KfW Development Bank

Ex post evaluation
Energy Efficiency Programme II, Bangladesh

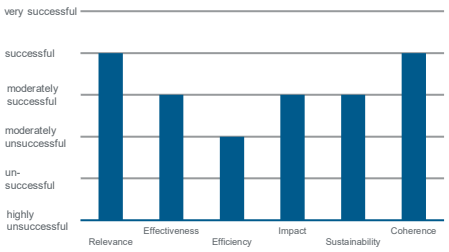
Title	Energy Efficiency Programme II		
Sector and CRS code	23630 Electric power transmission, distribution & storage		
Project number	BMZ No. 2006 65 869		
Commissioned by	Federal Ministry for Economic Cooperation and Development (BMZ)		
Recipient/Project-executing agency	Dhaka Power Distribution Company Limited (DPDC)		
Project volume/ Financing instrument	EUR 31.4 million / grant		
Project duration	6 April 2008 – 17 March 2016		
Year of report	2022	**Year of random sample**	2019

Objectives and project outline

The project included investments in the infrastructure of the Dhaka Power Distribution Company's (DPDC) power supply system in the form of new substations, the expansion of existing substations and new transmission lines.

The programme objective of the Energy Efficiency II measure was to increase energy efficiency in the DPDC power supply system and to improve the reliability, quality and transmission performance of the power supply system.

Overall rating:
moderately successful



Key findings

With investments in the power supply infrastructure, the project addressed a development-relevant weak spot in Bangladesh but was not optimally implemented. The project was rated as "moderately successful" for the following reasons:

- The positive assessment of relevance is based on the project's target-oriented focus. A reliable power supply is an important development goal and prerequisite for fulfilling many other development goals.
- In the last 15 years, Bangladesh has been able to considerably improve the quality of its electricity supply, and the project also made an effective contribution to this.
- The project was ultimately delayed by five years due to an inefficient implementation process.
- The achieved improvement in the power supply has presumably had a positive impact on household incomes and the productivity of the manufacturing industry. However, it is not possible to precisely estimate the impact.
- The project has the potential to achieve its objectives over a long period of time if the project-executing agency performs the appropriately management. The main focus will be on maintenance of the installed systems.

Conclusions

– For infrastructure projects of this type, realistic time periods and clear requirements for the project-executing agency's management are required.

– Investments in the efficiency and capacity of the power supply system have great potential in terms of development policy in view of the enormous increase in energy demand.

Rating according to DAC criteria

Overall rating: 3

Ratings:

Relevance	2
Coherence	2
Effectiveness	3
Efficiency	4
Overarching developmental impact	3
Sustainability	3

Relevance

Bangladesh is one of the most densely populated countries in the world. With 1,265 people per square metre of land area and a total population of over 165 million people, the country is less than half the size of Germany with a population twice as large.[1] Economic growth has accelerated significantly since independence in 1971 and gross domestic product (GDP) had risen by 270% to USD 1,320 per capita, adjusted for inflation, by 2016. In relation to the national poverty line, poverty fell from 56.6% in 1991 to 24.3% in 2016. The population also grew strongly during this period, by 240% between 1971 and 2016. Infrastructure was unable to keep pace with this strong growth. The quality and capacity of the electricity grid in Bangladesh were considered key limiting factors on the country's economic and social development during the 2007 project appraisal. As a result, Bangladesh ranked 99th out of 125 countries in the Global Competitiveness Index and 121st in the quality of electricity supply.[2]

Economic growth is also still being driven by an energy-intensive, increasingly industrial structure. Between 1988 and 2007, installed production capacity had more than doubled from 2.1 to 5.2 gigawatts, but demand continued to exceed supply. Another problem was that the transmission and distribution infrastructure constantly lagged behind this growth.[3] The number of days per year with load shedding increased to 364 from 1988 to 2007, making electricity supply in Bangladesh one of the most unreliable in the world.

The individual measures planned in this project are divided into three sub-areas, some of which are linked:

1) Construction of two 132 kV/33 kV substations and the expansion of an existing substation with one 132 kV and 33 kV gas-insulated switchboard plants each, 132 kV/33 kV transformers, control and protection systems and all necessary captive power plants for the safe operation of the substations, including all structures and construction measures.

