghana to Burkina Faso increased to 1,177 gigawatt-hours per year, and the duration of outages dropped to 33 minutes. However, the decrease in weighted average annual cost might not be sustained because of uncertainties related to surplus power from Ghana, international oil prices, the cost of transporting heavy fuel oil, the development of renewable energy in Burkina Faso, the increase in electricity demand, and Burkina Faso's security situation.

What Worked and Why?

The adaptable program loan was effective in supporting the WAPP's development continuously through a series of projects. Approving a series up front provided financing certainty for building the major electricity transmission infrastructure needed for regional development in the WAPP area and helped cement the commitment of the Economic Community of West African States and the national governments.

The project delivered outputs successfully and achieved expected outcomes because of its simple technical design that used known practices and international standards for transmission line construction, with support from World Bank–financed consultants. The 225-kilovolt transmission line was compatible with the voltage levels in Burkina Faso and the WAPP system. The short transmission line was routed along a relatively flat surface that made construction easier.

The Ghanaian and Burkinabe governments' ownership of the project was critical in preparing and implementing it successfully. The project was key to the WAPP integration strategic plan that contributed to developing regional energy trade. The governments supported the project fully because of its significant benefits to both countries, their experience in power trading through preexisting interconnection, and cooperation through WAPP membership.

The joint implementation committee was effective in facilitating close cooperation and coordination between the Ghana Grid Company (GRIDCo) and Société Nationale d'électricité du Burkina Faso (SONABEL). The committee monitored project progress; addressed issues; identified technical, financial, and social risks to implementation; and conducted site visits.

The project was designed to have one contract for building the BZ Transmission Line interconnecting the two countries, based on lessons learned in similar cross-border electricity projects. Building under one contract and assigning supervision in both countries to a single owner's engineer prevented construction-related coordination issues and ensured successful completion on time and on budget.

What Didn't Work and Why?

Engineering and bidding documents were not finalized at appraisal, which delayed implementation. The contract for the owner's engineer, who was assigned to prepare the documents, was awarded 12 months after project effectiveness. The project implementation units' inadequate capacity, the time needed to prepare the bidding documents in both English and French, the World Bank's slow clearance of the request for proposals, and ineffective donor coordination delayed procurement.

Risks related to donor coordination were identified adequately at appraisal, but incomplete or ineffective mitigation measures led to significant implementation delays. Measures to mitigate the risk of implementation delays were not in place or not incorporated into the design sufficiently. The donors' informal understanding that the project would use the World Bank's procurement guidelines and standard bidding documents was not enough to mitigate the "risk of incompatibility in procurement procedures among the three lenders" (World Bank 2011, 56).

The World Bank project team's supervision of the safeguards policies implementation had several significant shortcomings: (i) lack of a project-specific grievance redress mechanism, (ii) lack of a redress mechanism for workers, (iii) failure to enforce the implementation of on-campsite safety measures, (iv) the team's delayed response in organizing a mission after fatal accidents and a safety incident, (v) delays in compensation payments to project-affected people in Ghana, and (vi) not enough coverage of safeguards issues in Implementation Status and Results Reports.

GRIDCo's noncompliance with the financial covenant defined in the credit agreement was a major shortcoming. GRIDCo could not maintain a debt service coverage ratio equal to or greater than 1.3 per the covenant because tariffs were not high enough to cover GRIDCo's operation and maintenance costs. SONABEL complied with the same financial covenant throughout the project, but its financial situation is also precarious for the same reason. Both utilities' weak financial viability poses a substantial risk to sustaining the project outcomes and developing the transmission and distribution networks further in both countries.

The project electrified 25 villages in Burkina Faso, but the achievement did not lead to scaling up rural electrification more broadly in the project area. Neither SONABEL nor the Rural Electrification Agency of Burkina Faso has enough funds to expand the low-voltage grid in rural areas. Rural households with access cannot afford the high connection fees. Ensuring that there are sufficient funds to expand the low-voltage lines and offering a sustainable subsidy program to lower the connection fees could easily improve the electrification rate in those villages.

Medium-Term Impacts of the Project

We assessed the medium-term impacts of the BZ Transmission Line under the four special themes the Independent Evaluation Group used in FY 2024 for Project Performance Assessment Reports on transmission line projects: integration with regional power pools, power evacuation, renewable energy development, and increase in rural electrification.

Impact on Integration of Power Pool

The BZ Transmission Line contributed significantly to the regional integration of national electricity networks and strengthening the WAPP, leading to the implementation of other regional transmission connection projects. The project was successful in establishing a high-voltage 200-megawatt capacity transmission connection between Ghana and Burkina Faso, which began operating in 2018. Completing the BZ Transmission Line facilitated construction of the World Bank–financed North Core Transmission Line, which will connect Nigeria's power system to Burkina Faso's and Benin's through Niger. The Second Phase of the Inter-Zonal Transmission Hub Line Project is in preparation, with financing expected from African Development Bank.

Impact on Power Evacuation

The BZ Transmission Line has increased the availability of electricity in Burkina Faso significantly since 2018, increasing electricity exports from Ghana from 222 gigawatt-hours in 2018 to 1,777 gigawatt-hours in 2022. Imports from Ghana have been Burkina Faso's main source of electricity supply, accounting for about 48 percent in 2022. Without the project, Burkina Faso would have faced serious electricity shortages and could not have met the country's increasing electricity demand.

The increased availability of electricity through the BZ Transmission Line has improved the quality and reliability of Burkina Faso's electricity supply, but sustaining these outcomes depends on drought frequency and severity and the availability of other power sources. GRIDCo of Ghana supplies about 50 percent of Burkina Faso's electricity supply and regulates the voltage in Burkina Faso, improving the voltage quality. The number and average duration of load-shedding incidents have decreased because of the increased availability of electricity from Ghana. However, outages tend to increase in drought years. Sustaining the project outcomes depends on the success of climate change risk mitigation. Commissioning gas-fired power plants in Ghana in the long run and the North Core Transmission Line could significantly mitigate the risk of insufficient electricity supply in Burkina Faso.

Building the BZ Transmission Line contributed to establishing a 330-kilovolt backbone transmission line in Ghana, which improved the connection of the southern and northern parts of the national interconnected transmission network. Before the project, any tripping on one of the two 161-kilovolt lines linking the south and north would have overloaded the other line, causing power outages in the north. The project supported strengthening the transmission network in Ghana through construction of a 330/161-kilovolt transformer at the Aboadzé substation. Agence Française de Développement financed the 330-kilovolt line loop from the south of Ghana to the north connecting to the Bolgatanga substation, which was fully commissioned in 2021.

Impact on Renewable Energy

The BZ Transmission Line could help Burkina Faso develop solar energy incrementally by improving transmission system stability; enabling increased hydropower availability from Ghana; and improving the resilience, stability, and reliability of Burkina Faso's national transmission network. The increased hydropower supply should help Burkina Faso manage solar power's intermittent nature. Solar energy can be a medium- and long-term solution for increasing electricity availability and improving the country's electrification rate if the major barriers to its development are addressed.

Strengthening Ghana's national electricity network through the backbone transmission line integrated with other WAPP power networks should help the country achieve its ambitious plans to increase renewable energy capacity by 2030. The targets in *Ghana Renewable Energy Master Plan* are 447.5-megawatt solar power–installed generation capacity and 325-megawatt wind power–installed generation capacity at utility scale by 2030. The backbone transmission line and the integrated national grids of Ghana and Burkina Faso have created conditions for greater investment in renewable energy by increasing transmission capacity and balancing renewable energy's variability with hydropower and gas-fired generation.

Impact of Electrification

The increased availability of electricity supply through the BZ Transmission Line has had a substantial impact on increasing households' access to grid electricity in urban areas of Burkina Faso but less so in rural areas. The electricity supply increased from 1,671 gigawatt-hours in 2017 to 2,317 gigawatt-hours in 2021 (39 percent increase). In the same period, the urban household electrification rate increased from 46.1 percent to 81.8 percent, but rates for rural households increased from 1.2 percent to only 4.7 percent.

The ongoing security situation, a lack of funds to expand the electricity network, and the high costs of electricity connections are the main obstacles to improving Burkina Faso's electrification rate. The regions affected by armed conflict have recorded sharp decreases in electrification rates. Although Burkina Faso has achieved some success in expanding the distribution network, not every rural household is connected to the grid because of costs or distance from the closest distribution pole.

Beneficiary surveys and group discussions conducted at two villages that the project electrified near Ouagadougou show that access to electricity had a positive impact on the residents' socioeconomic welfare, with potential for more improvements. Access to grid electricity created opportunities to engage in income-earning activities, access to improved public services, efficiency in conducting household chores, and the availability of entertainment.

Lessons

This assessment offers the following lessons:

- **Distribution networks need to be expanded beyond the immediate areas supported under village electrification programs to gain the full benefit of large transmission projects on electricity access.** This project electrified 25 villages along the BZ Transmission Line. Our assessment shows that the number of households reached averaged only 25 percent in those villages, and unconnected households cited distance from the village centers as the reason they were not electrified. Burkina Faso could expand access to electricity rapidly by addressing both demand-side constraints (for example, cost barriers, awareness of the potential benefits of access to electricity) and supply-side constraints (for example, technical standards).

- **Implementing regional integration projects requires well-coordinated institutional and procurement arrangements among the recipient countries and financing agencies.** The project was designed for one contract with a single owner's engineer, the establishment of joint procurement processes, and the use of a high-level implementation coordinating committee. However, the financing agencies did not coordinate their conditions, which delayed effectiveness of the World Bank grant and credit by 18 months and contributed to a three-year delay in the project.

- **Ensuring project preparation readiness and completing engineering designs and bidding documents before project approval are essential for implementing large infrastructure projects quickly.** Although the World Bank funding allowed for retroactive financing, the owner's engineer (assigned to finalize the engineering designs and bidding documents) was not engaged until 12 months after credit effectiveness, delaying the documents' finalization. After the owner's engineer was hired, design changes on the Ghanaian side of the transmission line and the Bolgatanga substation delayed the contract procurement process further.

- **Successful design and implementation of regional projects require assurance that financing is available and a high-level commitment from national governments or supranational organizations.** The World Bank's approval of funding for a sequence of projects supporting the development of the WAPP program offered assurances to the national governments of the Economic

Community of West African States that funding was available for the projects. The approval provided momentum to the preparation and implementation of the projects under the adaptable program loan. Jointly developed strategic frameworks at the supranational level helped build commitment to the projects and programs.

