Ex post evaluation – Pakistan

Sector: Electric power transmission and distribution (CRS Code 23 63000)
Programme/Project: Ghakkar substation, BMZ No. 2003 65 882 *
Implementing agency: National Transmission and Despatch Company (NTDC)

Ex post evaluation report: 2016

		Project A (Planned)	Project A (Actual)
Investment costs (total)	EUR million	76.60	60.40
Own contribution	EUR million	25.47	18.64
Funding	EUR million	51.13	41.76
of which BMZ budget funds	EUR million	51.13	41.76

*) Random sample 2015

Summary: Construction of a 500/220/132kV substation in Ghakkar with open-air switchyards and transformers – as a complementary investment connected to the 1,450 MW Ghazi Barotha hydropower plant commissioned in 2004, co-financed by Financial cooperation (FC). The substation is operated by the state company NTDC and allows for the safe and efficient transmission of the environmentally friendly power generated in Ghazi Barotha to the interconnected grid as well as a stable, low-loss power supply to the economic region of Gujranwala.

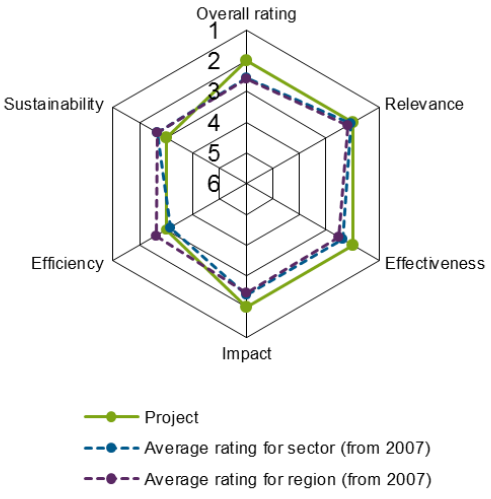
Objectives: The intended impact was to contribute towards an economically efficient energy supply via improved stability of the high-voltage network and towards reduced transmission losses. At the same time, the project was expected to support the economic development of Pakistan and to create the conditions for positive employment and income effects. The envisaged outcomes were the secure and efficient transmission of the power generated in the Ghazi Barotha hydroelectric power station into the entire Pakistani high-voltage network as well as a reliable and improved power supply in the economic region of Gujranwala.

Target group: The project's target group are electricity consumers in Pakistan, especially in the high-demand area of Gujranwala.

Overall rating: 2

Rationale: The financed installations were completed in 2011. They are in good condition and fulfil their technical purpose with an appropriate technical design. Thus the installations achieve all of the intended impacts. The substation is utilised as expected, but will reach its limits in the near future (3-5 years) due to ongoing expansion plans. NTDC is a competent operator and made a positive impression at all staffing levels. Nevertheless, greater diligence was called for at NTDC with regard to local maintenance. Operational bottlenecks due to local understaffing cannot be ruled out.

Highlights: The nationwide economic and institutional problems in the sector (primarily low cost coverage, high state subsidies and power losses) contrast sharply with the positive project effects at local level. Power generation constraints are contributing increasingly to the still widespread power cuts.



Rating according to DAC criteria

Overall rating: 2

Overall context

The political situation in Pakistan has destabilised considerably when compared to the time of project appraisal (PA, 2003), and since 2006 the country has been listed in the “High Alert” category in the “Fragile State Index”[1]. This is taken into account at certain points in the evaluation, but does not result in any adjustment of the set of objectives. There have been no potentially conflictive access or distribution issues owing to the nature of the project (switchgear in the area of power transmission); contributing to a secure provision of basic infrastructure has not had any exacerbating effects, even in Pakistan's increasingly fragile environment.