2) Installation of approx. 27 km of underground cable systems with 33 kV cables, approx. 19.5 km of underground cable systems with 132 kV cables and the supply of 33 kV reserve cables, and

3) Construction of a 132 kV overhead transmission line with a final length of approx. 9.4 km in the urban area of Dhaka.

The results chain was anticipated to be as follows: Investments in electricity infrastructure should lead to a reduction in electricity losses and increased energy efficiency. The resulting increased productive use of energy could then be translated into higher economic growth. The results chain is also plausible from today's perspective and the project is therefore able to contribute to solving the problems in the electricity grid within the framework appropriate to the size of the project.

[1] Word Bank (2022), World Development Indicators

[2] World Economic Forum: The Global Competitiveness Report 2006/2007.

[3] ADB (2016), Bangladesh: Sustainable Power Sector Development Program, ADB completion report

Since its independence in 1971, the government in Bangladesh has formulated its planned economic development in the form of five-year plans. Here, attention is paid to measures that strengthen economic development in the long-term and reduce poverty. In the Sixth Five-Year Plan of 2011, which was prepared during the project appraisal period, special attention was paid to energy, more specifically energy efficiency and the expansion of electricity supply. Also during the project appraisal period, the government decided on the Power System Master Plan (PSMP) from 2010, which focused on the expansion of power generation capacity and emphasised the importance of energy efficiency for this. The specific expansion plans were based on the "Vision 2030 Long Term Power Development Strategy for Bangladesh", which aims to provide a stable and high-quality electricity supply for the entire population. Ultimately, it can be said that the measure evaluated here was relevant for the partner country of Bangladesh and was logically integrated into the strategy.

Relevance rating: 2

Coherence

The Energy Efficiency Programme II is embedded in the German DC's priority area strategy of systematically strengthening the electricity distribution system throughout the country. The Energy Efficiency Programme I was designed to complement the Energy Efficiency Programme II. This was a cooperation with the project-executing agency Power Grid Company Bangladesh (PGCB) and it supported the electricity distribution grid outside Dhaka. In addition, in cooperation with the DPDC and the Bangladesh Power Development Board (BPDB) the Energy Efficiency Programme III came into being with aim of improving energy efficiency in households. Together, the three efficiency programmes formed a convincing DC strategy, which was supplemented at a later date with further programmes in the renewable energies area.

At international level, the project was coordinated with the Asian Development Bank (ADB) and at national level with the government of Bangladesh and the regional electricity supplier. At its core, the Energy Efficiency Programme II corresponded to one of five components, Part C "Distribution System Efficiency Improvement" of the Sustainable Power Development Programme designed by ADB. Part of the component, the expansion and new construction of 11 kV and 33 kV switching stations, was separated from the ADB and independently processed with the DPDC. Overall, the project was thus coherently integrated into the actions of German DC and the international and national partners. The project also contributed to the Sustainable Development Goals (SDGs), here specifically number seven ("Affordable and clean energy"), to which the Federal Republic of Germany has also committed itself.

In addition to the German DC projects, the Bangladesh government has implemented a number of measures in the electricity supply sector. The primary objective of the government measures was to improve the capacity of the electricity supply and the operational efficiency of the electricity supply companies. Although the capacity increase clearly missed the target of over 10 GW set in 2010, more than 4 GW of additional capacity was installed by 2015.[4] This growth was achieved through the construction of new gas and oil-fired power plants, with demand for electricity increasing significantly faster at over 7 GW. No public information is available on the expansion steps of the power distribution grid in Bangladesh and DPDC in particular. However, as the proportion of people with electricity connections increased significantly between 2007 and 2015, it can be assumed that national measures to expand the electricity grid have taken place. The project therefore represented significant support for the national infrastructure development plans.

Coherence rating: 2

Effectiveness

The objectives set out in the project are divided into three sub-areas. Firstly, the transmission power in the power distribution system should be significantly increased. Secondly, the declared aim was to significantly improve efficiency in the electricity distribution system. Thirdly, this should improve the quality of the power supply. It was not possible to provide current values for the indicators as part of the evaluation.