Carmen Nonay
Director of Finance, Private Sector, Infrastructure, and Sustainable Development
Independent Evaluation Group

1. Background, Context, and Design

Background and Context

1.1 The Economic Community of West African States (ECOWAS) is a regional economic union founded in 1975 to achieve collective self-sufficiency among its current 12 member states (with an estimated combined population of 330 million in 2024). ECOWAS adopted an energy policy in 1982 that led to the establishment of several regionwide energy programs, including the West African Power Pool (WAPP) in 1999. WAPP was intended as the main mechanism for integrating the national power systems and operations into a regional electricity market. WAPP's long-term goal is to provide the citizens of ECOWAS member countries with a stable, reliable, and affordable electricity supply. Ghana is a member of ECOWAS and WAPP. Burkina Faso, a founding member of ECOWAS, announced its immediate withdrawal from ECOWAS (along with Mali and Nigeria) on January 28, 2024, because of deteriorating relations with the regional group after military governments were established in the three countries. Burkina Faso did not withdraw from WAPP.

1.2 In June 2005, the World Bank Group Board of Executive Directors (the Board) endorsed the application of an adaptable program loan (APL) instrument to support the WAPP initiative through International Development Association (IDA) credits. The objective of the APL was to develop a robust platform for WAPP consisting of four distinct but mutually reinforcing subregional power system infrastructure development projects. The First Phase of the Inter-Zonal Transmission Hub Project (ITHP; the project assessed in this report) was the third project in the APL series approved in 2011,[1] which connected Ghana and Burkina Faso power systems through the construction of a high-voltage transmission line between the two countries. The connection aimed to create a cleaner source of lower-cost electricity supply from Ghana to Burkina Faso because Burkina Faso had few hydropower sources and relied heavily on diesel-fired units to generate electricity.

Objective, Design, and Financing

1.3 The project objective was "to reduce the cost and improve the security of electricity supply to Burkina Faso, while increasing Ghana's electricity export capacity" (World Bank 2012, 5). The key performance indicators were (i) average weighted annual cost of electricity supply in Burkina Faso, (ii) annual total duration of outages in Burkina Faso due to generation capacity deficit and load shedding, (iii) annual total hours of operation of the transmission line, and (iv) annual quantity of power exported from

Ghana to Burkina Faso. Neither the project objective nor the key performance indicators were revised during project implementation.

1.4 The project consisted of three investment and two technical assistance components. The first investment component was to finance the construction of a 210-kilometer, 225-kilovolt, high-voltage transmission line between Bolgatanga, Ghana, and Zagtouli, Burkina Faso (39 kilometers in Ghana and 171 kilometers in Burkina Faso) and its associated substations, as well as the installation of various systems.[2] Under the second investment component, the project was to finance the reinforcement of the transmission grid in Ghana for the reliable provision of 200 megawatts of transmission capacity to Burkina Faso through the transmission line.[3] The project was also to finance the electrification of 25 villages along the transmission line right-of-way in Burkina Faso under the third investment component.

1.5 The causal links in the project's theory of change 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. The theory of change was based on the premise that the 225-kilovolt, high-voltage transmission line would create transmission capacity to provide Burkina Faso with a new source of reliable and cheaper electricity. Increased electricity supply would then result in fewer and shorter load-shedding incidents while improving voltage quality and decreasing the cost of electricity supply (by replacing costly diesel-fired generation with cheaper power from Ghana). These achievements would result in a more reliable supply of electricity with higher quality for the consumers and allow more households to connect to the grid. The transmission line would also integrate Burkina Faso's electricity network with WAPP and potentially lead to integrating Mali into the power pool through the extension of the high-voltage transmission network. The increased transmission capacity in Ghana and Burkina Faso would facilitate integrating renewable energy (solar and wind) into the network in the medium term. As a long-term impact, improved availability, reliability, affordability, and quality of electricity supply in Burkina Faso would lead to productive uses of electricity, resulting in improved socioeconomic welfare. Appendix A presents the diagram for the theory of change.

1.6 At appraisal, the project cost was estimated adequately, and the project closed without any need for additional financing or cancellation of large loan savings. The estimated total project cost was $111.0 million, but the actual project cost was $109.7 million. The estimated IDA funding was $41.9 million (a $16.0 million grant and $25.9 million credit). The European Investment Bank and Agence Française de Développement (AFD) were to provide $30.9 million and $32.3 million, respectively. Société Nationale d'électricité du Burkina Faso (SONABEL) and Ghana Grid Company

(GRIDCo) were expected to contribute $3.4 million and $2.5 million, respectively. The project fully disbursed the IDA grant and credit.

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

Results

2.1 The project's core investment activities strengthened the interconnection of the Burkina Faso and Ghana power systems, thus increasing power exports from Ghana to Burkina Faso. The Bolgatanga-Zagtouli (BZ) Transmission Line was fully commissioned in June 2018. The project's main investment activities resulted in an increase in electricity supply in Burkina Faso, reduced supply costs, and fewer and shorter outages in the country. The new transmission capacity enabled the flow of cheaper hydropower and gas-generated power from Ghana into Burkina Faso, thus replacing higher-cost domestic electricity generated with imported heavy fuel oil (decarbonization of the power supply in Burkina Faso). The system's reliability and the quality of electricity in Burkina Faso improved because of the increased availability of electricity from Ghana.

2.2 By project closing on December 31, 2018, the project had already exceeded its operational targets, as defined in the key performance indicators. The BZ Transmission Line operated 8,497 hours per year, exceeding the target of 7,884 hours and achieving a higher level of availability (97.0 percent) than the targeted 90.0 percent. The duration of outages decreased from 130 hours to 8 hours per year as planned. The power exported from Ghana to Burkina Faso through the transmission line was 222 gigawatt-hours per year, surpassing the target of 158 gigawatt-hours per year. The cheaper electricity from Ghana reduced the average weighted annual cost of electricity supply in Burkina Faso from a baseline of $0.26 per kilowatt-hour to $0.20 per kilowatt-hour, compared with the target of $0.25 per kilowatt-hour. The project also connected 25 villages in Burkina Faso along the transmission line's right-of-way: 14 villages through a low-voltage distribution line and 11 villages directly from the transmission line shield wire.

2.3 Operating and maintaining the BZ Transmission Line properly, coupled with the surplus power from Ghana, ensured the sustainability of two project achievements: improved reliability and quality of the electricity supply. GRIDCo and SONABEL have enough operational and technical capacity to operate and maintain the high-voltage transmission line. The training on live-wire maintenance provided during project implementation allowed for maintenance of the transmission line to take place without interrupting service. The transmission line's double-circuit design resulted in redundant transmission capacity that was used during maintenance, which led to the increase in the amount of power exported from Ghana to Burkina Faso and the increase in the transmission line's operational hours, corresponding to a 99.5 percent availability of the transmission line. According to the data provided by SONABEL, the number of outages dropped significantly, from 547 in 2018 to 26 in 2022, and the average duration of outages decreased from 58 minutes in 2018 to 33 minutes in 2022.[4] During the same period, the amount of unserved energy dropped from 18,540 megawatt-hours to 160 megawatt-hours because of improvements in system reliability.

2.4 Sustaining the decrease in the average weighted annual cost of electricity supply in Burkina Faso is subject to risks and cannot be guaranteed. At the time of our assessment in May 2023, data were insufficient to calculate the weighted average annual cost of electricity supply in Burkina Faso as defined in the project results framework. As electricity from Ghana has steadily increased since project closing and now has the largest share of the energy mix (see paragraph 3.7), it is estimated that the impact of cheaper electricity from Ghana should have been strong enough to keep the weighted average annual cost of electricity in Burkina Faso lower than the preproject levels. However, sustaining this outcome will depend on the availability of surplus power from Ghana or other power-generating countries in the WAPP, the cost of international oil prices, the cost of transportation of oil from ports in Ghana and Côte d'Ivoire to Burkina Faso, the development of renewable energy (solar) in Burkina Faso, the increase in electricity demand, and the security situation in the country. Electricity demand has been increasing steadily, resulting in a slight increase in diesel-fired domestic generation to meet the demand. The increased use of such units could result in an increase in the weighted average annual cost of electricity. Similarly, as experienced in 2018, seasonal droughts could have an adverse effect on how much hydropower Ghana supplies to Burkina Faso, resulting in an increased use of diesel-fired units (see the section Impact on Power Evacuation in chapter 3).

2.5 The project electrified 25 villages in Burkina Faso, but the achievement did not lead to scaling up rural electrification more broadly in the project area because of insufficient funds to expand the low-voltage grid and high connection fees. Neither SONABEL nor the Rural Electrification Agency of Burkina Faso has enough funds to expand the low-voltage grid in rural areas. Rural households with access cannot afford the high connection fees. Although the project subsidized connection fees in the project area, only one-fourth of the households closer to the settlement's market centers in the project villages were connected to the grid. Ensuring that funds are sufficient to expand the low-voltage lines (not more than 1 kilometer from the village centers) and offering a sustainable subsidy program to lower the connection fees could improve the electrification rate in those villages easily (see the section Impact on Renewable Energy in chapter 3).

What Worked and Why?

2.6 The APL instrument was effective in supporting the development of the WAPP continuously through a series of projects. The instrument financed the construction of the main coastal transmission line connecting the transmission networks of Nigeria, Togo, Benin, and Ghana and the 60-megawatt Félou Hydroelectric Power Plant in Mali, Mauritania, and Senegal. The ITHP was the third project financed under the APL instrument. The sustained World Bank engagement provided continuous collaboration between the WAPP and its member countries and the World Bank for the development of the regional power pool and the socioeconomic development of WAPP's member countries. It also provided financing certainty for building the major electricity transmission infrastructure needed for regional development in the WAPP area.

2.7 Despite some implementation obstacles related to donor coordination and noncompliance with safeguard policies, the project delivered outputs successfully and achieved expected outcomes because of its simple technical design that used known practices and international standards for transmission line construction, with support from World Bank–financed consultants. The transmission line's 225-kilovolt voltage was compatible with voltage levels in Burkina Faso and the WAPP system, and the line's short route followed a relatively flat surface that made construction easier.

