

Ex Post-Evaluation Brief

INDIA: Energy investment programme, Hirakud sub-measure



Sector	23065 (hydroelectric plants)	
Project/Client	Energy investment programme ; 2. Hirakud/Orissa sub-measure – BMZ no. 1993 65 826*	
Programme executing agency	Odisha Hydropower Corporation Ltd. (OHPC)	
Year of sample/ex post evaluation report: 2012/2013		
	Appraisal (planned)	Ex post-evaluation (actual)
Investment costs (total)	EUR 24.80 million	EUR 19.27 million
Own contribution)	EUR 13.14 million	EUR 9.32 million
Funding, of which budget funds (BMZ)	EUR 11.66 million EUR 5.68 million	EUR 9.95 million EUR 5.30 million

* random sample 2012

Short description: In the framework of the “energy investment programme”, German Financial Cooperation funding was used to co-finance the renovation of various hydroelectric plants in India. The Hirakud sub-measure covered the financing of part of the foreign exchange costs for renovating two turbines at the Hirakud hydroelectric power plant in the Indian state of Odisha (called Orissa up to 2011); support included consulting services for quality assurance on site. As a result of these measures, the output of both turbines was increased in both cases from 24 MW to 32 MW. This boosted the total output of the seven machinery sets by 16 MW to 275.5 MW.

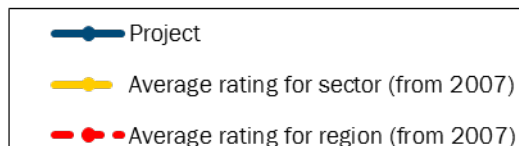
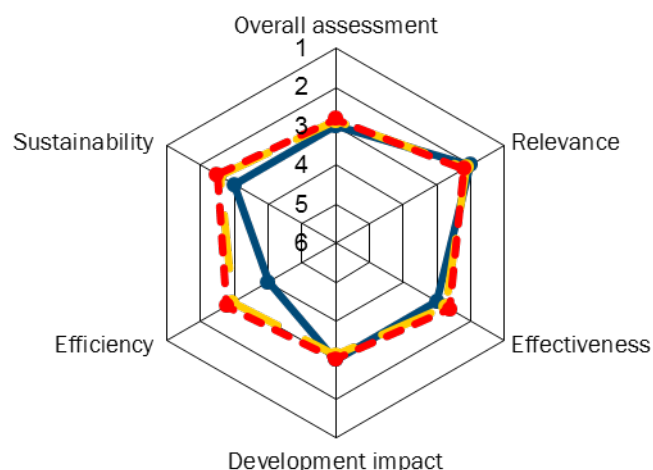
Objectives: The overall objective (impact) of the project is defined as "Contribute to an efficient and environmentally compatible power supply to the overall economy" with the indicators (a) predominantly productive usage, (b) cost recovery in economic terms, (c) reduced system losses and (d) reduced CO₂emissions; the project objective (outcome) was commercially efficient and environmentally compatible purchase of additional electricity produced from OHPC by the grid operator GRIDCO , with the hydroelectric plant's capacity and adequate microeconomic rates of return as indicators.

Target group: Given the customer base, the predominately productive electricity consumers.

Overall rating: 3

The project's overall development impact policy has been satisfactory: positive aspects consist of the contribution to a reliable energy supply in Odisha and climate protection. However, the specific objectives of the project were only met in part, and the previous commitment of the operator to the proper functioning of the plant must be kept at the same level to effectively address impairments in the sustained operation of the facility in technical and organisational terms.

Rating by DAC criteria



EVALUATION SUMMARY

Overall rating

The project addressed an important developmental bottleneck for both India and Odisha. Overall, its developmental impact is satisfactory. Positive aspects consist of the contribution to a reliable energy supply in Odisha and climate protection. However, the specific objectives of the project were achieved only in part: system losses in the state of Odisha are still above 40%. Continued attention is needed in technical and organisational terms to ensure sustainable operation.

