Ex post evaluation – Tajikistan

Sector: Energy (CRS Code: 2322000 Hydropower plants)
Project: Replacement of 220/500kV switchgear equipment at Nurek Hydropower Plant (2004 66 144)*
Implementing agency: Barki Tojik (vertically integrated power company in Tajikistan)

Ex post evaluation report: 2018

		Project (Planned)	Project (Actual)
Investment costs (total)	EUR million	26.30	25.00
Counterpart contribution	EUR million	1.30	0.00
Funding	EUR million	25.00	25.00
of which BMZ budget funds	EUR million	25.00	25.00

*) Random sample 2017

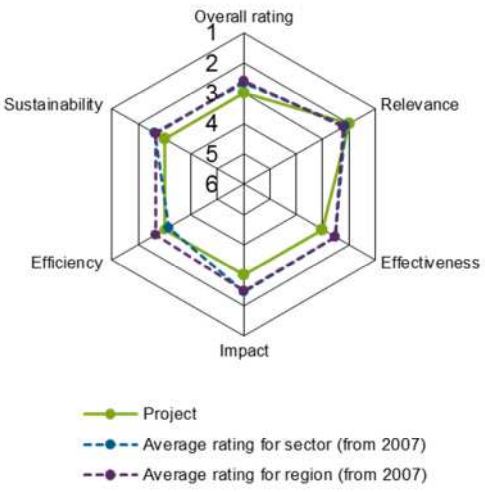
Summary: At the time of the appraisal (2007), the Nurek Hydropower Plant (HPP) accounted for 70 % of the total energy generated in Tajikistan. It became necesarry to rebuild the 220kV and 500kV switchgear equipment at the Nurek Hydropower Plant due to subsidence and earthquakes, as well as signs of wear brought on by age. Initially planned as a cooperative programme with the Asian Development Bank, the project was carried out separately for funding availability reasons. The FC financing was used for the reconstruction of the 220kV switchgear; the 500kV switchgear was renovated somewhat later using ADB funds. The total costs of the 220kV switchgear plant came to EUR 25 million, and were covered by an FC loan of EUR 18 million and an FC grant of EUR 7 million. The evaluation relates to the FC-funded 220kV switchgear.

Development objectives: Impact: Contribute to economic and social development in Tajikistan by securing the availability and reliability of electricity supplied from renewable energies, and make a contribution to climate protection. Project objective (outcome): Sustainable reduction in the risk to the national supply of electricity from renewable energy sources by increasing the industrial safety of the facilities.

Target group: All private and commercial consumers in Tajikistan.

Overall rating: 3

Rationale: The project's relevance is rated good given the significance of the hydropower plant. The goal achievement falls slightly short of expectations owing to external factors and the subordinate importance of the 220kV switchgear compared to the 500kV switchgear, but this is outweighed by the positive results. The production efficiency is good; compromises have to be made with the allocation efficiency owing to weaknesses with the sectoral environment and the executing agency. The impact indicator to measure climate effects was too ambitious and not achieved, but we nevertheless assume there will be positive developmental impacts for consumers in Tajikistan and for users benefiting from exports in Afghanistan. The technical sustainability of the plant is ensured; in light of the difficult sectoral environment, the poor financial situation of the executing agency and the uncertainty of the reform implementation, however, the sustainability can only be rated as satisfactory overall.



Rating according to DAC criteria

Overall rating: 3

Ratings:

Relevance	2
Effectiveness	3
Efficiency	3
Impact	3
Sustainability	3

Relevance

The reliability of Tajikistan's energy supply was identified as a core issue at project appraisal and continues to be of highest relevance. At project appraisal (2007), production via the Nurek hydropower plant (HPP) accounted for 70 % of Tajikistan's total energy production. At the time of the evaluation (2017), the production share was still 60 %. The renewal of the 220kV switchgear plant therefore addresses an important element in ensuring a reliable power supply from the Nurek HPP. It can be assumed that the previous 220kV switchgear plant would have failed in the medium term due to ground subsidence, restricting the power feeded into the grid by the Nurek HPP. The construction of the new switchgear plant was essential for ensuring continued operation. As a joint project with the Asian Development Bank (ADB), which financed the renewal of the 500kV switchgear plant in Nurek, the project had the potential to secure the power plant's entire supply line.