With regard to the Pakistani energy sector, many of the problems identified at the PA continue to persist. The still inadequate power supply with regular power outages is adversely affecting economic activities and the ability of social institutions to function properly. The power supply is proving not to be economically sustainable: following an increase in early 2015, average tariff revenues cover about 80 % of the average costs, while technical and non-technical losses in the overall system are still just under 20 %. This has led to significant government subsidies in all areas (generation, transmission, distribution) and to a system of "circular debt" throughout the sector (), albeit with large variations among the different utility companies. As a result of the generally inadequate financing level, they are finding it increasingly difficult to plan their investments with foresight and implement them in a prioritised manner. As compared to the time of PA, the unreliable supply situation is also exacerbated by increased power generation bottlenecks: due to the lack of generation capacity, currently at 3-4 GW, the peak load cannot be met. This results in significant shutdowns and load shedding which has a negative effect on residential, commercial, industrial and agricultural power consumers. Those bottlenecks and the high proportion of expensive thermal power generation are currently overshadowing the continuing investments needs in the field of transmission and distribution infrastructure. To date, necessary structural and institutional reforms in the sector have not been pursued with the necessary degree of consistency. Following initial reform steps (tariff increases – see above), it remains to be seen whether or to what extent further structural changes, such as e.g. the proposed “cap” on government subsidies, will actually be implemented .

Relevance

Lack of investment in the area of transmission and distribution was the main reason for the inadequate and unreliable electricity supply in Pakistan at the time of PA. The transmission grids which existed at the time (in the 220 and 132 kV ranges) had reached their capacity limits even during normal operation, and had not been expanded at the same pace as generation plants. This was particularly true in the area of the high-voltage grid, where there was a need to cope with significant seasonal volatility of electricity transmission in the various regions. The project was closely linked to the Ghazi Barotha Hydro Power Station/ HPS (1,450 MW) which was then nearing completion and was also financed by FC. The power generated by that HPS was intended to reduce power supply bottlenecks on the generation side. The improved transmission infrastructure in the project area thanks to the construction of a 500/220/132 kV substation in Ghakkar was aimed at avoiding overload of existing transformers, load shedding, grid losses and volatile voltage levels in the Gujranwala region.

At the time of PA, the construction of a substation was essential in order to improve the poor grid stability in the Gujranwala supply area and to safely feed the power generated by the Ghazi Barotha HPS into the national grid. Besides, the proposed additional 500 kV grid expansion and the additional generation capacity foreseen back then left no other option. In retrospect, the urgency of those problems identified is understandable and was properly addressed. The assumptions made and the underlying intervention logic are plausible: a reliable and improved power supply in the Gujranwala region and the safe and efficient

[1] Cf. http://fsi.fundforpeace.org/

power transmission from the Ghazi Barotha HPS (outcome) were suited to contribute to the more efficient provision of electricity in economic terms and thus to support Pakistan´s economic development (impact).

The country's instability, which has meanwhile increased, was less pronounced at PA and was not reflected in the intervention logic. From today's perspective, only the contribution of secured basic infrastructure of in an increasingly fragile environment would have been touched upon in this regard, if necessary.

The project was consistent with national priorities and with those of the BMZ and addressed a significant development bottleneck in Pakistan's energy sector. Systematic donor coordination in the sector is not taking place, and would not necessarily have been called for in the present case.

The overall relevance of the project is rated high.

Relevance rating: 2

Effectiveness

The project's outcomes comprise the secure and efficient transmission of environmentally-friendly power generated at Ghazi Barotha HPS into the entire Pakistani high-voltage network by means of the 500/220/132 kV Ghakkar substation as well as a reliable and improved power supply in the economic region of Gujranwala. The following were defined as indicators at the PA: (a) stability of the combined system / decrease in transmission-related shutdowns; (b) stabilised voltage level in the Gujranwala supply area; (c) reduced transmission losses in the 500 kV grid by approximately 30 MW and (d) reduced transmission losses across the entire high-voltage network. For indicators (c) and (d), reduced transmission losses (d) are more meaningful and more accurate than energy savings in the 500 kV network (c): The 500 kV grid has been expanded since 2003, from an original 4,175 to 5,187 km; at the same time production capacity has increased from 15.9 to 24.4 GW. Thus, the overall system should be taken into account (i.e. d), rather than evaluating, the - now significantly altered - 500 KV grid (i.e. c). Accordingly, only the loss percentage in the overall transmission system is used for evaluation.

