ECONOMIC AND FINANCIAL ANALYSIS

I. INTRODUCTION

1. The economic and financial analysis of the proposed Wholesale Metering and Transmission Reinforcement Project was conducted in accordance with the Guidelines for the Economic Analysis of Projects and Financial Management and Analysis of Projects to measure the projected costs and benefits based on the comparison of a with-project scenario with a without-project scenario.[1] A sensitivity analysis was conducted to ascertain the robustness of the analysis.

2. The project has two investment components: (i) installation of approximately 1,100 wholesale meters and an associated settlement system including 1,100 current transformers and 700 voltage transformers, and (ii) construction of an approximately 95-kilometer new 220-kilovolt single circuit single conductor transmission line interconnecting Rudaki and Ayni substations with a rated capacity of 320 megavolt-amperes. The economic and financial analysis was undertaken for each component and then consolidated for the project as a whole. Component (i) will reduce system losses at the national level, while component (ii) will increase the power transmission capacity for the Panjakent region that suffers from persistent power outages.

II. METHOD AND ASSUMPTIONS

A. Overview

3. Tajikistan, with a population of over 8 million, has installed generation capacity of 5,055 megawatts (MW), comprising eight large and a few hydropower plants, and three thermal power plants. These plants generated 17,092 gigawatt-hours (GWh) in 2013, of which 13,400 GWh was domestically consumed. The high reliance on hydrologic resources for power generation results in a power surplus in summer and a deficit in winter. Certain parts of the national transmission grid do not have sufficient capacity to transmit power, resulting in power outages in certain regions. Power demand is estimated to grow at, on average, 2.3% annually for a period until year 2032. Total transmission and distribution system losses in Tajikistan were estimated at around 22% in 2013, of which transmission system technical losses accounted for 5%. Distribution system losses were 17% and have remained virtually unchanged since 2006. The power system management lacks transparency and suffers from limited knowledge and technical capabilities. Metering and transmission reinforcement are necessary to accurately monitor energy use and efficiently allocate energy to meet growing and unmet demand.

4. In 2013, Panjakent, a region that houses a population of 261,000 along with several large industries, peak demand reached approximately 100 MW in the summer and 141 MW in the winter. The power demand is expected to increase to 187 MW by 2020. The current transmission capacity to the region is 67 megavolt-amperes, which falls short of meeting present and future demand. Additional transmission capacity under the project is urgently needed to supply power to the region.

[1] Asian Development Bank (ADB). 1997. *Guidelines for the Economic Analysis of Projects*. Manila; ADB. 2005. *Financial Management and Analysis of Projects*. Manila.

5. The retail tariff rate was increased by 15% in June 2014 to $0.022 per kilowatt-hour (kWh), and the government is committed to increase the tariff to $0.034 per kWh by 2020 to make Barki Tojik financially sustainable again (Table 1).

Table 1: Electricity Retail Tariff Projection: Barki Tojik, 2013–2020

Year	2013	2014	2015	2016	2017	2018	2019	2020
Tariff (TJS/kWh)	0.096	0.110	0.132	0.158	0.189	0.203	0.217	0.232
Tariff ($/kWh)[a]	.020	.022	.025	.028	.032	.033	.033	.034

kWh = kilowatt-hour.

Note: Figures for 2013 and 2014 are actual. Others are estimates agreed between Barki Tojik and Asian Development Bank staff.

[a] Expressed in $ centavos.

Source: Barki Tojik and Asian Development Bank estimates (financial management assessment report).

B. Least-cost Analysis

6. **Wholesale metering**. Wholesale metering is a necessary system requirement for the national power grid to function efficiently. Unaccounted energy is estimated to be 22% of the energy generated. Accurate wholesale metering and installation of efficient advanced metering infrastructure are expected to capture 200 GWh of equivalent energy. Installing a new generation capacity to generate the same amount of energy would cost significantly more. Wholesale metering with efficient advanced metering infrastructure is the least-cost option for reducing system losses.

