

FINANCIAL ANALYSIS

1. The financial analysis assessed the financial viability of the transmission rehabilitation project in accordance with the *Financial Management and Analysis of Projects* of the Asian Development Bank (ADB).¹ The financial internal rate of return (FIRR) is estimated by discounting the incremental annual cash flows arising from the comparison of with- and without-project scenarios over 25 years of operation. The analysis is carried out in real terms using 2014 prices, sensitivity analysis assesses the impact of variance in key assumptions.

2. Currently, Armenia has sufficient capacity to meet its domestic power demand but faces increasing challenges in energy security given its heavy reliance on its aging nuclear power generation plant and imported fuels. Power generated by the nuclear power plant (NPP) Metsamor accounts for approximately 31% of Armenia's total generation. However, the NPP has already exceeded its technical lifespan and no suitable alternative has been confirmed. Without a replacement for the NPP, a gap of 360–650 megawatts is expected by 2030. This will result in increased consumption of imported fuels (gas mainly) and potentially the need to import electricity from neighboring countries. As a landlocked country, the performance of Armenia's power subsector and its economy is closely linked to trade with neighboring countries. Armenia's transmission network has interconnections with its neighbors, however, only the lines with Georgia and Iran are operating. Power is imported from Georgia in the summer from its relatively cheaper hydropower plants and swapped with Iran on a seasonal basis. In that respect, a reliable transmission system is crucial to ensure an undisrupted power supply.

3. Most of the existing transmission assets in Armenia are old, with an average age of 45 years, and require inefficient high maintenance. The cost of supplying electricity is therefore high in the context of supply interruptions, power outages, maintenance costs, and technical losses. With the objective of maintaining a sufficient and reliable power supply, the government has prioritized rehabilitation of the power transmission system and development of domestic energy resources, and has requested support from various development partners in the form of concessionary loan and grant financing.²

4. The project aims to address the existing inefficiencies and anticipated threat to the energy security by focusing on rehabilitating selected segments of the transmission system and working with the Ministry of Energy Natural resources as the executing agency. The implementing agencies are the state-owned transmission companies, High Voltage Electric Networks (HVEN) Closed Joint-Stock Company (Vysokovoltnye Electriccheskie Sety), and the system operator Electro Power Systems Operator (EPSO) Closed Joint-Stock Company (Operator Systemy Electroenergetiky). The project comprises (i) rehabilitation of two substations in the transmission network; (ii) expansion of the existing supervisory control and data acquisition (SCADA) system and energy management system (EMS); and (iii) support for capacity building and training in both implementing agencies on substations and system operation. This project will be implemented, together with the European Bank of Reconstruction and Development (EBRD) as a parallel cofinancier providing funds for the rehabilitation of two other substations not included as part of this project.

¹ Asian Development Bank. 2005. *Financial Management and Analysis of Projects*. Manila.

² Development partners, including ADB, European Bank for Reconstruction and Development, Japan Bank for International Cooperation, KfW, World Bank, and United States Agency for International Development for the rehabilitation of transmission system.

A. Major Assumptions

5. The transmission system requires immediate rehabilitation to secure energy security. HVEN owns 14 220-kilovolt substations in the system. All have undergone different degrees of rehabilitation since the 1990s.

Table 1: High-Voltage Substations in Armenia

Substation	Rehabilitation Work
Eight substations: Agarak-2, Ararat-2, Lichk, Marash, Shaumyan-2, Shinuhayr, Yeghegnadzor, and Zovuni	Four substations were selected for the phase 1 project Rehabilitation of the remaining four substations is proposed for phase 2 of the project
Three substations: Alaverdi, Kamo, and Vanadzor-2	Recently rehabilitated with KfW financing
Gyumri-2	Rehabilitation completed in February 2014 with KfW financing
Two substations: Asjnak and Haghtanak	Partially rehabilitated with World Bank financing.

Source: Asian Development Bank.