The attainment of the outcomes defined at PA can be summarised as follows:

Indicator	Status PA	Ex post evaluation
(1) Stability of the combined system: reduction of unplanned shutdowns during normal operation due to overloading of individual components	Status: - Target value: approaching zero	No shutdowns in the transmission network, but regularly in the distribution system (see below)
(2) The voltage level is greatly improved in the GEPCO supply area	Status: - Target value: -	Achieved. Although no constant data series were available, the frequency measured at evaluation was constant at 50 Hz. The voltage was stable.
(3) The losses in the Pakistani transmission system are under 7.6 %.	Status: 7.6 % Target value: <7.6 %	2.48 %

The statistics relating to the Pakistani transmission and distribution system which were available at the time of the evaluation show that the relevant indicators were met.

The losses across the entire Pakistani high-voltage network (132/ 220/ 500 kV) were 2.48 % in 2014, which is well below the target value of a maximum of 7.6 % – and below the international reference value of 3 %. As a result of the situation referred to above, this is indicative not only of the performance capacity of the substation, but also of the greatly improved operation of the entire transmission network. At this

point, it should be noted that since the year 2000, the 132 kV transmission grids are run by the distribution companies (known as DISCOs) - and no longer by the state transmission company NTDC (project-executing agency). Losses in the area overseen by NTDC were 2.65 % in 2014.

In the supply area of the regional electricity supplier GEPCO (Gujranwala), both voltage quality and general electricity supply have improved appreciably. The number of customers increased from 1.8 million in 2003 (83 % private consumers) to 2.9 million in 2015 (86 % private consumers). Due to the general power deficit and the rapidly growing demand for electricity, power cuts of (on national average) over eight hours still occur each day in urban areas and up to 20 hours/day in rural areas, in order to keep the network stable. By contrast, supply stability and quality in Gujranwala are much better: according to an evaluation by the National Electric Power Regulatory Authority (NEPRA)[2]: with an identified annual average of 10.5 outages per consumer and an average downtime of 13.1 minute, power interruptions and downtimes were below the national annual target values of 13 interruptions and 14 minutes.

From the evaluation's point of view, the capacity utilisation of the substation itself is suitable as a suitable additional parameter at outcome level. This allows for a more immediate measurement of investment performance itself and thus enables an assessment that is less inter-related with general sector developments. The facility's utilisation can be classified as very good, and all outlets are in use. The capacity utilisation of the 220/132 kV transformers is slowly approaching its limits - due to rising power demand among the population and additional power plants in the interconnected grid. The average rate of capacity utilisation is 75 %, with a peak of 109 %. Therefore, consideration must be given to future expansion in the 220/132 kV range. Capacity utilisation of the 500/220 kV autotransformers is currently around 40 % during normal operation and allows for sufficient redundancy. An extension of the 220/132 kV system part can therefore be implemented. The utilisation of the entire system is fully consistent with expectations at the time of PA. Current expansion needs are owed to the dynamic development in the sector and not caused by planning errors back then. In 2015, two new 132 kV high-voltage lines were connected to the substation. This expansion was in line with the project's design.

In summary, the project's effectiveness is rated as good.

Effectiveness rating: 2

Efficiency

The project's actual implementation took 54 months, instead of 22 as originally planned. The delays were above all attributable to the lengthy contract award process and discrepancies during the evaluation of bids. However, Ghazi Barota HPS was also commissioned around three years later than originally planned, which mitigated the limitations resulting from the substation's delayed construction.

Thanks to strong competition among bidders at the time, the total costs of EUR 60.4 million are well below the PA estimates (EUR 76.6 million). The omission of the SCADA components[3] – ultimately funded from other sources – from the scope of supply further reduced foreign exchange costs in this regard. The costs are low by international comparison, and as a result the production efficiency can be assessed as good.