7. **Transmission line**. The least-cost option for reducing power outages in the Panjakent region is the expansion of transmission capacity to the region. The lack of hydrological resources (that can generate in winter) and fossil fuel makes installation of a power plant unfeasible. The transmission line routing and capacity specifications are designed with a least-cost approach.

C. Financial Analysis

8. The financial analysis was undertaken from the viewpoint of Barki Tojik, the project executing agency. The period of analysis covers 5 years of the project implementation as well as 25 years of operations (2015–2044). The financial internal rate of return (FIRR) and financial net present value were calculated by projecting future revenue and cost streams for each project component at 2014 constant prices.

9. **Project costs**. The project cost stream includes both the capital expenditure and operational expenditure. The capital expenditure comprises investment costs, taxes and duties, and physical contingencies, but excludes price contingencies and financial charges during implementation. The operational expenditure includes (i) an annual cost of 2.5% of the investment costs, and (ii) major overhauls costing $0.5 million every 5 years starting from 2025 for the transmission line component. For the wholesale metering component, a periodic upgrading cost of 1% of the investment costs and the gradual replacement of the meters between 15 and 21 years were considered for the operational expenditure.

10. **Project benefits**. The main financial benefit of the wholesale metering component to Barki Tojik is the incremental revenue (net of tax) from additional energy billed measured by average retail tariff. The benefit of the transmission line component accrues from incremental energy transmitted to the Panjakent region, measured by retail tariff (net of tax) and incremental cost of power supply.

11. The weighted average cost of capital (WACC) was calculated based on the amounts and financing terms of the capital investment. The Asian Development Bank (ADB) will finance the project's capital cost by grant, but since the grant proceeds are provided to Barki Tojik as a subsidiary loan from the Ministry of Finance, ADB's grant proceeds are considered debt from Barki Tojik's perspective. The subsidiary loan will have an interest rate of 5% in US dollars. The income tax applied to Barki Tojik is 15%. Government contribution is through tax and duty exemption on capital costs. The National Bank of Tajikistan's refinancing rate of 8.15% (average for 2010–2013) is used as a proxy for the opportunity cost to the government, as the government has not indicated a clear official cost. The real WACC is 2.3% (Table 2).

Table 2: Weighted Average Cost of Capital of the Project
(%)

		ADB Subloan	Barki Tojik	Total
A	Weighting	80.60	19.40	100
B	Nominal cost	5.00	8.15	
C	Tax rate	15.00	0.00	
D	Tax-adjusted nominal cost	4.25	8.15	
E	Inflation rate	1.50	7.50	
F	Real cost	2.71	0.60	
G	Weighted component of WACC	2.18	0.12	2.30
	WACC			**2.30**

ADB = Asian Development Bank, WACC = weighted average cost of capital.
Source: ADB estimates.

12. **Sensitivity analysis**. The sensitivity analysis examined the robustness of the project's financial viability by assessing the impact of a 10% increase in capital costs and a 10% decrease in revenues.

D. Economic Analysis

13. The economic analysis was carried out from the point of view of the Tajikistan economy, using domestic price numeraire. Financial costs of tradable inputs were converted to economic costs by applying a shadow exchange rate factor. Similar to the financial analysis, the period of analysis covers 5 years of project implementation as well as 25 years of operations (2015–2044). The economic internal rate of return (EIRR) and economic net present value were calculated by projecting future benefit and cost streams for each project component at 2014 constant prices.

14. **Project costs**. The economic cost of capital expenditure includes investment costs and physical contingencies, but excludes taxes and duties, price contingencies, and financial charges during implementation. The investment costs include the costs of turnkey contracts, consulting services, and land acquisition and resettlement. The costs of tradable inputs are adjusted upward by a shadow exchange rate factor of 1.11. The costs of local labor are adjusted downward by a shadow wage rate factor of 0.8 applied to the unskilled labor portion of the local cost component (assumed to be 10% of local investment costs and physical contingencies). The cost of land acquisition was valued at the opportunity cost of the land, and resettlement costs were added to it. Similar to the financial cost, the economic cost of the operational expenditure includes (i) an annual cost of 2.5% of the investment costs, and (ii) major overhauls costing $0.5 million every 5 years starting from 2025 for the transmission line component. For the wholesale metering component, a periodic upgrading cost of 1% of the investment costs and the gradual replacement of the meters between 15 and 21 years were

considered for the operational expenditure. The power supply costs include the cost of incremental power generation, transmission, and distribution.