2.8 The Ghanaian and Burkinabe governments' ownership of the project was critical in its successful preparation and implementation. The project was key to the WAPP integration strategic plan that contributed to the development of regional energy trade. Both governments supported the project fully, benefiting both countries significantly while increasing their cooperation in bilateral and regional electricity trade. During project preparation, both governments had agreed to set up joint procurement and implementation arrangements that improved project implementation efficiency and completed the transmission line earlier than estimated. However, issues related to donor coordination had a significant adverse effect on overall project implementation efficiency (see chapter 3).

2.9 The joint implementation committee was effective in facilitating close cooperation and coordination between GRIDCo and SONABEL. The utilities' functional relationship in project implementation was formed by an agreement through the joint implementation committee, which consisted of officials from both utilities, the project manager of the owner's engineer, and a representative from the WAPP secretariat. The formation of the committee was one of the project's effectiveness conditions. The committee convened regularly to monitor progress; address issues; identify technical, financial, and social risks to implementation; and conduct site visits. It also shared project-related information with all stakeholders regularly to ensure their involvement in the project.

2.10 Building the BZ Transmission Line and its substations under one contract and assigning supervision in both Ghana and Burkina Faso to a single owner's engineer (a joint procurement strategy) prevented construction-related coordination issues and ensured successful completion and commissioning on time and within budget. The strategy, drawn from lessons learned in similar cross-border transmission projects, eliminated the need for two contractors, each under a separate contract in each country. It also increased supervision efficiency, simplifying coordination to address issues promptly and preventing implementation delays. The procurement strategy (one contract with a single owner's engineer) resulted in the efficient implementation of civil works and prevented any potential project implementation delays. All project documents were prepared in both English and French to address the countries' official languages (English for GRIDCo and French for SONABEL).

2.11 The results framework indicators were specific, achievable, relevant, and time-bound and captured the project's expected results, but our assessment could not repeat the measurement of some indicators. Formulating the project objective was simple, but the objectives of reducing the cost and improving the security of the electricity supply to Burkina Faso and increasing Ghana's electricity export capacity were more output-oriented than outcome-oriented. The nine indicators (three outcome indicators and six intermediate outcome indicators) were enough to capture the expected results. For example, completing the transmission line (an output) also satisfies the condition for achieving the project objective to increase Ghana's electricity export capacity. The amount of electricity transmitted through the line (an intermediate outcome) also satisfies the condition for achieving improved security and reliability of Burkina Faso's electricity supply. The reduction in the cost of the electricity supply because of the availability of cheaper electricity from Ghana is an outcome because it relates to the electricity supply's affordability and the utility's financial viability. However, a lack of relevant data prevented us from measuring two important outcome indicators: (i) the reduction in the average weighted annual cost of the electricity supply in Ghana and (ii) the reduction in the duration of outages as defined in the results framework.

What Didn't Work and Why?

2.12 Engineering and bidding documents were not finalized at appraisal, which delayed project implementation. The delay was not expected to affect the hiring of an owner's engineer (who was assigned to prepare the engineering and bidding documents) and institutional support to the utilities because the expenses were related to critical preliminary activities and were eligible for retroactive financing. However, the engineer was hired 12 months after project effectiveness because of the project implementation units' inadequate procurement capacity, the time needed to prepare bidding documents in English and French, and the World Bank's slow clearance of the request for proposals (because of lengthy discussions with the procurement and legal departments related to the cross-termination clauses). After December 2013, the owner's engineer began finalizing the technical and bidding documents, but the project could not conclude all major infrastructure investment contracts by the end of 2015 because ineffective donor coordination delayed procurement.

2.13 Two risks related to donor coordination were identified correctly at appraisal, but ineffective mitigation measures, or a lack of such measures, led to significant implementation delays when both risks materialized. The project design lacked any measures to mitigate the risk of incompatibility in procurement procedures among the three lenders. Additionally, the donors' informal understanding that the project would use the World Bank procurement guidelines and standard bidding documents was not enough to mitigate that risk. Having all lenders sign a formal agreement for common procurement procedures could have been a better mitigation measure.

2.14 Complex cross-conditionalities among the three donors delayed project effectiveness by 18 months. The Board approved the project in June 2011. Burkina Faso signed the IDA grant agreement two months after approval in August 2011, but Ghana took nine months to sign the IDA credit agreement. As of May 2012, Burkina Faso had already approved the IDA and European Investment Bank financing agreements, but both Ghana and Burkina Faso were still negotiating the AFD financing agreements. Other legal covenants needed to be fulfilled for project effectiveness, such as GRIDCo and SONABEL signing an electricity transmission agreement and a power purchase agreement. GRIDCo also needed to submit an acceptable financing and implementation plan for the 161-kilovolt transmission lines and the 330-kilovolt backbone transmission line, which would ensure the availability of electricity to be transmitted to Burkina Faso via the BZ Transmission Line.[5] All legal covenants were fulfilled by December 2012 when the project became effective—18 months after Board approval. The World Bank project team's insufficient supervision of the implementation because of a change in task team leader and staff rotations also contributed to the project's delayed effectiveness. The time required for project effectiveness and the late hiring of the owner's engineer resulted in a significant delay in procuring infrastructure investment contracts that eventually led to project closing date extensions for a cumulative period of three years.

2.15 Insufficient donor coordination on procurement slowed project implementation significantly. The donors faced challenges in making a formal agreement to coordinate procurement and other aspects of project implementation. For example, World Bank procedures allowed the reimbursement of taxes, but AFD's rules did not; all three donors' response times to procurement formalities and clearances were lengthy; donors' prequalification requirements were different, which prevented procurement for the BZ Transmission Line construction from proceeding; and the European Investment Bank and AFD required prequalification, but the World Bank did not. To eliminate this bottleneck, the World Bank agreed to reallocate IDA funds from financing construction of the transmission line section on the Ghana side to construction of the Bolgatanga substation, and AFD agreed to reallocate some of its funds for the substation construction to financing for the transmission line. After reallocating the funds, the BZ Transmission Line procurement proceeded quickly.

2.16 The World Bank project team's supervision of the safeguards policies implementation had significant shortcomings. First, although project-affected people could voice their grievances through existing official channels, the project did not establish a project-specific grievance redress mechanism until near the end of project implementation. Similarly, workers had a grievance mechanism but no redress mechanism. Second, contractor implementation and enforcement of on-campsite safety measures were insufficient, resulting in two fatalities and the serious injury of a third worker. The World Bank team was late in responding and organizing a mission after these accidents. Third, compensation payments to project-affected people on the Ghana side were delayed because of the time required to verify incomplete documents to process compensation claims and the unavailability of project-affected people (who worked as seasonal farm workers in other locations) for asset inventory surveys and valuation of compensations, resulting in a two-month delay in completing civil works. Fourth, the Implementation Status and Results Reports, which the project team prepared after every supervision mission at six-month intervals, did not cover the safeguards policies implementation sufficiently.

2.17 GRIDCo's noncompliance with the financial covenant defined in the credit agreement was a major shortcoming. To improve GRIDCo's financial viability, one financial covenant in the loan agreement required the company to maintain a debt service coverage ratio equal to or greater than 1.3 starting from 2012 and then sustain it. GRIDCo failed to comply because low tariffs were not adjusted regularly to cover its operation and maintenance costs. SONABEL complied with the same financial covenant throughout the project duration, but its financial situation is also precarious because tariffs are not high enough to cover its costs fully. The weak financial viability of both utilities poses a substantial risk to sustaining the project outcomes and developing the transmission and distribution networks further in both countries.

3. Medium-Term Impacts of the Project

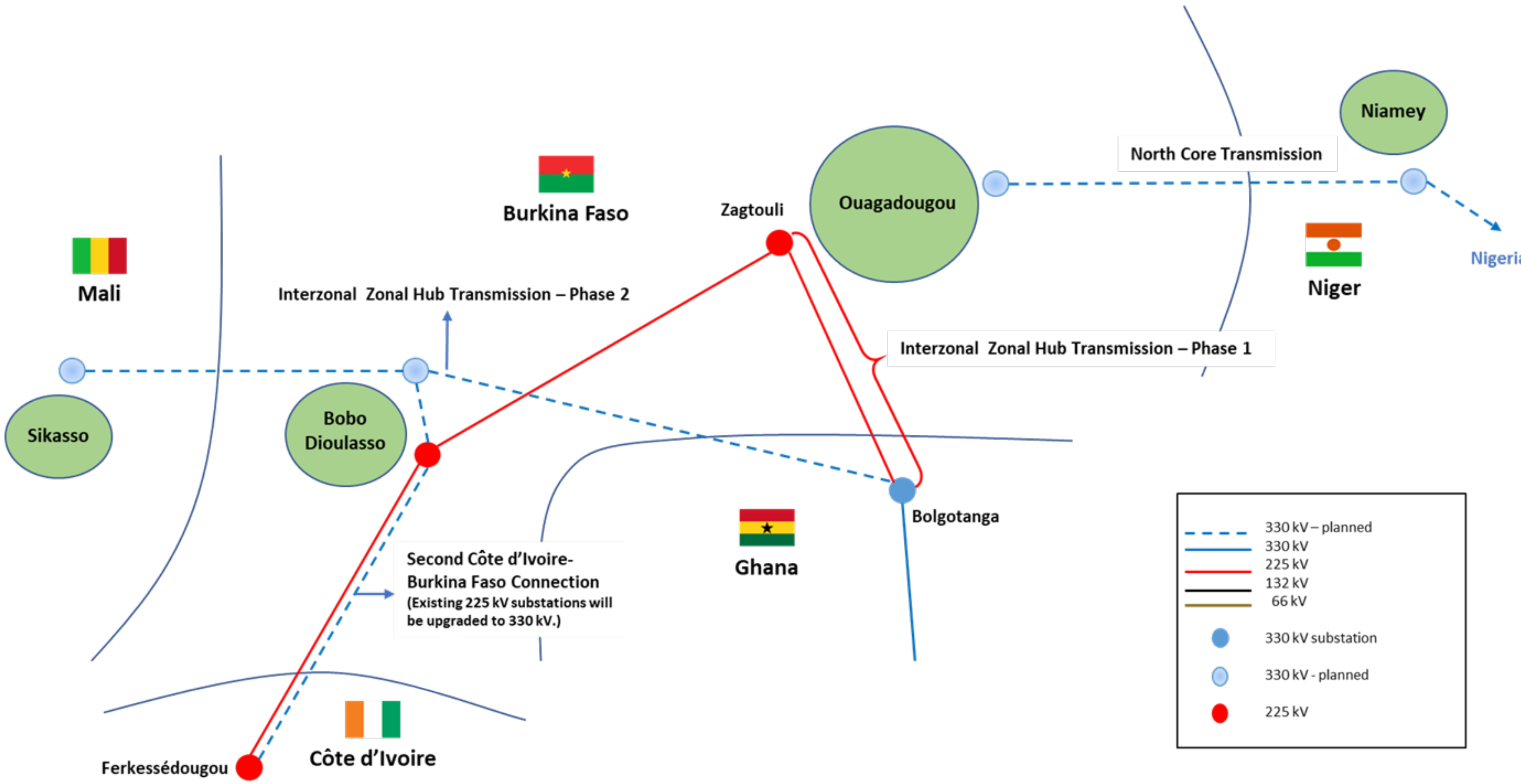
3.1 In this chapter, we assess the medium-term impacts of the BZ Transmission Line under the four special themes the Independent Evaluation Group used in FY 2024 for Project Performance Assessment Reports on transmission line projects: integration with regional power pools, power evacuation, the development of renewable energy, and an increase in rural electrification. Our assessment of results and impacts on rural electrification also includes a summary of a beneficiary survey that we conducted at only 2 of the 25 villages electrified in the project area (because of security constraints).[6]