The allocation efficiency of the project itself (impact / input relation – see below) can be rated as high, not least because of the close complementarity with the Ghazi Barotha HPS mentioned above. In the GEPCO supply area, technical and non-technical losses have fallen since 2003 from 13 % to 10.7 %, and the collection rate in 2015 was an exemplary 97 %. This is in sharp contrast to the inefficient framework conditions in the sector as a whole (see above): according to the World Bank, public subsidies for the energy sector accounted for around 0.8 % of GDP in the financial year 2014/15 (compared to 1.5 % in 2012/13) and tend to favour wealthier segments of the population and large consumers. However, the current reform efforts allow for a positive outlook in this area – after many years of stagnation. Overall allocation efficiency is evaluated as marginally satisfactory.

Efficiency rating: 3

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[2] NEPRA (2015): "Performance Evaluation Report of Distribution Companies 2013-14"

[3] Supervisory Control and Data Acquisition (SCADA): computer-based system for monitoring and controlling technical processes

Impact

In technical terms, the project was designed within clear geographical boundaries, i.e. electricity transmission from the Ghazi Barotha HPS and improved power supply in the Gujranwala region. This was also reflected in the definition of the target group. Impact indicators were, however, formulated on a nationwide basis, which leads to a certain attribution gap between project results and the claimed impact: in principle, the relationship between stable and efficient power supply on the one hand and economic development, increased employment and incomes on the other is plausible., due to the variety of other economic, technical and political factors in play this can, however, not be attributed to an individual intervention. This holds particularly true for projects in the high-voltage transmission range, since both positive and negative network effects (changes in power plant fleet or in the entire network infrastructure) can enhance or reduce the overall economic impact of a single project. The system level indicators defined at PA fall just short of meeting the set targets, with a current cost recovery ratio of around 80 %; with regard to power losses in the overall system, the current rate of almost 20 % lies below the specified maximum of 24 %. The third impact indicator – the share of productive electricity consumption – is not used for evaluation: according to revised criteria, this aspect is no longer relevant for assessment. This is due, on the one hand, to methodological problems, since small enterprises and the informal sector are usually also recognised as "private consumers"; on the other hand, there is sufficient evidence for the welfare effects of consumptive electricity usage in terms of hygiene, education, etc. – as highlighted under the topic “access for all”.

In light of the many influencing factors (see above), only qualitative assessments are possible for the current “state-of-the-art” impact dimensions, namely “economic development” and “access”. In terms of economic development, there has been a significant observable increase in business start-ups in the supply region – and particularly in energy-intensive businesses (rice mill, ceramic industry, electrical industry, steel foundries) in the substation's vicinity. The number of newly installed power connections in the Gujranwala region since the facility's commissioning (+570,000 to 2.9 million) – for which the project was a mandatory requirement – can be used to help evaluate the “access” dimension. Thus, GEPCO was able to increase the amount of electricity sold between 2010 and 2015 by 55 %. The above-mentioned developments – in connection with the proper operation and good utilisation of the station – allow us to draw the sufficiently plausible conclusion that the project's impact has been significantly positive.

As regards the increasingly fragile conditions in Pakistan (see above), the project does indeed contribute to a secured basic provision of infrastructure from today’s perspective; beyond this, no conflict-reducing effects are perceptible. Furthermore, the project was implemented under existing – and largely functional – institutional structures, and disparities possibly leading to intensified conflicts or similar effects, such as access problems, can - by default - not originate from energy transmission projects.