[4] Ministry of Power, Energy and Mineral Resources (2016), Power System Master Plan 2016

The project-executing agency DPDC was not prepared to provide the requested information as part of the evaluation. For this reason, reference was made to the current available values.

Indicator	Status PA, target PA	Ex post evaluation
(1) Increase in transmission power within the DPDC network	Increase by 570 MVA to 132 kV level	Growth of 495 MVA in 2014, later values cannot be determined
(2) Increase in voltage in the 132 kV distribution system of the DPDC	At least a 5% increase	Cannot be determined
(3) Increase in the amount of electricity transmitted in the supply system (three years after commissioning)	Increase of 1,600 GWh	Growth of over 1,820 GWh in 2014
(4) Increase in the number of newly connected end customers (three years after commissioning)	72,000 new customers	315,000 new customers in 2014
(5) Average utilisation of the installed 132/33 kV transformers at peak load	50%	55%

- Indicator 1 “Increase in transmission power within the DPDC network”: It can be concluded that the transmission power within the DPDC network has been increased. As early as 2014, i.e. shortly before the end of the project, the transmission capacity in the DPDC grid was raised to the 132 kV level by almost 500 megavolt amps (MVA). Since the transmission capacity in Bangladesh has increased due to increasing demand, it can be assumed that this indicator was met at the time of the evaluation.
- Indicator 2 “Increase in voltage in the 132 kV distribution system of the DPDC” and Indicator 3 “Increase in the amount of electricity transmitted in the supply system (three years after commissioning, i.e. 2017)”: The increase in voltage in the 132 kV distribution system of the DPDC of 5% intended as an indicator of efficiency (Indicator 2) cannot be technically determined, but the transferred amount of electricity (Indicator 3) already increased by over 1,800 GWh before the project was completed, which exceeded the value originally targeted for 2017 of 1,600 GWh. The additional amount of electricity transferred can also be attributed to the large number of new DPDC customers and increased demand.
- Indicator 4 “Increase in the number of newly connected end customers”: As early as 2014, almost 315,000 new end customers were connected to the distribution system – more than four times as many as originally defined as the target indicator. In view of the fact that both population growth and demand have risen since then, it can be concluded that further end customers have been connected since 2014. By way of comparison: DPDC acquired 106,855 new customers in the entire catchment area in the 2021/22 fiscal year.
- Indicator 5 “Average utilisation of the installed 132/33 kV transformers at peak load”: As a further criterion, the average utilisation rate of the added 132/33 kV transformers at peak load was targeted at 50%, which stood at 55% at the end of the project. Here too, it can be assumed that this value has remained the same or has increased since then.

Overall, it can be assumed that the quality of the electricity supply has improved considerably over the last 15 years from the perspective of DPDC end customers. In 2007, DPDC’s system losses were around

25%, which fell to 9% by 2015. In the 2022 annual report, this figure had fallen even further to close to 6%.[5]

The project will have contributed to achieving these goals by improving the quantity and quality of the electricity supply. The ADB reports a significant improvement in the quality of supply from 2012. While load shedding had to be expected almost every day in the years before, this indicator fell rapidly from 2012 onwards. This is a sign of the improved stability of the grid. For 2015, only 61 days of load shedding are documented and this figure had fallen to almost zero by 2022. Even though these figures do not apply exclusively to the DPDC supply area, it can be assumed that similar improvements have also been made here.

In general, the improvement described for the individual indicators is also corroborated by other sources. In 2019, the country was already ranked 68th out of the 141 countries in the quality of electricity supply in the Global Competitiveness Report. DPDC's annual reports also show improvements in terms of reducing electricity losses, connecting new customers and the amount of electricity transported.[6] This enormous progress can also be linked to the measures implemented in the project.

However, it must be noted that only a very small part of the quantitative growth in the indicators described above can be attributed to the project. The parallel investments in the infrastructure of the electricity grid play an important role in the development of the indicators. However, the exact investment volumes are not public information. Overall, it can be concluded that the project contributed to achieving the target indicators, but the exact scope remains unclear.