As a result of the high share of hydropower in the energy mix in Tajikistan, there is an energy surplus in summer and an energy deficit in winter. The switchgear plant can make only a limited contribution towards resolving this problem. The energy deficit in winter is now being tackled by the government and other donors. A new thermal power plant in Dushanbe (400MW heating capacity) provides heat energy for households in the winter months, replacing about 20 % of the capital's electrical heating systems. In addition, self-financed work is now underway at the Rogun hydroelectric power plant, with the aim of ensuring the short-term and temporary availability of 200MW (planned total capacity of 3,600MW) in an effort to improve the supply in winter. Further expansion is planned as soon as the financing of the overall project has been secured. Due to the persistent supply deficit in winter, the FC-financed switchgear plant is absolutely essential for ensuring supply for the Tajikistani population and the economy in the south of the country in particular. From today's perspective, the switchgear plant is also relevant for summer electricity exports to Afghanistan. The 220kV Nurek plant operates in collaboration with other power plants in the southern electricity grid in this regard.

The expansion of production capacities will reduce the general relevance of the FC-financed switchgear plant as a percentage of the total energy system. The power output from the 220kV switchgear plant depends on demand in southern Tajikistan and the need for exports to Afghanistan (March to October). If there is no marked increase here, we anticipate a stagnation or possible reduction in the relevance of the 220kV switchgear plant, since it is expected that additional energy will already be fed into the southern energy grid via the existing 500kV north-south line as soon as further energy sources can be developed in the central and northern areas of the country (e.g. Rogun HPP or Kayrakkum HPP).

The causal link identified at the project appraisal is a sound basis: the new construction of the switchgear plant increases operational safety at the Nurek HPP, improving reliable power supply thus allowing for economic and social development. A reliable electricity supply is essential for further economic development, as evidenced, for example, by the decline in economic power in the winter months due to the water-related power deficit in Tajikistan.

The project is highly consistent with the objectives of the partner country: at the request of the partner it was agreed with the BMZ outside of the agreed priorities due to its particular urgency. Energy security is a high priority in the national development strategy up to 2030. The project is in line with international climate and development goals (SDG7) and the energy sector concept of the BMZ. The power is supplied mainly in the south of the country, a priority region for German FC. There has been close coordination with other donors. The ADB financed the necessary construction of the new 500kV switchgear plant at the Nurek HPP. The World Bank has meanwhile provided funding for the required renovation of the electromechanical systems at the Nurek HPP, and tenders are already in progress.

Relevance rating: 2

Effectiveness

The project objective (outcome) is to sustainably reduce the risk to the national supply of electricity from renewable energy sources by increasing the industrial safety of the facilities. This is measured in the evaluation using the two indicators listed in the following table:

Indicator	Target value	Actual value as of EPE
(1) Failure-free supply of 2,100GWh per year via the 220kV switchgear plant	2,100GWh	Average (2013-2016): 1,506GWh[1]
(2) Failure-free supply of the power generated by the Nurek power plant and allocated for the 220kV level, with availability > 98 %.	> 98 %	Average (2013-2016): 87.6% Constantly 100%, with the exception of the years 2015 (42 %) and 2016 (99.95 %).

The old outdoor switchyard was successfully replaced with a modern, gas-insulated 220kV system. To date, indicator (1) has only been achieved in 2016; initial data for 2017 have also been positive so far. The reasons behind the positive numbers in 2016 include high demand, e.g. in exports, the failure of generation capacity due to maintenance works at the Sangtuda 1 power plant, a high water supply in 2016, lower energy demand at Talco (aluminum factory) and thus more unused capacities to cover demand in southern Tajikistan. Assuming a supply of around 20 % of production via the 220kV plant (basis for target formulation of 2,100GWh in PP), and considering the total energy output of the HPP, it would have been necessary to achieve an average value of 2,045GWh over the years 2013 to 2016. In reality, the average of the individual values measured is only 1,506GWh/a. Taking into account the expansion of production capacity and the increasing importance of the 500kV level, among other factors, there is no guarantee that future targets will be met.

The FC-financed plant is technically capable of supplying the generated energy – and even of going beyond the indicator values. The risk of increasing silting at the HPP has so far not adversely affected the achievement of the objective, and this is set to be reduced in future by the construction of the Rogun HPP. The required renovation of the Nurek HPP is being financed by the World Bank, thus reducing risks with regard to technical problems with turbines or autotransformers for example, as well as dam safety. It is therefore not expected that the future achievement of objectives will be jeopardised due to a failure of the HPP. With the exception of an as yet unexplained four-hour period of complete failure on 28 October 2016, the power plant has operated failure-free.