15. **Project benefits**. The economic benefits of the project include additional energy that can be consumed efficiently, which would have not been available without the project. The wholesale metering component will allow Barki Tojik to operate the power grid system and optimize energy allocation more efficiently. Energy that is more accurately accounted for will result in energy saving among consumers. The more reliable energy made available by energy saving can be utilized more efficiently and productively by those who had been unable to do so due to power shortages. All these benefits are estimated to amount to at least 1.5% of the energy that is consumed at a national level. The transmission component will increase transmission capacity for regions that suffer from frequent power outages. The estimated annual power outages amount to 416 GWh annually. The additional power that will be available for incremental consumption is valued based on willingness to pay, estimated by the generation cost by a small diesel generator ($0.31/kWh). Non-incremental benefits in the form of resource cost savings will also be realized from the additional power supply resulting from additional transmission capacity, which will displace the large diesel generators used by industrial customers during power shortages. These cost savings are valued based on the alternative cost of large diesel generators ($0.25/kWh).

16. The discount rate used for the economic analysis is 12%. The sensitivity analysis examined the robustness of the project's economic viability by assessing the impact of a 10% increase in the capital costs and a 10% decrease in revenues.

III. RESULTS

A. Financial Analysis

17. The project FIRR was estimated at 15.8%, exceeding the WACC of 2.3% and confirming the project's financial viability (Table 5). The FIRR for the wholesale metering component was estimated at 18.8%, and the FIRR for the transmission line component was estimated at 14.4%.

18. The sensitivity analysis on both the 10% increase in capital costs and the 10% decrease in revenues shows that the project's financial viability remains robust against these shocks for each of the two project components (Table 3). In all cases, the FIRR does not fall below the WACC.

Table 3: Sensitivity Analysis: Financial Internal Rate of Return
(%)

	Wholesale Metering Component	Transmission Line Component
Base case	18.8	14.4
Capital costs increased by 10%	17.1	13.2
Revenues decreased by 10%	16.8	12.9

Sources: Asian Development Bank and technical assistance consultant estimates.

B. Economic Analysis

19. The project EIRR was estimated at 19.2%, exceeding the benchmark rate of 12.0% and confirming the project's economic viability (Table 6). The EIRR for the wholesale metering

component was estimated at 29.9%, and the EIRR for the transmission line component was estimated at 15.1%.

20. The sensitivity analysis on the 10% increase in capital costs and the 10% decrease in revenues shows that the project's economic viability remains robust against these shocks for each of the two project components (Table 4). In all cases, the EIRR does not fall below the benchmark rate of 12%.

Table 4: Sensitivity Analysis: Economic Internal Rate of Return
(%)

	Wholesale Metering Component	Transmission Line Component
Base case	29.9	15.1
Capital costs increased by 10%	27.4	13.6
Revenues decreased by 10%	27.1	13.2

Sources: Asian Development Bank and technical assistance consultant estimates.

IV. CONCLUSIONS

21. **Financial analysis**. The financial analysis confirms the financial viability of the project. The FIRR of 15.8% is higher than the WACC of 2.3%. Based on a comparison of the with- and without-project scenarios, the project cash flow, measured at 2014 constant prices for the project life of 25 years, reflects the costs (capital investment and operation and maintenance) and revenues (domestic sales) attributable to the project from the perspective of Barki Tojik.[2] The project remains financially viable under the assumption that the end-user tariffs continue to increase at the current rate of 13% per annum in real terms. The sensitivity analysis also confirms the project's financial sustainability under adverse conditions.

22. **Economic analysis**. The project's EIRR is 19.2%, confirming the project's economic viability. The project will reduce system losses and increase the electricity consumed in the country. The EIRR was also estimated for each component.[3] The sensitivity analysis confirms the robustness of the project's economic viability under adverse conditions, including increased capital costs and reduced benefits.