Effectiveness rating: 3

Efficiency

The completion of the individual measures of the project was partially delayed by several years. Originally, the project was expected to be concluded in 2010. However, the last plant could not be put into operation until 2015. There are many reasons for this, although initially an inefficient procurement process led to significant delays. Although bids for implementation were available in good time and according to the original time schedule for all individual measures, no quick agreement could be reached with the DPDC. This delay was mainly related to the proposed new substation, the completion of which was also affected by a delay in delivery by the provider. The provider was unable to meet its delivery commitments, which, combined with cumbersome handling of the problem by the project-executing agency, led to inefficient implementation. At the end of the delayed award process, raw material costs had increased in the meantime, which led to an increase in costs for the cable systems. This could have been avoided by timely implementation. In the third part of the project, the construction of a 132 kV transmission line, there was also a considerable delay due to unsettled ownership of the building land. These delays were also related to the lengthy award process, as it led to illegal settlement on the building land during this time, which first had to be resolved in court and repeatedly led to shifts in the pipeline route. On a business level, it can therefore be stated in the context of inefficient implementation in all three sub-areas of the project that essential planning processes were not carried out optimally and thus led to a significantly higher time commitment for all participants. The delays had a significant negative impact on the project's progress and production efficiency is therefore inadequate.

Further impairments can also be attributed to the unsettled political environment. Strikes by workers and owners of land abutting the construction projects also contributed to the delays in the project.

From an economic point of view, the project can be regarded as efficient. Correct action has been identified to address the power supply bottleneck. Alternative power supply options such as decentralised photovoltaic systems could not have provided the same benefits for users in the urban context of Dhaka at the time of project planning and implementation. Industrial users in particular require greater power supply capacity than would have been the case had the project been implemented at the same cost as decentralised supply systems.

---

[5] See: https://dpdc.org.bd/list/annualreport/Annual_report_2021-22.pdf

[6] See: বার্ষিক প্রতিবেদন (dpdc.org.bd)

Overall, the assessment is dominated by the cumbersome implementation; the project took far too long to complete successfully. Efficiency is therefore rated as unsatisfactory.

Efficiency rating: 4

Overarching developmental impact

The overarching objective of the programme was the quantitative and qualitative improvement in the provision of electrical energy for DPDC end customers, which was intended to contribute to positive economic development at impact level.

This affected several development goals at once. First of all, access to affordable, reliable and clean energy is a development goal in itself, set out in the seventh UN Sustainable Development Goal. Moreover, energy, and in particular access to reliable electricity, is central to almost all the major challenges facing Bangladesh today, including alleviating poverty (SDG 1), gender equality (SDG 5), climate change adaptation (SDG 13), security of food supply (SDG 2), health (SDG 3), education (SDG 4), sustainable cities and communities (SDG 11), jobs (SDG 8) and building resilient infrastructure, promoting sustainable industrialisation and supporting innovation (SDG 9).

The expansion of the transmission grid and distribution systems improved the efficiency and reliability of the power supply, which benefits both households and companies in the manufacturing industry and in the service sector. For the clothing industry and its employees, this can have directly led to more stable incomes and more secure long-term prospects. More precise information is not available for Bangladesh and the DPDC supply area in particular, but conclusions can also be drawn about the impact of this project from countries with similar economic and institutional starting conditions. From India it is known that a grid connection increased households' non-agricultural income by around 9% during the evaluation period (1994–2005).[7] However, grid connection and improved power quality, measured in terms of fewer power outages and more hours of supply per day, increased non-agricultural income by around 28.6% in the same period. For countries such as Bangladesh, the quality of supply is therefore a significant factor in realising economic potential. The individual measures implemented in the project will most likely have contributed to achieving this.

Key social and societal institutions such as hospitals and schools also benefit from the increased reliability. The diesel generators often used for these facilities, as well as for companies, have two major disadvantages. Firstly, they are significantly more expensive per kilowatt hour generated than electricity from the grid, which poses considerable and sometimes difficult to cover additional costs, especially for social institutions. Secondly, the combustion of the fuel used releases local air pollutants, which in turn can lead to consequential damage to the health of the local population. The electricity supplied via the electricity grid in Bangladesh mainly comes from gas-fired power plants and is not only cheaper, but also more environmentally friendly than locally produced electricity from smaller generators.[8] In addition, the local workers hired as part of the construction project benefited directly from the project.