6. The project includes the phase one rehabilitation of two substations. The rehabilitation needs to be time-staggered to avoid interrupting service delivery. Only two substations can be rehabilitated in parallel, as a substation cannot be switched off completely. The work includes replacing aging power transformers, circuit breakers, instrument transformers, disconnectors, and control and protection equipment. HVEN will carry out the substation rehabilitation work. The Asian Development Bank (ADB) will finance the rehabilitation of Agarak-2 and Shinuhayr. The other two substations (Ararat-2 and Yeghegnadzor) are to be rehabilitated in parallel with the ADB project under EBRD financing.

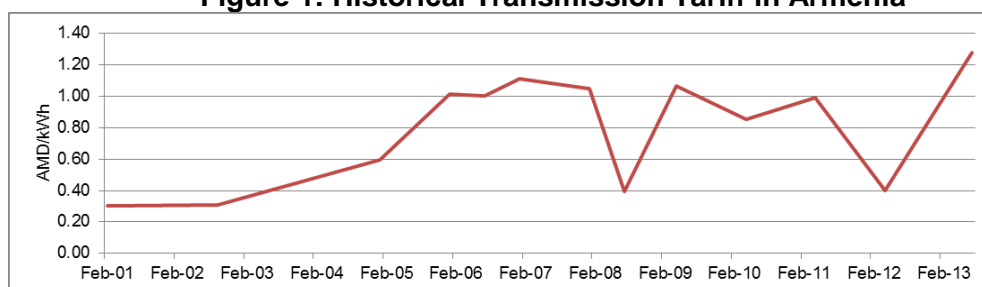
7. In addition, the project aims to expand the existing SCADA system and EMS by installing additional hardware and software, communication equipment, and optical ground wire. EPSO will improve and upgrade the load dispatch center. The supervision consultant will provide training to HVEN on configuration, setting, and operation and maintenance (O&M) of the substations; and EPSO on control system handling.

8. The project benefits and costs were computed by comparing the with- without-project scenarios. Without the project, the substations will continue to wear out and electricity transmitted will be significantly reduced and eventually come to a halt with failing components. With the project, the power supply will not be disrupted—critical to ensuring system reliability.

9. **Project revenue.** Incremental benefits expected to arise from the project include the avoidance of interrupted power supply. Improvement of system stability, safeguards consumers from voltage fluctuations. The financial analysis assumes that without the project the energy throughput at the two substations will be disrupted constantly as a result of increased shutdowns and outages. Based on the technical configuration of the substations, a gradual decrease of the electricity inflow and outflow at the four substations was calculated to model the scenario where no rehabilitation work is to take place. As the two substations form part of the overall transmission system in which a steady electricity flow would require the rehabilitation of more than these two substations, the potential impact of the other aging assets in the transmission system on the incremental benefit of the project was assessed by taking into account the disruption of the flow as a result of rerouting electricity. An approximate 2% per annum reduction in the energy flow is assumed as a result of the outages and/or cessation of operation in other substations in the system where no or partial rehabilitation takes place.

10. The regulatory body, the Public Services Regulatory Commission (PSRC), defines the tariff determination methodologies and sets tariffs for generation, transmission, distribution, and export. The tariff is adjusted annually to reflect inflation and currency changes. The historical development of the transmission tariff in Armenia has been volatile (Figure 1). The tariff-setting methodology provides for recovery of allowable costs and return, which comprise (i) allowable annual costs, including O&M costs, taxes (excluding profit tax and value added tax), mandatory payments set by government legislation, and other justifiable costs associated with the licensed activities; (ii) annual depreciation of fixed assets recognized by PSRC; and (iii) allowable return comprising norm of return on capital and compensation for necessary financial costs not included in the list of allowable costs but incurred for ensuring sustainable provision of services. For government-approved investment projects, PSRC would automatically include such costs, including the debt repayment for the associated loans, in the next tariff determination when the licensee files a petition.