The project-executing agency employs qualified operating staff. The transfer of responsibilities from the Project Management Unit to the executing agency's operating staff following completion of the construction work was completed smoothly. An operating and maintenance budget is available; no investment

[1] Individual data: 2013: 392.7; 2014: 2,042.6; 2015: 1,229.1; 2016: 2,363.1; 2017: 1,973.2 (until September 2017).

costs have been recorded to date. No further subsidence at the location of the new switchgear plant has been noted to date. A corresponding monitoring process is in place.

At the time of the evaluation, indicator (2) had not been achieved on average over the years (87.6 %). However, the unusually low value is attributable only to the partial breakdown of the switchgear for a lengthy period of time in 2015 as the result of an operational fault – most likely due to initial lack of experience. We assume that this indicator will be achieved in the future, since gas-insulated switchgear (GIS) generally have very low or no susceptibility to failure.

In summary, the outcome was not as good as expected at the time of the evaluation (indicators missed), but this was generally outweighed by the positive results. Indicator 1, in particular, is dependent on external factors – thus the failure to achieve this indicator was not solely attributable to the functionality and importance of the switchgear plant. The failure to achieve indicator 2 was solely attributable to a singular event.

Effectiveness rating: 3

Efficiency

The actual implementation of the project has been extended by 21 months compared to the original estimate. The delays are mainly attributable to protracted procurement procedures and weaknesses in the implementation on the part of the supplier/contractor. However, it was possible to maintain the operation of the old 220kV switchgear plant until completion, so the delays did not lead to negative effects in terms of energy supply from the HPP. The total cost of EUR 25 million is approximately EUR 1.6 million below the costs estimated at the project appraisal. The construction of gas-insulated switchgear (GIS) is a sensible approach to resolving the core problem while ensuring low capital expenditure, low operating costs, and low space requirements. The production efficiency is good from a project standpoint.

From the executing agency's point of view, the internal rate of return is lower than expected at project appraisal due to lower output and supply as well as on-lending rates of 8 %, but remains positive overall. The planned renovation measures at the HPP can be viewed as positive. The executing agency's financing costs after on-lending of the FC funds by the state and the lower supply via the 220kV switchgear (20 % instead of an estimated 33 % at the appraisal), on the other hand, had a negative impact on the internal rate of return. The export of power to Afghanistan was not taken into account at project appraisal, however; with more transparent accounting, this could increase the executing agency's revenues and thus improve its financial situation.

The failure of the entire system was considered in macroeconomic terms at appraisal. No isolated analysis of the FC-financed switchgear component (without the 500kV plant financed by the ADB) was conducted. Given that the Nurek HPP currently covers about 60 % of the energy demand in Tajikistan and the 220kV switchgear supplies 20 %, the plant's total share of the national power supply is 12 %. Based on this consideration alone, macroeconomic profitability can be considered assured. The importance of the project for the Tajikistani power supply can be expected to diminish with the construction of new power plants, however. The creation or renovation of generation capacities would have been significantly more capital intensive (costs for rehabilitation of Nurek HPP estimated at USD 700 million), and the need for the construction of a new switchgear plant would have remained.

The allocation efficiency (see also statements under Sustainability) is constrained by the difficult framework conditions in the sector and the worrying financial situation of the project-executing agency Barki Tojik. Barki Tojik finds itself in an unsustainable debt situation (accounts receivable of approximately USD 800 million). Electricity tariffs are not sufficient to cover costs (55 % shortfall) and the collection rate (83 %) is low. Planning capacity and financial management remain very weak. The external audit reports of the annual financial statements continue to present findings, but these have reduced greatly over the past two years. Although operating and maintenance costs can be covered, the investment budget for infrastructure is almost entirely externally funded, and the infrastructure is in need of significant upgrading. At least 60 % of the generation capacities need to be upgraded over the next ten years. The distribution network is in very bad condition and prone to faults. According to the executing agency, the system losses only amount to 16.9 %, but commercial losses are not taken into consideration in this calculation.

The efficient design and implementation of the project can be assessed as positive, but the sectoral framework conditions and the financial situation of the executing agency have limited efficiency up to now, despite the positive prospects for the future.