Impact on Integration with the Regional Power Pool

3.2 The BZ Transmission Line contributed significantly to the regional integration of national electricity networks and strengthening the WAPP. The WAPP started in 2011 with the construction of the 330-kilovolt Coastal Transmission Backbone connecting the national electricity networks of Nigeria, Benin, Togo, Ghana, and Côte d'Ivoire. Its objective was to increase the availability and improve the reliability of the electricity supply in WAPP coastal countries to reduce power supply deficits and drought-induced power supply outages through the availability of gas-fired generation. The subsequent phase of the WAPP development was the ITHP, which would connect WAPP zone A countries with zone B countries.[7] The project under assessment in this report constituted the first phase of the ITHP and successfully established a high-voltage, 200-megawatt-capacity transmission connection between Ghana and Burkina Faso. The transmission line has been in operation and is providing much needed electricity supply to Burkina Faso since its commissioning in 2018. Overall, the BZ Transmission Line has been successful in further integrating Burkina Faso's national electricity network with the WAPP and strengthening the WAPP's infrastructure.

3.3 The Second Phase of the ITHP and the North Core Transmission Line would improve the outcomes achieved under the First Phase of ITHP in connecting WAPP zone A and zone B countries (figure 3.1). Under the Second Phase of ITHP, a second 330-kilovolt transmission line would be built between Bolgatanga in Ghana and Sikasso in Mali, passing through Burkina Faso's second-largest city, Bobo Dioulasso. The line will require expanding the Bolgatanga substation and building new 330-kilovolt substations in Bobo Dioulasso and Sikasso. The project is under preparation with main funding from the African Development Bank, but because of the current political and security situations in Mali and Burkina Faso, the project preparation progress has been slow. The 330-kilovolt North Core Transmission Line, which will connect Burkina Faso and Benin to Nigeria through Niger, would strengthen the transmission networks in the zone B countries of Niger, Burkina Faso, and Mali while supplying the electricity needed for the socioeconomic development of nations with limited energy resources. The North Core Transmission Line is under construction with funding from the World Bank, the African Development Bank, the European Commission, and the French government. However, political developments in Niger in summer 2023 delayed construction of Niger's portion of the transmission line; therefore, the earliest the transmission line can be commissioned will be December 2025. Once completed, the transmission line will create a 275-megawatt transmission capacity between Niger and Burkina Faso. The project will provide access to electricity to 575,000 people living in the rural areas of Burkina Faso.

Figure 3.1. Section of West African Power Pool Network Connecting Zone A and Zone B Countries

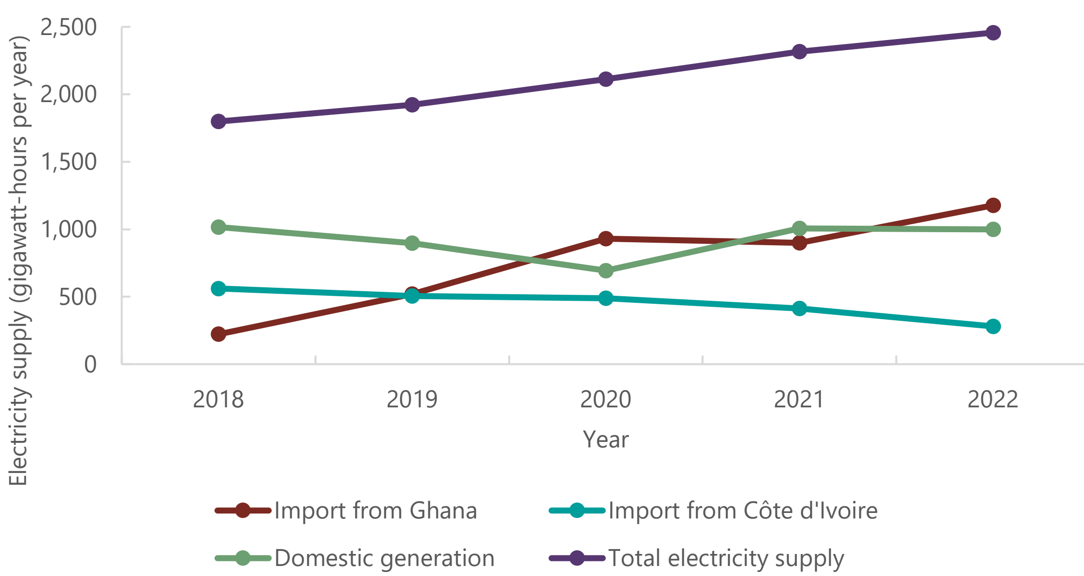


Source: World Bank 2011a, 2018b, 2019.
Note: kV = kilovolt

Impact on Power Evacuation

3.4 The BZ Transmission Line has increased the availability of electricity in Burkina Faso significantly since its commissioning in 2018. The transmission line has a 200-megawatt transmission capacity. The electricity transmitted through the line annually from Ghana to Burkina Faso has increased steadily, from 222 gigawatt-hours to 1,177 gigawatt-hours in 2022, and the availability of the line increased from 95.51 percent to 99.50 percent in the same period. As figure 3.2 shows, the electricity imported from Ghana has been the main source of the electricity supply in Burkina Faso, compensating for the steady decline in electricity imported from Côte d'Ivoire. Domestic generation has been mostly stable at approximately 1,000 gigawatt-hours per year, except in 2020. Electricity imported through the line constituted 48 percent of the electricity supplied in Burkina Faso in 2022 through the interconnected national grid. Without the project, Burkina Faso would have faced serious electricity shortages and could not have met the country's increasing electricity demand. Therefore, the electricity imported from Ghana through the line is critical for meeting the electricity demand, and it contributes to the socioeconomic development in this country classified as a fragile and conflict-affected situation. The project's target was to transmit 158 gigawatt-hours of electricity from Ghana to Burkina Faso. By project closing in December 2018, the project had transmitted 222 gigawatt-hours from Ghana to Burkina Faso that year, surpassing its target of 158 gigawatt-hours. The data show that this outcome was sustained and increased again by more than five times (table 3.1).

Figure 3.2. Grid-Connected Electricity Supply in Burkina Faso



Source: SONABEL 2023.

Table 3.1. Sources of Grid-Connected Electricity Supply in Burkina Faso

	Import from Ghana		Import from Cote d'Ivoire		Domestic Generation		
Year	GWh/yr	Share of Supply (%)	GWh/yr	Share of Supply (%)	GWh/yr	Share of Supply (%)	Total Supply (GWh/yr)
2017	—	0	583	35	1,087	65	1,671
2018	222	12	561	31	1,016	56	1,799
2019	519	27	505	26	898	47	1,922
2020	930	44	489	23	694	33	2,113
2021	900	39	412	18	1,006	43	2,317
2022	1,177	48	280	11	1,000	41	2,457

Source: SONABEL 2023.
Note: — = not available; GWh = gigawatt-hour.

3.5 Integrating the two national power grids has increased the availability of electricity from Ghana through the BZ Transmission Line and improved the quality and reliability of the electricity supply in Burkina Faso, but sustaining these outcomes depends on drought frequency and severity and the adaptive capacity of affected countries acting jointly. Burkina Faso has an installed generation capacity of about 500 megawatts compared with Ghana's approximately 5,500 megawatts. Ghana supplies about half of the electricity in Burkina Faso, so GRIDCo also regulates the voltage in Burkina Faso, which has improved the voltage quality at the transmission-system level in that country. The improvement has been sustained since the two national power grids were connected through the BZ Transmission Line.[8] Similarly, the reduction in the number and average duration of load shedding in Burkina Faso because of the increased availability of electricity from Ghana has improved the reliability of the electricity supply significantly (table 3.2). At project closing in 2018, the number of load-shedding incidents per year was 547, and their average duration was 58 minutes—a significant improvement compared with 178 minutes in 2010, just before project approval. The number and duration of load-shedding incidents continued to decrease in 2019 and 2020. However, Burkina Faso faced a significant upsurge in the number and average duration of load-shedding incidents in 2021 because of drought in Ghana and Côte d'Ivoire that affected hydropower generation adversely in the two countries and reduced electricity supply to Burkina Faso. The number and average duration of load-shedding incidents returned to their low levels again in 2022, when the drought ended and SONABEL commissioned the 54-megawatt Kossodo Thermal Power Plant. Sustaining the project outcomes depends on the success of climate change risk mitigation. Droughts caused by climate change have become more frequent and reduced hydropower generation in Ghana, but commissioning both the North Core Transmission Line and the country's gas-fired power plants is expected to significantly reduce the risk of an insufficient electricity supply in Burkina Faso. However, our assessment could not find any evidence that the drought-affected countries act jointly to address the climate change and the negative impacts of droughts on electricity generation and supply. Thus, an insufficient electricity supply caused by droughts is a moderate to high risk for sustaining project outcomes.