Impact rating: 2

Sustainability

The sectoral conditions in Pakistan remain difficult. The latent energy deficit, fragmented political responsibilities, persistent technical losses, low end-user tariffs, expensive thermal power generation, the low collection rates of several DISCOs and the resulting low cost recovery in the sector represent major challenges. In comparison to other state actors in the sector, the financial situation of NTDC appears to be stable, albeit state-dependent. The revenues obtained by NTDC are determined by a supply tariff for generating companies on the one hand and by payments received from DISCOs on the other. Accordingly, NTDC relies in the latter case on the respective DISCOs' financial discipline in order to avoid additional subsidies. Those companies, in turn, exhibit differences in loss and collection rates. The tariff level set by the regulators is thus only one factor among many.

Comparisons with other substations (for example, in Lahore) show that the voltage stability in the Ghakkar substation is good. The station's design complies with sustainability requirements. NTDC is sufficiently capable of ensuring the sustainability of the investment in terms of operation and maintenance. Technical staff and management are knowledgeable and professional. Nevertheless, we have called for greater diligence with regard to operation monitoring. Since the end of 2012, Ghakkar has had a fibre-optic connection to the national load control centre via the SCADA system (computer-based monitoring and control system).

Owing primarily to difficulties in staff recruitment, only 62 out of the required 110 persons were available to operate the substation. This represents a potential operational risk; the issue is of a structural nature, however, as NTDC - like many Pakistani enterprises - is struggling with high staff turnover. Qualified employees often turn to work abroad for higher salaries. Given the current staffing problems, it would thus be desirable to automate all substations. At present, however, this is not yet feasible due to costs reasons and the company´s policy. New 500 kV and 220 kV substations will be provided with an automation concept for switchgear in future, allowing for their unmanned operation.

Over the next five years, it is planned to connect numerous new power stations with altogether roughly 22 GW of installed generation capacity. To integrate those, NTDC must build new high-voltage lines from the south to the load centre in the middle of Pakistan. The stability of the entire transmission and distribution network is thus largely dependent on further investments in the expansion of those lines.

From today's perspective, it can be assessed that the planning of the project was appropriate at the time of PA and that it was implemented properly. We see no increased risk for the operation of the substation, with only minor reservations (see above). In principle, the sustainability of the project itself can be classed as "good", but the currently prevailing sectoral problems only allow for an overall rating down of just "satisfactory".

Sustainability rating: 3

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

Projects (and programmes) are evaluated on a six-point scale, the criteria being **relevance, effectiveness, efficiency** and **overarching developmental impact**. The ratings are also used to arrive at a **final assessment** of a project's overall developmental efficacy. The scale is as follows:

Level 1	Very good result that clearly exceeds expectations
Level 2	Good result, fully in line with expectations and without any significant shortcomings
Level 3	Satisfactory result – project falls short of expectations but the positive results dominate
Level 4	Unsatisfactory result – significantly below expectations, with negative results dominating despite discernible positive results
Level 5	Clearly inadequate result – despite some positive partial results, the negative results clearly dominate
Level 6	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.

Sustainability is evaluated according to the following four-point scale:

Sustainability level 1 (very good sustainability): The developmental efficacy of the project (positive to date) is very likely to continue undiminished or even increase.

Sustainability level 2 (good sustainability): The developmental efficacy of the project (positive to date) is very likely to decline only minimally but remain positive overall. (This is what can normally be expected).

Sustainability level 3 (satisfactory sustainability): The developmental efficacy of the project (positive to date) is very likely to decline significantly but remain positive overall. This rating is also assigned if the sustainability of a project is considered inadequate up to the time of the ex post evaluation but is very likely to evolve positively so that the project will ultimately achieve positive developmental efficacy.

Sustainability level 4 (inadequate sustainability): The developmental efficacy of the project is inadequate up to the time of the ex post evaluation and is very unlikely to improve. This rating is also assigned if the sustainability that has been positively evaluated to date is very likely to deteriorate severely and no longer meet the level 3 criteria.

The **overall rating** on the six-point scale is compiled from a weighting of all five individual criteria as appropriate to the project in question. Rating levels 1-3 of the overall rating denote a "successful" project while rating levels 4-6 denote an "unsuccessful" project. It should be noted that a project can generally be considered 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 "satisfactory" (level 3).