Rating: 3

Relevance

Odisha's strong economic growth (more than 500% in nominal terms and about 285% in real terms since 1999) requires a significantly increased energy supply. By aiming at additional power generation in a commercially efficient and environmentally compatible manner, the project is addressing a fundamental prerequisite for development in the state of Odisha. The most pressing problem in Odisha's electricity sector is its ageing distribution grid and system losses stubbornly remaining at about 40%. With hindsight, a German Financial Cooperation approach in this area may have made more sense. However, it must be borne in mind that solving that problem requires significantly higher funding amounts than those available to renovating the Hirakud hydroelectric plant. Without the project, turbines 3 and 4 would probably have had to be shut down, resulting in expensive electricity purchases from neighbouring states as an alternative - until the build-up of sufficient capacity in Odisha. By using a window of opportunity, the renovation maintained and even increased existing capacity in a very cost-effective manner. In addition to the German Financial Cooperation project, the marked economic inefficiencies in Odisha's energy sector at the start of the project were to be addressed by a sector reform programme supported by the World Bank.

The project corresponds to both the German Development Cooperation's and the Indian government's priorities. The project is also consistent with the current BMZ sector concept "*Sustainable energy for development*". The governments of Odisha and India still regard the energy sector as an important catalyst for reducing poverty, achieving the targeted economic growth and for creating employment.

With the future massive expansion of coal-fired power stations and rising prices of fossil fuels, generating electricity in Odisha will become more expensive in future. On this basis and due to the provision of cost-effective electricity from hydroelectric power, the project is justifiable *ex post* in sectoral terms. By expanding and modernising renewable energy providers, the project also contributes to reducing CO₂ emissions. The project has high relevance in terms of global climate protection targets and supports MDG-7 (ensure environmental sustainability). The project is also compatible with India's *National Action Plan on Climate Change* and makes a contribution to achieving the national goal of reducing the greenhouse

gas intensity of the Indian economy by 20-25% until 2020. The project outcome was well-defined and is logically correlated to the overall objective/ impact. In the latter case, however, a clear attribution to the project is more difficult: whilst a contribution is made to providing energy more efficiently, this contribution is very small from a sector perspective and difficult to measure. From a current perspective, the overall objective must therefore be reformulated and take into account the aspect of avoided CO₂ emissions: "Contribute to the efficient and *environmentally compatible* provision of electricity to the overall economy".

Sub-Rating: 2

Effectiveness

The physical outcome of the measures funded by the German Financial Cooperation is the installation of two machinery sets with state-of-the-art technology. With adequate supply of water, an elevated output of 32 MW (compared with the original 24 MW) can be sustained for a further 40-50 years. The implementation objective was, however, only achieved in part.

The amount of electricity generated in an average hydrological year remains around 9% lower than the first indicator's target value. However, the failure to achieve this indicator is primarily due to reservoir sedimentation and not to inadequate operation of turbines 3 and 4. Since the dam was constructed, its storage volume has been reduced by about 25% by siltation. This process is likely to continue at the same rate in future. OHPC has adequate funds for carrying out emergency repairs, but the company needs the supplier's support for larger repairs and the purchase of spare parts. Meanwhile, the tariff paid by GRIDCO for turbines 3 and 4 and the whole Hirakud power plant is not covering costs, and therefore the intended internal rate of return is not being generated.

Despite this, the project's effectiveness is still rated as satisfactory due the provision of cost-effective electricity to cover medium and peak loads.

Sub-Rating: 3

Efficiency

The project increased the installed output of Hirakud by 16 MW without the need for changes to cables, wiring or other construction measures.

Compared with the original estimate, the costs were ultimately lower by the amount of EUR 5.5 million (around 22%); this was partly due to a significantly lower expenses for contingencies. However, there was a slight increase in basic costs of around 6%, which largely resulted from- higher consulting services caused by delays. The specific renovation costs were about 300 EUR/kW of installed output. Measured against comparable renovations, these costs were in the low range. The quality of the facilities supplied is rated as adequate.