Table 3.2. Number and Duration of Load Shedding and Unserved Energy per Year in Burkina Faso

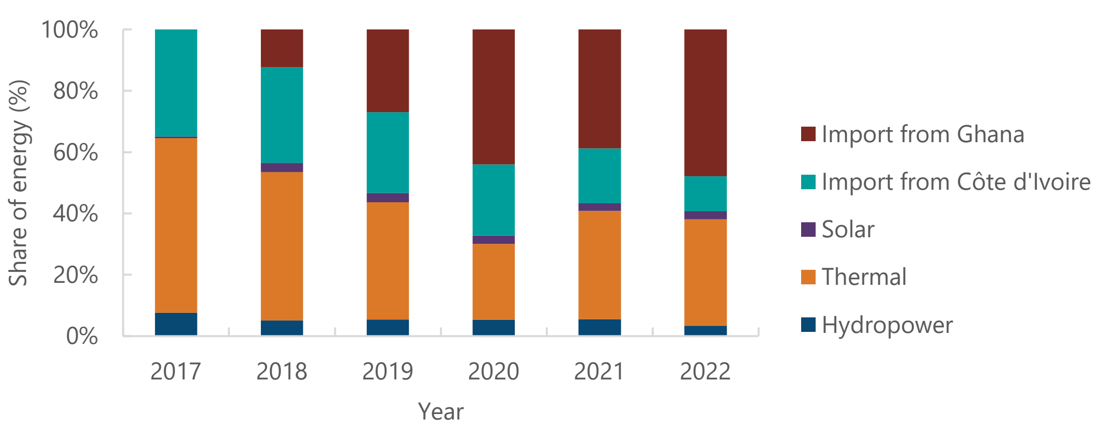
Year	Number	Average Duration (minutes)	Unserved Energy (MWh)
2018	547	58	18,540
2019	228	50	3,544
2020	50	26	479
2021	272	153	32,474
2022	26	33	160

Source: SONABEL 2023; Ministere de l'Energie, des Mines et des Carrieres, Burkina Faso 2022a.
Note: MWh = megawatt-hours.

3.6 The impact of cheaper and cleaner electricity (hydropower and gas-fired generation) imported from Ghana on replacing expensive and dirty diesel-fired generation in Burkina Faso has been significant, but the share of diesel-fired generation in the energy mix has started to increase incrementally in recent years. One of the project's main goals was to replace the costly and dirty diesel-fired generation with cheaper and cleaner hydropower and gas-fired generation from Ghana through the BZ Transmission Line. After the transmission line was commissioned, total diesel-fired generation (by SONABEL and private companies) dropped from its peak of 950 gigawatt-hours in 2017 to 870 gigawatt-hours in 2018 and reached its lowest amount of 524 gigawatt-hours in 2020. However, the total amount of diesel-fired generation sharply increased in 2021 to 820 gigawatt-hours to compensate for the drought-caused decrease in electricity imported from Ghana and Côte d'Ivoire. Although the imported electricity surpassed its predrought levels in 2022, the continued decline in electricity imported from Côte d'Ivoire and the increasing demand for electricity prevented a reduction in diesel-fired generation in Burkina Faso. Diesel-fired generation is still important for meeting the country's electricity demand, and Burkina Faso will have to rely on it in the medium term because of the country's limited hydropower potential, which is mostly developed. However, once the North Core Transmission Line is commissioned, the additional electricity transmission capacity will allow Burkina Faso to import cheaper and cleaner electricity from WAPP network countries, such as Nigeria, to meet the electricity demand that has been growing at an average annual rate of 10 percent. The project's impact on replacing and avoiding diesel-fired generation is still significant because without the BZ Transmission Line, Burkina Faso's fuel-generation mix would have had much more thermal capacity (diesel-fired generation capacity) than it does today.

3.7 The cheaper electricity transmitted from Ghana had initially resulted in a decrease in the average weighted annual cost of electricity supply in Burkina Faso, but sustaining this decrease has risks. An expected project outcome was a decrease in the average weighted annual cost of electricity supply (or the increased affordability of electricity) because of replacing costly diesel-fired generation with cheaper hydropower and gas-fired generation from Ghana. At project closing, the cost of electricity had decreased from $0.26 per kilowatt-hour before the project to $0.20 per kilowatt-hour against the target of $0.25 per kilowatt-hour.[9] When we conducted the assessment, the available data were insufficient to calculate the weighted average annual cost of the electricity supply in Burkina Faso. However, as shown in figure 3.3 and table 3.3, the share of cheaper electricity imported from Ghana in the energy mix has steadily increased, and the share of thermal generation first decreased from 57 percent in 2017 to its lowest of 25 percent in 2020 and then bounced to 35 percent in 2021—a decrease of 22 percentage points since 2017. Because electricity from Ghana has the largest share of the energy mix and is expected to increase soon (because 150 megawatts of the 200-megawatt capacity of the BZ Transmission Line is now used), the impact of importing cheaper electricity from Ghana should have been strong enough to keep the weighted average annual cost of electricity in Ghana lower than the preproject levels and then lower it even further. However, this shift would also depend on international oil prices, the cost of transporting oil from ports in Ghana and Côte d'Ivoire to Burkina Faso, the development of renewable energy (for example, solar) in Burkina Faso, and the rate at which the demand for electricity will increase in the region.

Figure 3.3. Change in Energy Mix Between 2017 and 2022



Source: SONABEL 2023; Ministere de l'Energie, des Mines et des Carrieres, Burkina Faso 2022a.

Table 3.3. Share of Different Energy Sources Between 2017 and 2022 (percent)

	Domestic			Imported		
Year	Hydropower	Thermal	Solar	Cote d'Ivoire	Ghana	Total
2017	8	57	1	35	0	100
2018	5	48	3	31	12	100
2019	5	38	3	26	27	100
2020	5	25	3	23	44	100
2021	6	35	3	18	39	100
2022	3	35	3	11	48	100

Source: SONABEL 2023; Ministere de l'Energie, des Mines et des Carrieres, Burkina Faso 2022a.

3.8 **The reduced surplus generation capacity in Ghana (in terms of both installed capacity and available capacity affected by droughts) poses a great risk to the sustenance of the electricity supply to Burkina Faso through the BZ Transmission Line.** In 2021, Ghana had to decrease the amount of electricity it supplied to Burkina Faso through the transmission line because of a drought, which increased the number and duration of load-shedding incidents. As of the end of 2022, Ghana had an installed generation capacity of 5,454 megawatts, with a dependable capacity of 4,843 megawatts. The domestic peak demand in 2022 was 3,065 megawatts; the system's peak demand, including exports, was 3,469 megawatts. Therefore, Ghana still has a comfortable surplus energy capacity to meet Burkina Faso's electricity import requirement, but because of Ghana's high population growth rate, coupled with significant potential for economic growth, Ghana is estimated to surpass a peak demand of 5,000 megawatts by 2030. (The demand for electricity in Ghana has been increasing at an average annual rate of 10 percent for the past six years). Besides Burkina Faso, Ghana exports electricity (as does Nigeria) to Benin and Togo, where demand has been increasing by an average of 4 percent and 6 percent, respectively, for the past decade. Burkina Faso and other countries importing electricity from Ghana might begin facing power shortages in the medium term unless Ghana expands its installed generation capacity by about 3,000 megawatts by 2032 (as it plans to do) or electricity is sourced from other power-generating countries within the WAPP system, such as Nigeria through the North Core Transmission Line (to be commissioned by December 2025).

3.9 **The BZ Transmission Line helped increase Ghana's electricity exports significantly and enabled the use of surplus generation.** A long history of power trade between Burkina Faso and Ghana favored the increase in trade to use both the increased transmission capacity and the surplus generation capacity in Ghana. One of the project's objectives was to increase Ghana's electricity exports. Ghana has been importing and exporting electricity for more than two decades. As shown in table 3.4, Ghana's electricity exports increased significantly after the BZ Transmission Line was commissioned in 2018, and the electricity imports gradually decreased to negligible amounts because of the increase in domestic generation capacity. The gradual completion of the 330-kilovolt backbone transmission line looping the Ghanaian electricity network from south to north has also been important for increasing Ghana's electricity exports to Burkina Faso.

Table 3.4. Ghana's Electricity Import and Export (gigawatt-hours)

Year	Import	Export	Net Export
2015	236	581	345
2016	765	473	292
2017	320	377	57
2018	140	739	599
2019	127	1,430	1,303
2020	58	1,855	1,797
2021	44	1,734	1,690
2022	37	2,215	2,178

Source: Energy Commission of Ghana 2023.

3.10 Building the BZ Transmission Line also contributed to establishing a 330-kilovolt backbone transmission line in Ghana to better connect the southern and northern parts of the national interconnected transmission network. Before the project, any tripping on one of the two 161-kilovolt lines linking the south and north of the national transmission system (the Kumasi-Techiman and Kenyasi-Sunyani lines) would have overloaded the other line, causing power outages in the north. The project supported strengthening the transmission network in Ghana through the construction of a 330/161-kilovolt transformer at the Aboadzé substation. AFD financed the 330-kilovolt line loop from south to north starting from Kumasi, passing through Kintampo and Tamale, and connecting to the Bolgatanga substation (which connects to the Zagtouli substation in Burkina Faso through the BZ Transmission Line), which was fully commissioned in 2021. After the commissioning, the reliability of the electricity supply in Ghana's northern regions improved.

3.11 Overall, the BZ Transmission Line had a significant impact on increasing the availability and improving the reliability of the electricity supply in Burkina Faso while facilitating the improvement of electricity reliability in the northern regions of Ghana. However, sustaining and improving these outcomes, specifically for Burkina Faso, will depend on the availability of additional electricity transmission capacity from power-generating countries in the WAPP system. The household electrification rate in Burkina Faso is low (23.4 percent), with a significant difference between urban (82.0 percent) and rural (4.7 percent) areas, according to government data for 2022. Electricity consumption is approximately 90 kilowatt-hours per capita per year, which is significantly lower than the average annual electricity consumption of 370 kilowatt-hours per capita in Sub-Saharan African countries.[10] To increase its electrification rate and to meet the steadily increasing electricity consumption per person, Burkina Faso needs to have significantly higher amounts of electricity supplied to its grid while also expanding its electricity network, but the BZ Transmission Line is expected to reach its full capacity in the medium term. Burkina Faso will not be able to meet its growing electricity demand unless additional capacity is created by either increasing capacity in the existing transmission line or constructing new cross-border transmission lines (such as the Bolgatanga-Bobo Dioulasso-Sikasso line connecting Ghana to Mali via Burkina Faso). The inability to meet demand would hamper Burkina Faso's socioeconomic development and create a main obstacle to social inclusion, which is one of the main drivers of fragility in the country.