However, it must also be noted in this sub-area that a clear causal link cannot be established between the project and the developmental impacts described. This would require precise information on electricity consumption and usage over time, the socio-economic background of users and, above all, precise data on the quality of the power supply. Although this information was not available, it seems plausible overall that the project did have smaller positive impact on the development objectives.

Overarching developmental impact rating: 3

Sustainability

The installed systems are expected to run for a longer period of time and help to ensure the quality of the electricity demand, which will continue to increase in the future. Due to the first problems with the maintenance of the systems, there is a small question mark behind the time horizon of use and it remains to be

[7] Chakravorty et al. (2007), Does the quality of electricity matter? Evidence from rural India, Journal of Economic Behavior & Organization

[8] IFC (2019), The Dirty Footprint of the Broken Grid

seen whether problems will arise in the medium term as a result. Shortly after the commissioning of the substations, a complaint was raised about water ingress in the cable cellar, which was not immediately remedied even after several requests. In addition, corrosion can be detected on the external parts of the systems after a short time, which can be problematic for the long-term functionality.

The improved financial position of DPDC through lower system losses and a modern distribution infrastructure can be rated positively in the medium to long-term. The company is therefore better equipped for the future and can more professionally fulfil its mandate to provide its many end customers with a reliable electricity supply. This means that developmental impact that has already been generated can continue to arise in the future assuming professional management takes place.

The project also made a positive contribution to the environmental footprint. The increase in efficiency in the electricity distribution system is also indirectly leading to a reduction in CO2 emissions in the predominantly fossil-fuel-powered power plant park in Bangladesh. In addition, a more efficient electricity distribution system can make an important contribution to national energy security. Although Bangladesh has its own natural gas reserves, the country must increasingly purchase natural gas liquids on the global energy market in order to meet the increasing energy demands of the population. The improved efficiency achieved by the project has helped to improve energy security as far as possible.

In terms of occupational health and safety, the project was overshadowed by two fatal accidents. A worker and a passer-by died during construction work on the 132 kV transmission line. To resolve the matter, the project-executing agency and the contractor reached an agreement with the affected parties on the level of compensation. KfW also carried out an audit of the health and safety requirements at the project-executing agency DPDC. This revealed blatant shortcomings in safety management, which resulted in safety training for management, the executing agency, suppliers and service providers. It is hoped that at least the project-executing agency has developed a sensitive approach to future construction projects and the general operating procedure based on this experience. In conclusion, it must be noted that the project-executing agency has not always proven to be a reliable project partner overall. It is significant that the project-executing agency was not available for obtaining information within the scope of this evaluation report.

Sustainability rating: 3

Notes on the methods used to evaluate project success (rating)

Projects are evaluated on a six-point scale, the criteria being **relevance**, **coherence**, **effectiveness**, **efficiency**, **overarching developmental impact and sustainability** and a final **overall rating** of the development effectiveness. The scale is as follows:

Level 1	very successful: result that clearly exceeds expectations
Level 2	successful: fully in line with expectations and without any significant shortcomings
Level 3	moderately successful: project falls short of expectations but the positive results dominate
Level 4	moderately unsuccessful: significantly below expectations, with negative results dominating despite discernible positive results
Level 5	unsuccessful: despite some positive partial results, the negative results clearly dominate
Level 6	highly unsuccessful: the project has no impact or the situation has actually deteriorated

Rating levels 1–3 denote a positive assessment or successful project while rating levels 4–6 denote a negative assessment.

The **overall rating** on the six-point scale is compiled from a weighting of all six individual criteria as appropriate to the project in question. Rating levels 1–3 of the overall rating indicate a "successful" and levels 4–6 an "unsuccessful" project. It should be noted that a project can generally be rated developmentally "successful" only if the achievement of the project objective ("effectiveness"), the impact on the overall objective ("overarching developmental impact") **and** the sustainability are rated at least "moderately successful"
(level 3).