Figure 1: Historical Transmission Tariff in Armenia



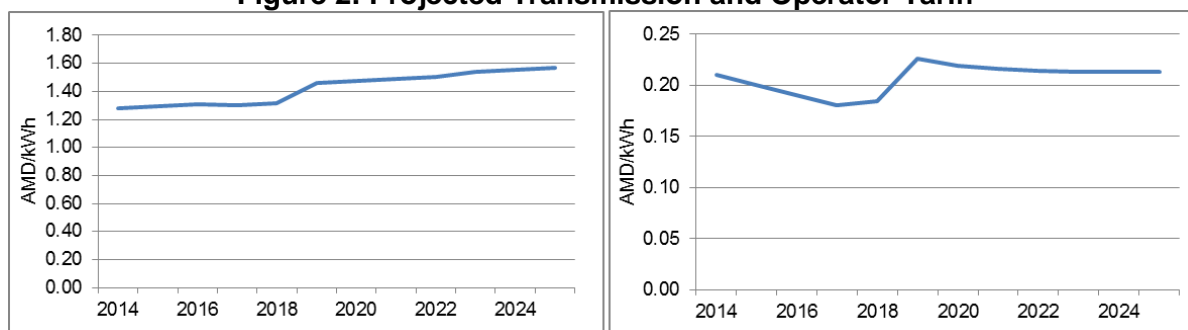
kWh = kilowatt-hour.

Source: Electro Power Systems Operator and High Voltage Electric Networks company statistics.

11. The last PSRC tariff adjustment was in July 2013. The approved transmission tariff of AMD1.28/kilowatt-hour allows for recovery of all allowable costs and debt servicing of existing loans at HVEN. The operator's tariff of AMD0.23/kilowatt-hour covers all costs incurred at EPSO. EPSO and HVEN are expected to file new tariff petitions with PSRC to cover the project costs. Associated capital investments and finance costs will form part of the new tariff. PSRC is assumed to approve the new tariff.³ In the financial analysis, future tariff is projected by taking into account general business operation projection, and debt servicing of existing loans and a new loan from ADB based on due diligence of HVEN data (Figure 2). The allowable margin and business environment are assumed to remain unchanged throughout the projected period.

12. Transmission losses may be reduced as a result of upgrading the SCADA system and EMS with better control and monitoring capability. New software and hardware will be installed and additional communication equipment and optical ground wire put in place to enhance system reliability. The investment project is important to maintain the stability of overall system control and monitoring for both current operations, as well as potential future growth in energy flow in the system. However, as transmission losses are estimated by taking the entire transmission system into account, accurately attributing a specific portion of benefit to the SCADA system and EMS upgrading is difficult. Therefore, the overall revenues and costs for the company under with- and without-project scenarios were considered. Incremental costs and benefits were discounted to calculate the FIRR in real terms to ascertain the cost sustainability at EPSO.

³ The government agreed to provide such guarantee in the form of a covenant in the loan agreement.

Figure 2: Projected Transmission and Operator Tariff

kWh = kilowatt-hour.

Source: Asian Development Bank estimates.

13. **Project costs.** The total project costs include (i) civil works and electrical equipment for the rehabilitation of two substations,⁴ (ii) electrical equipment for the national load control center, (iii) factory acceptance testing and training, (iv) environment and social mitigation costs for the disposal of obsolete equipment, (v) supervision consultancy, (vi) O&M costs, (vii) taxes and duties, (viii) project management costs, and (ix) physical contingencies.

14. The project will be implemented over 5 years. The implementation consultant and turnkey contractors will be recruited during the first 12 months. The rehabilitation work will be completed in 8–11 months depending on the substation. Upgrading the SCADA system and EMS will take about 15 months. The O&M cost is estimated at 2% of the capital expenditure for equipment rehabilitation and civil works. Physical contingency is based on 10% of the total investment cost to cover potential variations.

B. Weighted Average Cost of Capital

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

Item	EPSO			HVEN		
	ADB Loan	Gov Equity	Total	ADB Loan	Gov Equity	Total
Weighting	80.9	19.1	100.0	73.5	26.5	100.0
Nominal cost	3.6	15.6		3.6	15.6	
Tax rate	20.0	0.0		20.0	0.0	
Tax adjusted nominal cost	2.8	15.6		2.8	15.6	
Inflation rate	4.0	4.0		4.0	4.0	
Real cost	(1.1)	11.2		(1.1)	11.2	
Weighted cost	0.0	2.1		0.0	3.0	3.0
Weighted Average Cost of Capital for EPSO			2.1			
Weighted Average Cost of Capital for HVEN						3.0