Impact on Renewable Energy

3.12 Because of its geographic location, Burkina Faso has abundant solar irradiation and high development potential for using solar energy. The global horizontal radiation ranges from 5.4 kilowatt-hours per square meter per day in the south of the country to 6.0 kilowatt-hours per square meter per day in the north, and there are more than 3,000 hours per year of direct sunshine[11] The International Renewable Energy Agency estimates that Burkina Faso has a maximum development potential of 95.9 gigawatts of solar photovoltaics (IRENA 2021).[12] SONABEL commissioned the 33.7-megawatt Zagtouli solar power plant in 2017 (the largest solar power plant in Western Africa), which connects to the Zagtouli substation, the terminal substation of the BZ Transmission Line. The 30-megawatt Nagréongo solar power plant developed under a public-private partnership went online in 2022. The power plant is located 30 kilometers northeast of Ouagadougou, in the opposite direction of the BZ Transmission Line. Currently, the installed solar generation capacity in Burkina Faso is about 64 megawatts (about 12 percent of the total installed generation capacity in the country), but the share of solar energy in the energy mix is only 3 percent. Another 27-megawatt solar power plant is under construction in the Kona region between Ouagadougou and Koudougou and is expected to be commissioned in 2024.

3.13 **The BZ Transmission Line can facilitate the incremental development of solar energy in Burkina Faso by improving the transmission system stability and the baseload electricity supply needed for integrating solar energy into the national grid.** The increased availability of the electricity supply from hydropower facilitates the integration of solar energy into the national grid more easily because the grid can absorb solar energy's variability. In addition, the BZ Transmission Line increased the national transmission network's resilience and improved its system reliability by connecting it to

Ghana's national grid through a 200-megawatt transmission capacity. These technical improvements should contribute to the development of renewable energy in Burkina Faso.

3.14 **As Burkina Faso's electricity network is integrated with the rest of the WAPP through the BZ Transmission Line, solar energy can be a medium- and long-term solution for increasing the availability of the electricity supply and the electrification rate in the country if the major barriers to its development are addressed.** Burkina Faso has been relatively successful in developing utility-scale solar power generation. However, its development faces major barriers, primarily the country's extremely fragile security situation, which has been preventing an expansion of the national grid and investments in power generation. Political and institutional instability is another major barrier. The country experienced two military coups within nine months in 2022 and averted a military coup attempt as recently as September 26, 2023. Such political and institutional instability has a direct adverse impact on economic activity. Additionally, the Russian invasion of Ukraine has been a barrier for the entire economy in general, and disruptions in maritime logistics have affected Burkina Faso negatively.

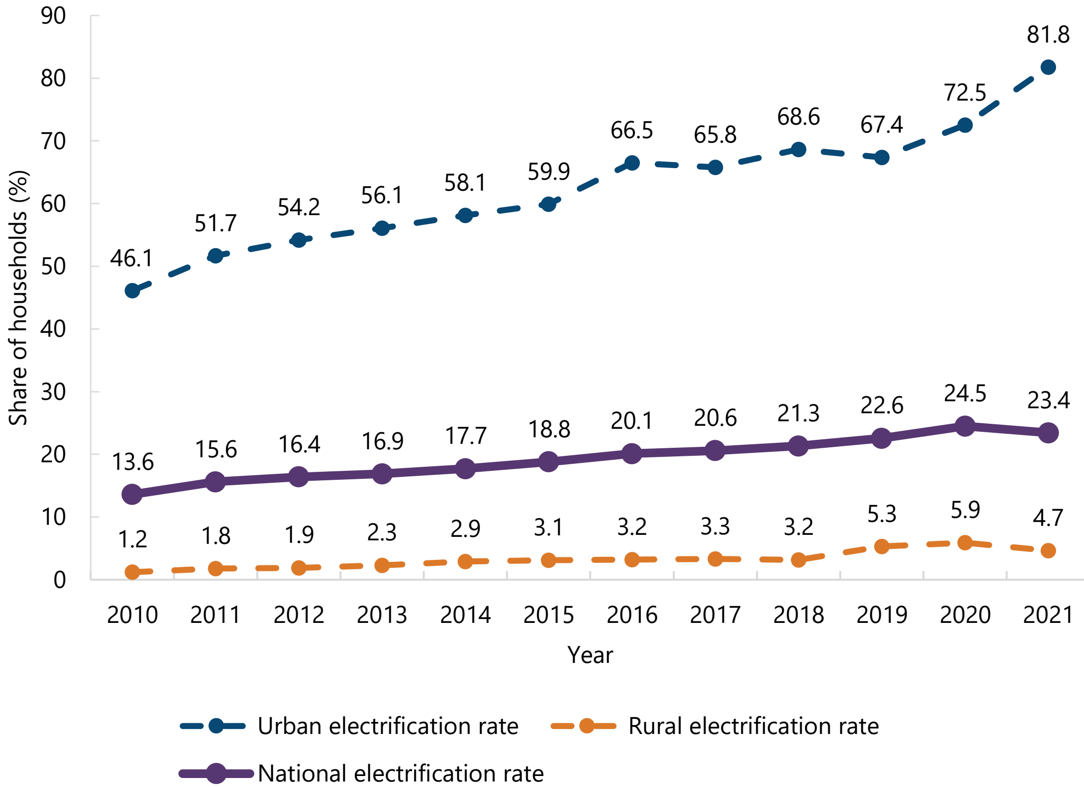
3.15 **Commissioning the 330-kilovolt backbone transmission line in Ghana (which the project supported indirectly) improved the transmission network's stability significantly, which should make it easier for the country to integrate renewable energy into the grid.** Ghana has an advanced electricity network and had been developing renewable energy and hydropower before the project started. The first solar power plant (the 2.5-megawatt Navrongo Solar Power Plant in Bolgatanga, developed by the Volta River Authority) was commissioned in 2013 and then followed by publicly and privately developed solar power plants.

3.16 Strengthening Ghana's national electricity network through the backbone transmission line integrated with other WAPP power networks should help the country achieve its ambitious plans to increase its renewable energy capacity by 2030. As of the end of 2022, Ghana had a utility-level solar power–installed generation capacity of 112 megawatts connected to the grid. It also has about 42 megawatts of distributed power generation capacity that can be supplied to the national electricity network as the country implements net metering for this kind of generation. Ghana's Renewable Energy Master Plan set targets of 447.5-megawatt solar power–installed generation capacity and 325-megawatt wind power–installed generation capacity at utility scale by 2030 (Energy Commission of Ghana 2019). Building the backbone transmission line and integrating Ghana's national grid with Burkina Faso's created the conditions for greater investment in renewable energy by increasing transmission capacity and balancing renewable energy's variability with hydropower and gas-fired generation. GRIDCo has already conducted some preliminary technical impact studies for potential renewable energy projects, but integrating renewable energy in large amounts to meet Ghana's 2030 targets requires a detailed, systemwide technical study to identify the robustness and readiness of the transmission system in Ghana.

Impact on Electrification

3.17 The increased availability of the electricity supply through the BZ Transmission Line has had a substantial impact on increasing households' access to grid electricity in urban areas of Burkina Faso but less so in rural areas. At project appraisal in 2010, the grid-based electrification rate of households in Burkina Faso was 13.6 percent nationwide, with a significant difference between urban and rural electrification rates (46.1 percent and 1.2 percent, respectively). With the completion of the transmission line and a 39.0 percent increase in the total annual electricity supply (from 1,671 gigawatt-hours in 2017 to 2,317 gigawatt-hours in 2021), the urban household electrification rate had increased to 81.8 percent in 2021 but had increased to only 4.7 percent for rural households (figure 3.4).[13] In the same year, Burkina Faso's population was estimated at 22.0 million people, of which 68.0 percent (15.0 million) lived in rural areas and 32.0 percent (7.0 million) lived in urban areas. Thus, at a 4.7 percent rural household electrification rate, out of 2.5 million rural households, only 120,000 (720,000 people) had access to grid electricity,[14] and 14.3 million households did not have access to electricity. Using the same assumptions, the number of people with access to electricity in urban areas was about 5.8 million, whereas 1.3 million people did not have access to grid electricity. Overall, only 29.0 percent of the population (6.5 million people) had access to grid electricity, compared with 71.0 percent of the population (approximately 15.5 million people) who did not have access.

Figure 3.4. Urban, Rural, and National Electrification Rates in Burkina Faso



Source: SONABEL 2023; Ministere de l'Energie, des Mines et des Carrieres, Burkina Faso 2022a.

3.18 **The ongoing security situation, a lack of funds to expand the electricity network, and the high costs of electricity connections are the main obstacles to improving Burkina Faso's electrification rate.** The regions affected by armed conflict have recorded sharp decreases in electrification rates.[15] For example, Boucle du Mouhoun's electrification rate initially increased from 19.1 percent in 2015 to 32.4 percent in 2020, but it decreased sharply to 9.4 percent in 2021. Similarly, the electrification rate in Centre-Ouest increased from 29.7 percent in 2015 to its peak of 61.1 in 2020 but dropped to 44.5 percent in 2021. In all other regions, electrification rate increases ranged from 1.4 percent (in the Est region, where the security situation is fragile) to 36.8 percent point (in the Centre-Sud region, where armed conflicts are rare). Insufficient funds are also a major barrier to expanding the country's rural distribution network. The government entity in charge of rural electrification (Agence Burkinabè de l'Électrification Rurale) has been successful in expanding the distribution network to cover 28.0 percent of the inhabitable areas as of 2021. However, not every household in these areas is connected to the grid, either because the electricity connection fees are high or the houses are far away from the closest distribution pole.