[2] FIRR is 18.8% for the wholesale metering component and 14.4% for the transmission component.
[3] EIRR is 29.9% for the wholesale metering component and 15.1% for the transmission component.

Table 5: Project Financial Internal Rate of Return
($ million)

Year	Capital Cost	O&M Cost	Revenue	Net Cash Flow
2014				
2015				
2016	1.56			(1.56)
2017	10.02			(10.02)
2018	18.58			(18.58)
2019	25.07			(25.07)
2020	11.77	0.93	11.70	(1.00)
2021		0.93	11.91	10.98
2022		0.93	12.13	11.20
2023		0.93	12.35	11.42
2024		0.93	12.57	11.64
2025		1.61	12.79	11.18
2026		0.93	13.02	12.10
2027		0.93	13.26	12.33
2028		0.93	13.50	12.57
2029		0.93	13.74	12.81
2030		1.61	13.99	12.38
2031		0.93	14.24	13.31
2032		5.46	14.50	9.04
2033		0.93	14.76	13.83
2034		5.46	15.02	9.57
2035		1.61	15.29	13.68
2036		5.46	15.57	10.11
2037		0.93	15.85	14.92
2038		5.46	16.13	10.68
2039		0.93	16.42	15.50
2040		1.61	16.72	15.11
2041		0.93	17.02	16.09
2042		0.93	17.33	16.40
2043		0.93	17.33	16.40
2044		1.11	32.33	31.22
FNPV	**59.10**	**44.22**	**242.30**	**155.10**
FIRR	**15.79%**			
WACC	**2.30%**			

FIRR = financial internal rate of return, FNPV = financial net present value, O&M = operation and maintenance, WACC = weighted average cost of capital, ( ) = negative.
Sources: Asian Development Bank and technical assistance consultant estimates.

Table 6: Project Economic Internal Rate of Return

($ million)

	Year	Capital Costs	O&M Costs	Power Supply Cost	Incremental Benefits	Non-Incremental Benefits	Net Benefits
	2014						
	2015						
	2016	1.38					(1.38)
	2017	9.06					(9.06)
	2018	16.64					(16.64)
	2019	22.29					(22.29)
	2020	35.93	1.63	5.66	16.03	8.52	(18.67)
	2021		1.63	5.66	16.03	8.52	17.25
	2022		1.63	5.66	16.03	8.52	17.25
	2023		1.63	5.66	16.03	8.52	17.25
	2024		1.63	5.66	16.03	8.52	17.25
	2025		2.30	5.66	16.03	8.52	16.59
	2026		1.63	5.66	16.03	8.52	17.25
	2027		1.63	5.66	16.03	8.52	17.25
	2028		1.63	5.66	16.03	8.52	17.25
	2029		1.63	5.66	16.03	8.52	17.25
	2030		2.30	5.66	16.03	8.52	16.59
	2031		1.63	5.66	16.03	8.52	17.25
	2032		5.77	5.66	16.03	8.52	13.11
	2033		1.63	5.66	16.03	8.52	17.25
	2034		5.77	5.66	16.03	8.52	13.11
	2035		2.30	5.66	16.03	8.52	16.59
	2036		5.77	5.66	16.03	8.52	13.11
	2037		1.63	5.66	16.03	8.52	17.25
	2038		5.77	5.66	16.03	8.52	13.11
	2039		1.63	5.66	16.03	8.52	17.25
	2040		2.30	5.66	16.03	8.52	16.59
	2041		1.63	5.66	16.03	8.52	17.25
	2042		1.63	5.66	16.03	8.52	17.25
	2043		1.63	5.66	16.03	8.52	17.25
	2044		1.80	5.66	37.80	8.52	38.86
ENPV		**43.72**	**26.67**	**44.41**	**64.35**	**66.79**	**23.71**
EIRR		**19.22%**					
Discount rate		**12%**					

EIRR = economic internal rate of return, ENPV = economic net present value, O&M = operation and maintenance, ( ) = negative.

Sources: Asian Development Bank and technical assistance consultant estimates.