15. Table 2 shows the weighted average cost of capital calculation. ADB will provide financing from the Special Funds resources equivalent to \$37 million for a 25-year term including a grace period of 5 years at an interest rate of 2.0% per annum throughout the loan maturity. The government will relend the equivalent amount to EPSO and HVEN on terms

⁴ ADB financing will be provided for the rehabilitation of Ararak-2 and Shinuhayr substations. The rehabilitation of Ararat-2 and Yeghegnadzor substations will to be covered by EBRD financing on a parallel basis.

confirmed through a covenant in the loan agreement.⁵ The opportunity cost of the government for its in-kind contribution is assumed to be at the long-term sovereign bond yield of 15.6% plus the ordinary capital resources rate as the relend rate. Domestic inflation rate is 4%. Corporate income tax is 20%.

C. Financial Internal Rate of Return

16. The financial analysis of the project indicates that the project is financially sustainable.⁶

Table 3: Financial Internal Rate of Return Estimates
(\$ million)

Item	2014	2015	2016	2017	2018	2019	2020	2025	2030	2035	2040
High Voltage Electric Networks											
Net revenue	0.0	0.0	0.0	1.0	1.1	3.5	3.5	6.1	9.8	13.6	12.7
Capital expenditure	(0.3)	(2.4)	(10.2)	(13.1)	(1.6)	(1.1)	0.0	0.0	0.0	0.0	11.3
Operating outflow	0.0	0.0	(0.2)	(0.4)	(0.6)	(1.2)	(1.2)	(1.9)	(2.9)	(3.9)	(3.7)
Net cash flow	(0.3)	(2.4)	(10.4)	(12.5)	(1.2)	1.2	2.3	4.2	6.9	9.7	20.3
Financial Internal Rate of Return											12.8%
Financial Net Present Value @ Weighted Average Cost of Capital (\$ million)											61.0
Electro Power Systems Operator											
Net revenue	0.0	0.0	0.0	0.0	0.2	1.0	0.9	1.4	2.0	2.0	1.9
Capital expenditure	(0.1)	(1.4)	(0.7)	(14.2)	(0.1)	(0.2)	0.0	0.0	0.0	0.0	7.8
Operating outflow	0.0	0.0	0.0	(0.0)	(0.2)	(0.4)	(0.4)	(0.6)	(0.7)	(0.7)	(0.7)
Net cash flow	(0.1)	(1.4)	(0.7)	(14.2)	(0.1)	0.3	0.5	0.8	1.3	1.2	9.0
Financial Internal Rate of Return											3.6%
Financial Net Present Value @ Weighted Average Cost of Capital (\$ million)											3.7

() = negative value.

Source: Asian Development Bank estimates.

D. Sensitivity Analysis

17. The expected return to the project will remain sustainable under various scenarios including (i) capital cost, O&M cost, and revenue projection assumptions change; (ii) EBRD financing does not materialize therefore the phase 1 rehabilitation program is limited to two substations instead of four; and (iii) the FIRR of the combined project, including all ADB- and EBRD-financed components (Table 4).

Table 4: Financial Results of Sensitivity Analysis of the Project

Item	HVEN FIRR (%)	EPSO FIRR (%)
Base case	12.8	3.6
Increase in capital cost by 10%	11.9	3.1
Increase in operation and maintenance cost by 10%	12.7	3.4
Decrease in revenues by 10%	11.7	2.9
Only two substations rehabilitated instead of four	9.7	3.6
EBRD cofinanced components included in the project	11.0	3.7

EBRD = European Bank of Reconstruction and Development, EPSO = Electro Power Systems Operator, FIRR = financial internal rate of return, HVEN = High Voltage Electric Networks.

Source: Asian Development Bank estimates.

⁵ According to para. 5 of Section D2/Bank Policies of ADB's Operations Manual, the terms of lending from ADB's ordinary capital resources should be the minimum acceptable relending terms for Asian Development Fund loan.

⁶ Project costs and benefits included in the analysis covered both ADB-financed components only.