3.19 **The project did not have any direct impact on Ghana's electrification rate.** In 2015, Ghana had an electrification rate of 76.0 percent (household), which is estimated to have increased to 88.6 percent in 2022 (the highest access-to-electricity rate in Sub-Saharan Africa, excluding South Africa). Ghana is on track to achieve universal access to electricity by 2030 (World Bank 2023). The BZ Transmission Line did not have any impact on Ghana's electrification rate because the project was designed to export electricity from Ghana to Burkina Faso to increase availability and improve the reliability of its electricity supply. However, the 330-kilovolt backbone transmission line (which is one of the main transmission lines within WAPP and provides electricity to the BZ Transmission Line) has improved the quality and reliability of the electricity supply in the northern regions of Ghana while increasing the availability of electricity as well. The data show that the household electrification rates in the northern provinces of Ghana increased, though they increased less in Upper West and Upper East, the two provinces bordering Burkina Faso (table 3.5). The Northern Electricity Distribution Company (a fully owned subsidiary of the Volta River Authority) distributes electricity in the northern half of the country, including the provinces listed in table 3.5, which are sparsely populated compared with the regions in the southern half of the country. With the Ghanaian government's support, Northern Electricity Distribution Company has been expanding the distribution network in these regions. It is not possible to establish a direct connection between the commissioning of the 330-kilovolt backbone transmission line and the increase in the electrification rate in those five northern provinces, but improved system reliability and the increased availability of a reliable electricity supply should lead to an increase in the electrification rate, which should eventually ensure universal access in these provinces and the rest of the country by 2030.

Table 3.5. Electrification Rates in Five Northern Provinces of Ghana (percentage of population)

Year	Upper West	Upper East	North-East	Northern	Savannah
2017	75.9	60.5	47.1	68.0	49.4
2018	n.a.	n.a.	n.a.	n.a.	n.a.
2019	76.5	60.7	59.1	70.2	54.5
2020	78.0	63.0	62.9	70.6	55.4
2021	79.5	64.2	72.8	80.5	60.1
2022	81.1	65.5	74.3	82.2	61.3

Source: Energy Commission of Ghana 2023.
Note: n.a. = not applicable.

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

3.20 **The project electrified 25 villages along the BZ Transmission Line.** Fourteen villages were electrified through an existing 33-kilovolt distribution line and 11 villages through a shield wire system that taps electricity directly from the high-voltage transmission line. We originally planned to conduct a beneficiary survey in 6 villages electrified in the project area, but because of security concerns, we could visit only 2 villages closer to Ouagadougou to conduct the survey. We interviewed 20 people, a group that included 9 women.

3.21 **Beneficiary surveys and group discussions conducted at the two villages show that access to electricity had a positive impact on the residents' socioeconomic welfare and offered further upward potential.** The interviews revealed that access to grid electricity created opportunities to engage in income-earning activities—for example, residents cited selling soft drinks and ice cream, operating barber shops and hair salons, and engaging in milling and carpentry as key activities. Access also improved educational opportunities because students had extended study hours in the evenings, and access to electricity also improved health care opportunities because health care centers and pharmacies could store medications in refrigerators and stay open in the evenings. The impact on household chores included a reduction in the times needed to fetch water (and the availability of cleaner water because of the use of electric pumps for water pumping) and a reduction in the burdens women experience when fetching water and grinding grains. Villagers' social lives improved because they had access to better forms of entertainment, such as television, and more lighting in the evenings improved their security. The villagers reported satisfaction with the reliability of the electricity supply and that outages were rare. They had no complaints about voltage fluctuations. Electricity fees were paid up front. On average, consumers spent about 11 percent of their incomes for electricity.

3.22 **Although the project successfully brought electricity to these villages, the funds were insufficient to subsidize connecting every household in those villages close to the grid.** Village leaders estimated that only 25 percent of the households in the villages are connected to the grid and that they are the households closer to the village centers where economic activity takes place. Households that are farther from the village centers tend to use solar photovoltaic panels to generate electricity, but their use is restricted to lighting and televisions. The demand from such households to connect to grid electricity is high. Other households within connection distance also remain unconnected because of the high costs of connecting and a lack of adequate connection subsidies. The fact that villages located within sight of electrified village centers still do not have access to grid electricity suggests that SONABEL and Agence Burkinabè de l'Électrification Rurale have technical and financial limitations preventing them from capitalizing on the increased electricity available through the BZ Transmission Line to expand access in the area.

4. Lessons

4.1 **Distribution networks need to be expanded beyond the immediate areas supported by donors under village electrification programs to gain the full benefits of large transmission projects on electricity access.** This project electrified 25 villages along the BZ Transmission Line to support increased national electrification. Our assessment shows that the number of households reached averaged only 25 percent in the electrified villages, and unconnected households cited their distance from the village centers as the reason they are not electrified. With the potential for an increased power supply to Burkina Faso from Ghana and other WAPP countries as integrating member countries' networks expand, Burkina Faso could rapidly expand access to electricity by addressing both demand-side constraints (for example, cost barriers, awareness of the potential benefits of access to electricity) and supply-side constraints (for example, technical standards) to expansion.

4.2 **Implementing regional integration projects requires well-coordinated institutional and procurement arrangements among the recipient countries and the financing agencies.** Drawing on previous experiences with transmission line projects, the project was designed for having one contract with a single owner's engineer, establishing joint procurement processes, and setting up a high-level implementation coordinating committee. However, the financing agencies did not coordinate their conditions, which delayed effectiveness of the World Bank grant and credit by 18 months and contributed to a three-year delay in the project. Additionally, the donors did not have a formal agreement on a joint procurement strategy. Their informal understanding was that the project would use World Bank procedures and processes, but it was not implemented, and each donor followed its own rules, which delayed procurement of the main contracts and contributed to the project's overall implementation delay.

4.3 **Project preparation readiness and, critically, completing engineering designs and bidding documents before project approval are essential for implementing large infrastructure projects quickly.** Although the World Bank funding allowed for retroactive financing, the owner's engineer, who was responsible for finalizing the engineering designs and bidding documents, was not engaged until 12 months after credit effectiveness, delaying the documents' finalization. After the owner's engineer was hired, design changes on the Ghanaian side of the transmission line and the

Bolgatanga substation delayed the contracts procurement process for the transmission line even more.

4.4 **The design and implementation of regional projects successfully require assurance that financing is available and a high-level commitment from national governments or supranational organizations.** The World Bank's approval of funding for a sequence of projects supporting the development of the WAPP program provided assurances to the national governments of the ECOWAS that funding was available for the projects. The approval gave momentum to the preparation and implementation of the projects under the APL. Jointly developed strategic frameworks at the supranational level helped build commitment to the projects and programs.

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[1] Other projects in the APL series were APL1, First and Second Phases of the Coastal Transmission Backbone Project (P075994 and P094917; $100 million IDA financing); APL2, Félou Hydroelectric Project (P094916; $160 million in IDA financing); and APL4, the First Phase of Côte d'Ivoire, Sierra Leone, Liberia, and Guinea Power System Re-development Project (P113266; $150 million in IDA financing).

[2] The substations include a 225/161-kilovolt substation in Bolgatanga and a 90/33-kilovolt substation in Ouaga Est, as well as the extension of the 225/90-kilovolt Zagtouli substation. The various systems include telecommunications systems, supervisory control and data acquisition systems, and energy management systems.

[3] Because financing from other sources was already secured for the reinforcement of the Ghanaian transmission grid, the project was intended to finance only the installation of a 330/161-kilovolt, 200-megavolt ampere transformer at the Aboadzé substation near Takoradi in Ghana and the preinvestment studies of the 161-kilovolt Atebubu-Tamale transmission line.

[4] The data were insufficient to remeasure this indicator at the time of the assessment in May 2023. Therefore, we used data provided by Société Nationale d'électricité du Burkina Faso to assess the sustainability of project outcomes related to the reliability of the electricity supply.

[5] The project also financed the construction of a new substation in Aboadzé to strengthen the backbone transmission line.

[6] We originally intended to conduct the survey in six villages, but because of security concerns, we visited only two villages closer to Ouagadougou (Lougsi and Ouarmini) and canceled visits to four villages (Dagouma, Pissi, Tambolo, and Tanghin).

[7] Zone A countries include Benin, Burkina Faso, Cote d'Ivoire, Ghana, Niger, Nigeria, and Togo. Zone B countries include The Gambia, Guinea, Guinea-Bissau, Liberia, Mali, and Senegal. The national transmission networks in zone A are more connected than the national transmission networks in zone B.

[8] Our assessment did not cover the quality and reliability of the electricity supply at the distribution system level. However, fluctuations in voltage and unplanned outages were reportedly common at the consumer level because of the dilapidated distribution network.

[9] The cost of electricity was calculated as total generation cost (domestic generation + import) ÷ total energy injected into the system.

[10] The average annual electricity consumption per person is 6,500 kilowatt-hours in Europe and 11,500 kilowatt-hours in the United States.

[11] These figures are comparable to those in Morocco (with an 800-megawatt installed solar energy generation capacity), where the average global horizontal radiation is 5.8 kilowatt-hours per square meter per day, and the duration of direct sunshine per year is between 2,700 and 3,500 hours.

[12] IRENA (2021) also reports that Burkina Faso has an estimated maximum development potential of 1.95 gigawatts from wind energy.

[13] The rural electrification rate increased to 5.3 percent in 2019 and 5.9 percent in 2020 but decreased to 4.7 percent in 2022. The main reason for this decrease was the damage to the distribution network because of the ongoing armed conflict in the country.

[14] This number is based on the assumption of an average household of six people.

[15] Burkina Faso is divided into 13 regions: Boucle du Mouhoun, Cascades, Centre, Centre-Est, Centre-Nord, Centre-Ouest, Centre-Sud, Est, Hauts-Bassins, Nord, Plateau-Central, Sahel, and Sud-Ouest. Ouagadougou is in the Centre region.