Efficiency rating: 3

Impact

The overall objective (impact) defined at the project appraisal was adjusted as follows during the evaluation: Contribute to economic and social development in Tajikistan by securing the availability and reliability of electricity supplied from renewable energies, and make a contribution to climate protection as a result. While the relationship between stable and reliable power supply on the one hand, and economic development on the other is plausible, as mentioned above, due to the variety of other technical and political factors in play this is not attributable to an individual measure. This applies particularly for projects in the high-voltage transmission range since both positive and negative network effects can boost or reduce the overall economic impact of a project.

Economic growth in the year of project appraisal (2007) was 21 %. Following an economic crisis influenced by external factors in 2009, a consolidation has been ongoing since 2010. In 2016, growth was at 6.9 %. Economic performance and the government budget are heavily dependent on remittances from Tajikistani migrant workers in Russia, and changes in the international oil price have a direct impact on Tajikistan's economy. Nonetheless, the power supply is also of great importance, with the government expecting a slowdown in economic growth of 1.5-2 % in winter due to electricity shortages, which underpins the project's impact hypothesis. Studies by the World Bank estimate the annual economic losses due to the winter deficit at up to USD 200 million (3 % of GDP). In a study by the EBRD, Tajikistani companies cited the unreliable power supply as their biggest challenge. The Tajikistani economy is energy-intensive by regional standards, not least because of false incentives due to low tariffs. The Talco aluminum smelter in particular, which provides much of Tajikistan's economic output and is the country's largest consumer of electricity, depends on a reliable power supply. At present, this is mainly ensured by the 500kV switchgear at Nurek. The 220kV plant is, however, able to help prevent further losses – particularly in the winter months – and also supply smaller companies with electricity. The FC project mainly supplies the southern part of the country, where two special economic zones were set up in 2008 and 2010, respectively, and more economic development is set to take place in the future. Agriculture, too, relies on an adequate and reliable power supply for irrigation.

The creation of jobs during the construction phase and increasing agricultural production in the region had a direct impact on the income of the population around the hydropower plant. It is plausible that the project is contributing to improved living conditions in the target group. In Tajikistan, the majority of people heat with electricity in the extremely cold winter months, and even the sewage pumps in multi-storey buildings cannot be operated without a power supply. Schools often close in winter if there is no electrical energy to run the heaters. The poverty rate has fallen from 94 % to 31.3 % (2015) since the Tajikistani Civil War, but although the country has improved in the Human Development Index in absolute terms, it dropped from being ranked in position 122 (0.592) in 2007 to 129 (0.627) in 2015 (it should be noted that fewer countries were included in the ranking in 2007 than in 2015: 177 compared to 188). Although it cannot be directly proven that the project has contributed to social development, this can be plausibly assumed.

The indicator for the achievement of the overall objective (impact) covers the climate target area and meets current standards. The basis for the calculation, however, must be revised. The target value of 7 million tCO_2 defined at appraisal is based on the total production of the Nurek HPP and the assumption that this would be covered by imports from Uzbekistan, Kazakhstan and Russia in the event of a failure. Similar to the indicator formulation at outcome level and assumptions at appraisal, a supply of approximately 20 % would have had to be assumed. Therefore, the target value was adjusted for the EPE: avoidance of at least 1.4 million metric tonnes of CO_2 emissions per year.

This target value has not yet been achieved, however, as less electricity than expected has been fed into the grid via the 220kV system since project appraisal – the power output of at least 250MW estimated at appraisal was too optimistic. Since power output over time and CO_2 avoidance correlate directly, this automatically results in a failure to meet the indicator.

Furthermore, the weighted grid emission factor of 0.669 tCO_2/MWh was estimated at project appraisal for the countries from which the energy was sourced, and no positive change expected in the energy mix in these export countries was included in the calculation of the values. In light of the further construction of hydropower plants, Tajikistan's grid emission factor will continue to develop positively, as the import of coal-based electricity will be significantly reduced. It can therefore be assumed that even the revised indicator will not be met in the medium term. Due to the positive climate effects, this is not considered negative here.

Indicator	Status PA	Ex post evaluation
Indicator: Avoidance of at least 1.4 million tCO_2 emissions per year	NA	838,638tCO_2[2] * Grid emission factor estimated/adjusted at EPE 0.425tCO_2/MWh

The project has a broad impact thanks to the introduction of GIS technology in Tajikistan, which had not been used previously. Since the completion of the FC project, the technology has been used in other switchgear plants, including the 500kV switchgear plant in Nurek.

The export of electricity to Afghanistan via the switchgear plant during the summer months had an unintended positive impact; Afghanistan has a supply deficit and imports the majority of its electricity. Therefore, the exports from Tajikistan via the 220kV switchgear plant have also helped improve the summer electricity supply in Afghanistan. Existing power purchase agreements (min. / max. energy: 650GWh / 1,007GWh; min. USD 0.035/kWh; max. transfer capacity 300MW) will generate export revenues (approximately USD 49 million) which are highly relevant for the financial strengthening of the project-executing agency.

There have been no environmental or social concerns associated with the switchgear plant; Nurek HPP itself cannot be assessed as part of the evaluation.

In general, we assume a positive overall impact on the economy and living conditions in Tajikistan. Looking solely at the FC project, the defined climate goals were not achieved. Nevertheless, the climate impact of the operation of the Nurek HPP remains generally positive.

Impact rating: 3

Sustainability

The sectoral conditions in Tajikistan remain difficult (see Efficiency). The executing agency, Barki Tojik, continues to experience financial distress. Reforms have gained momentum lately, but a lengthy restructuring process is still to be expected. An action plan for the reform implementation and restructuring of Barki Tojik is in place, with major donors linking their financing commitments to the implementation of this plan and key reform demands (e.g. ending cross-subsidisation between different operating units). It remains to be seen to what extent these demands will ultimately be implemented in a consistent manner. The division of Barki Tojik into separate units for production, transmission and distribution has been completed, but has not yet been legally concluded. A mechanism for future tariff modelling is currently being developed; the government has promised a gradual, further increase in tariffs of 15 %. The last uniform increase in tariffs of 15 % took place on 1 October 2016.

One positive development is the political rapprochement with Uzbekistan, which hopes for the timely resumption of electricity exchange between the two countries. Similarly, the transnational CASA-1000 power project for Tajikistan, Kyrgyzstan, Afghanistan and Pakistan (currently in tenders for supply and construction works) from 2022 will allow for the stabilisation of sector finances by means of increased summer exports and sufficient winter electricity supply thanks to imports. USD 160-200 million in revenue per year is expected through CASA-1000. One prerequisite here is the transparent use of revenue, which

[2] tCO_2 individual values: 2013: 166,925; 2014: 868,121; 2015: 522,386; 2016: 1,004,321. Based on new grid emission factor.

should be ensured with the support of the World Bank. At the same time, there is a high demand for investment in all areas of the sector due to outdated power plants and grids in need of upgrade. There is no budget for such investments at Barki Tojik, and all projects require external financing and thus the assumption of additional debt. The increase in tariffs for ultimate customers which took place in 2017 is a step in the right direction, but there is still political opposition to a tariff increase. The collection rate is in need of urgent improvement. Initial sub-projects dealing with electricity meters and revenue management, supported by the EBRD and the World Bank, have already led to an increase in the executing agency's revenues. Debt restructuring on the part of the executing agency appears necessary for a fresh start, however. Due to the systemic importance of Barki Tojik, we continue to expect support from the state to maintain operations.

The political leadership has recognised the importance of power supply for economic and social development. However, risks remain with regard to the actual implementation of the reforms and the conversion of the inefficient public supplier into profitable individual companies.

In terms of this FC project, the evaluation gives rise to a positive forecast with regard to sustainable operation. The GIS plant generally has little to no susceptibility to failure, and requires little capital investment in maintenance. The executing agency's operating and maintenance personnel are well-trained and adequate. The construction of the GIS also resulted in the dismissal of operating and maintenance personnel, who are now employed at other sites. The upcoming renovation of the Nurek HPP reduces the risk of a production failure, which can be supplied via the 220kV system. The construction of the Rogun hydropower plant is slowing down silting in the reservoir. The 500kV switchgear plant in Nurek was built as planned, and works in concert with the FC-financed plant. We assume that the switchgear plant can be operated effectively over its service life.

The sustainability analysis for the project therefore arrived at a positive result. However, the sustainability can only be rated as satisfactory overall given the difficult sectoral environment, the poor financial situation of the executing agency and the uncertainty of reform implementation. Based on the correlations described in the Effectiveness section for the expected decline in relevance of the 220kV switchgear plant within the grid as a whole, we also assume that the achievement of objectives at outcome level will be rather lower.

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).