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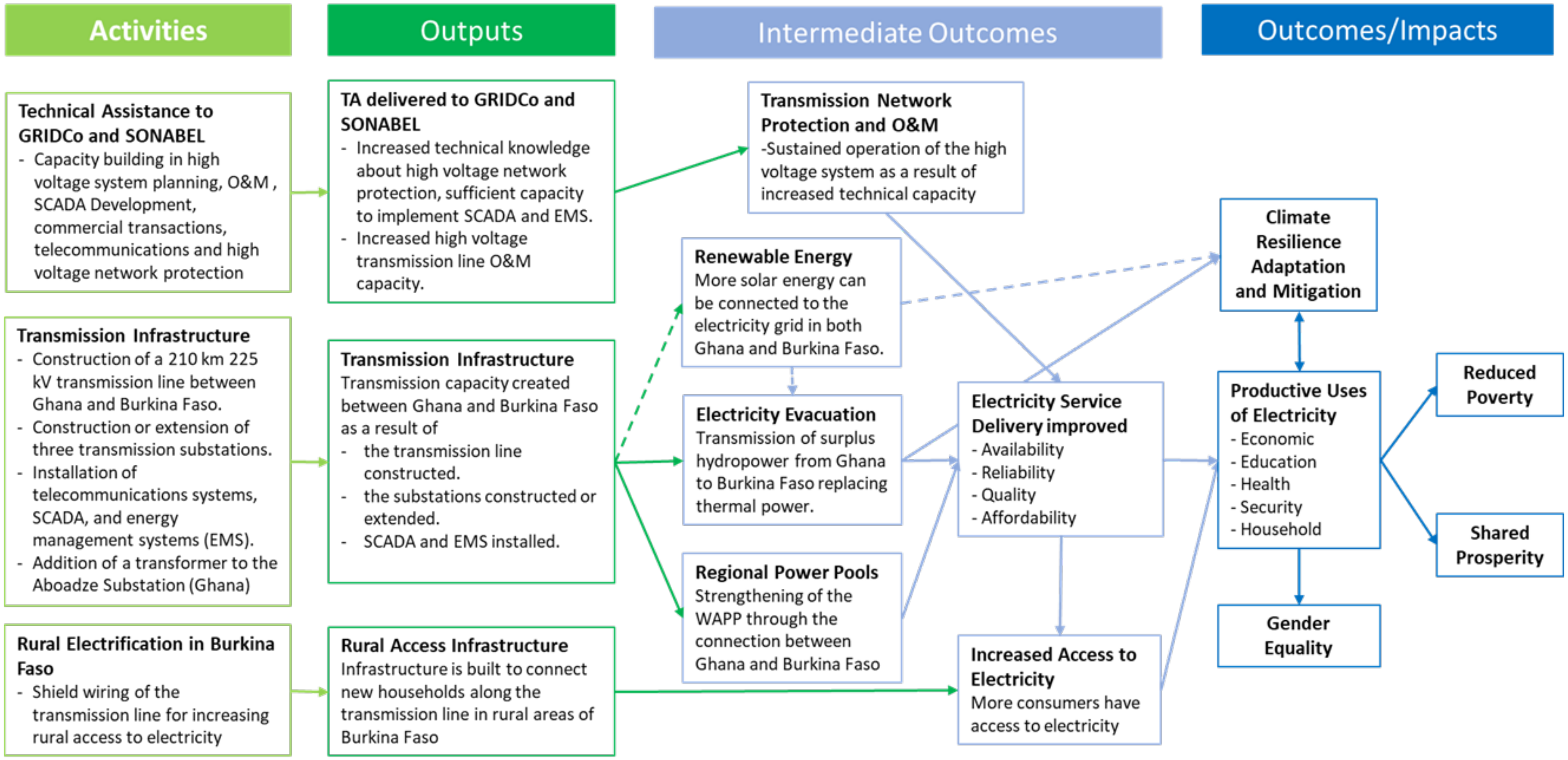
Appendix A. Theory of Change



Source: Independent Evaluation Group.
Note: EMS = energy management systems; GRIDCo = Ghana Grid Company; kV = kilovolt; O&M = operation and maintenance; SCADA = supervisory control and data acquisition; SONABEL = Société Nationale d'électricité du Burkina Faso; TA = technical assistance; WAPP = West Africa Power Pool.

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 approach and is based on evidence gathered through the following: (i) key project documents and data from the World Bank, the Ghana Grid Company, the Energy Commission of Ghana, Société Nationale d'électricité du Burkina Faso (SONABEL), and Agence Burkinabè de l'Électrification Rurale, as well as other sector-specific documents; (ii) semistructured interviews with World Bank staff, government counterparts, and representatives of the following groups: Ghana Grid Company, SONABEL, Agence Burkinabè de l'Électrification Rurale, chambers of commerce and industry, private companies, and key development partners active in the energy sector (for example, African Development Bank and European Investment Bank) and their beneficiaries; (iii) site visits to Zagtouli and Ouaga Est substations; and (iv) beneficiary group discussions and beneficiary surveys in 2 villages out of the 25 villages that were electrified in the project area.

Semistructured Interviews

During the meetings, we conducted key informant interviews using semistructured interviews, which qualitatively assessed the project interventions and implementation results in line with the theory of change and the points of inquiry. Semistructured interviews included the following questions (separated by themes):

1. Impact of the project and sustainability of development outcomes

    a. What is the current utilization level of the Bolgatanga-Zagtouli Transmission Line? What are the issues related to the optimal use of the transmission line, if any?

    b. What has been the impact of the project on power evacuation to Burkina Faso? Did the reliability and quality of the electricity supply improve? Did the increased availability of cleaner and cheaper electricity from Ghana lead to a decrease in the supply cost of electricity?

    c. What has been the impact of the transmission line on Ghana's power exports?

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

e. What has been the impact of the project on the integration of the Burkina Faso transmission grid with the West Africa Power Pool?

f. How has the project supported the development of renewable energy, if at all, in Burkina Faso and Ghana? What are the barriers to the development of renewable energy in these two countries?

g. What has been the socioeconomic impact of the project? Has there been an increase in industrial and business activity in the project area? What has been the impact of the project on the big and small extractive industries? What has been the impact of electricity on the villages electrified by the project? (We assessed this further using a limited beneficiary survey, explained in the next section, Beneficiary Survey.)

h. What are the risks to the sustainability of the development outcomes that 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 the power sector

   a. Has there been any policy or regulatory change related to the electricity sector?

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

   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?

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 Ghana and Burkina Faso?

   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 and World Bank 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 World Bank 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 that collects data and gains the views of project beneficiaries to assess the impact of a project's intervention. To assess the socioeconomic impact of the Bolgatanga-Zagtouli Transmission Line on the residents of the villages along the transmission line that were electrified by the project, we conducted a beneficiary survey in 2 villages (Ouarmini and Lougsi) out of 25 that were connected to the national grid. We intended to conduct beneficiary surveys in four additional villages along the transmission line farther to the south of Ouagadougou, but we canceled those visits because of security concerns.

Ouarmini and Lougsi are clusters of smaller settlements, and each has five clusters. Lougsi is estimated to have 250 households (about 1,500 people total), and Ouarmini is estimated to have 200 households (about 1,200 people total). Consistent with the general population composition, we estimated the male-female ratio to be 90 percent. Both villages have good tarmac road access. Ouarmini is 23 kilometers from Ouagadougou city center, and Lougsi is 21 kilometers away. The proximity of these villages to Ouagadougou is an important factor that affects the socioeconomic activity in the villages and prospects for economic growth and development.[1]

We designed the survey to capture the immediate impact that access to electricity at home and in business can have on socioeconomic activities. We formulated the questions for easy translation and comprehension from English to French. The survey used the questions listed in table B.1 to adequately assess the level of access to electricity (according to the Multi-Tier Framework for measuring access to electricity).[2]

Table B.1. Survey Questions and Type of Response

Survey Questions	Type of Response
Access	
1. Do you have electricity at home?	Yes or no
2. If not, what is the reason your house is not connected to the electricity?	Text
3. If you are connected to electricity, which year were you connected?	Year
Availability, reliability, quality, and affordability	
4. Are you satisfied with the reliability of electricity services at your house?	Yes or no
5. How many hours during the day is electricity available in your house?	Hours
6. How many hours during the night is electricity available in your house?	Hours
7. How many times do you experience power outages at your home (day)?	Number
8. How often do you experience voltage fluctuations during the day?	Number
9. How often do you experience load shedding, and for how long?	Number-Minutes
10. What percentage of your income is spent on electricity (monthly)?	Percentage
11. Do you regularly pay your bills?	Yes or no
Socioeconomic impact	
12. Which electrical equipment do you have at your house?	Text
13. Do you use electricity to help you earn money?	Yes or no
14. If yes, what do you do with electricity to earn money?	Text
15. Has your household income increased because of using electricity?	Yes or no
16. Has electricity improved the quality of public and commercial services you receive?	Yes or no
17. If yes, which services have improved?	Text
18. Has using electricity eased the burden of your daily chores?	Yes or no
19. If yes, what are the improvements?	Text

Source: Independent Evaluation Group.

Because we could visit only two villages, the survey findings cannot be statistically generalized to assess the impact of access to electricity on 25 villages electrified under the project. However, the surveys were useful for confirming and comparing the findings with the findings of the beneficiary surveys conducted at 6 villages electrified under the Tanzania Backbone Transmission Investment Project.[3] We selected the 2 villages to visit because of their proximity to Ouagadougou. We chose respondents among the population who had electricity at home or used electricity to earn money so we could assess the impact of access to electricity on residents' socioeconomic status. We held a beneficiary group discussion in each village, after which the respondents were chosen on a voluntary basis. We interviewed four women and six men in Lougsi and five women and six men in Ouarmini. Although the sample size is too small to form any statistically significant conclusions, the survey still provided enough data to assess the impact of electricity on households and businesses. The responses from the villagers surveyed were generally consistent, with occasional outliers.

Both villages have diverse economies for such rural settlements dominated by agriculture and husbandry. Businesses that use electricity are flourishing, such as milling, welding, restaurants, small markets, social venues (for example, TV saloons, pubs), and offices that provide official documentation processing with computers and photocopying services. Most of the population still lives at the subsistence level, but certain signs (such as using a refrigerator for food preservation or the fact that the cost of electricity is less than 15 percent of residents' monthly incomes) confirm that economic activity has been growing, and some families have already moved out of the subsistence level.

Two short-term consultants from World Bank headquarters conducted the surveys using a paper survey. Both consultants had conducted a similar survey for the Tanzania Backbone Transmission Investment Project's Project Performance Assessment Report and had limited French language proficiency. Two local consultants translated the interviews between English and French.

Overall, the survey produced useful findings about the socioeconomic impacts of access to electricity in rural areas in the 2 villages, but these cannot be extrapolated to the 25 villages electrified by the project because the sample size is too small. The results can best be interpreted as indicative rather than representative for all 25 villages. The survey 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.

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[1] The farthest village from Ouagadougou that was electrified under the project is Tambolo (155 kilometers away). Tambolo is only 12 kilometers from the border that Burkina Faso shares with Ghana. Villages close to the border benefit from cross-border trade.

[2] For more information on the Multi-Tier Framework for measuring access to electricity, see https://mtfenergyaccess.esmap.org/methodology/electricity.

[3] A separate report was prepared to assess the performance of the Tanzania Backbone Transmission Investment Project.