Current benchmark figures applicable for German Financial Cooperation energy projects were not complied with in Odisha: energy losses, in particular, range far above the 20% benchmark. Reforms in the sector have, however, resulted in a significant cost coverage increase in the electricity sector and therefore improved allocation efficiency. However, this has not occurred to a sufficient extent at project level. The dynamic electricity generation costs of the turbines renovated through the project are at 1.66 c€/kWh - compared to an average tariff of 1.22 c€/kWh for the Hirakud hydroelectric plant. Accordingly, project-specific cost recovery stands only at about 73%. It must be stressed, however, that the Hirakud hydroelectric plant produces cost-effective electricity and OHPC - as a company - operates economically.

As regards its efficiency in terms of its climate protection impact on the, it should be noted that the dam was built in the 1960s and is also used for flood control and irrigation. It would therefore have a long life even without the renovation. Consequently, the two machinery sets that have been renovated can be classed as emissions-free technology.

When evaluating efficiency, cheap investment, electricity generation and emission reduction costs must be weighed against inadequate cost coverage and high losses in the transfer and distribution system; the latter must be accorded the largest weighting in the overall analysis: accordingly, efficiency as a whole can no longer be rated as satisfactory.

Sub-Rating: 4

Impact

The project contributes to reliable and cost-effective electricity generation, even though at a small and barely measurable scale from a sector perspective. Without the intervention, however, the old turbines would have had to be shut down, and as an alternative expensive electricity purchased from neighbouring states until sufficient capacity in Odisha would have been built. A critical view is taken of the continued high electricity losses of more than 40%.

The relatively high share of the productive electricity usage (about 66%) is indicative of the power sector's role in economic growth and employment in India. The project can therefore have an indirect positive effect on poverty. There is, however, no evidence of any productive jobs having been created through the project as was assumed in the appraisal report.

A further contribution to the overall impact on development policy is in climate protection terms: around 224,400t of CO₂ emissions are prevented without additional costs.¹

Sub-Rating: 3

¹ Compared with an alternative coal-fired power plant in operation, the incremental costs of the renovation measures are around zero based on a discount rate of 10%.

Sustainability

Through the project, foundations for the sustained operation of turbines 3 and 4 have been laid for the next 40 to 50 years. OHPC indicates strong ownership and willingness to maintain the operational capability of the plant. However, there are some technical and organisational problems that have not yet caused any outages but must be addressed urgently to ensure sustained operation in future: For example, there are malfunctions in the management programme (PLC) and issues with the hydraulics system in the intake gates; there are also difficulties obtaining certain spare parts as, according to OHPC, those are not freely available on the market. To address these problems, OHPC has been in contact with the plant supplier, but with no final outcome. The availability of sufficient spare parts should also be ensured for the hydraulic steel structures and switching system – as well as the regular execution of preventative maintenance work. The installation of grills in front of the turbine inlets, as recommended during final inspection inspectors, is now contributing to improved operational sustainability. Despite the positive coverage contribution, the electricity tariff being paid for the Hirakud plant presently does not cover total costs. In the foreseeable future, the project's microeconomic sustainability appears to be assured due to cross-subsidies between the power stations and other income sources for the operator. The latter is due largely to the interest income of the whole group distributed across the individual power stations. There is an upward trend with this other income which - in 2011/2012 - amounted to around 28% for the whole company and to around 30% of the income from electricity sales for the Hirakud plant.

The project is not known to have had any permanent negative social environmental impact. Its hydrological features have become more evident since project appraisal, partly due to increased availability of reliable data. Sedimentation of the storage area will lead to reduced energy production over the long term. In principle, erosion and the impact of erosion can be limited either through planting / afforestation on vegetation-free slopes or through barriers on the river bed. Containment dams can also be built or wash load pumped out. The costs of these measures would not be covered by the additional electricity generated. Without these measures the intensity of flood water would, however, continue to rise as less water can be held in the storage area. In an extreme case, the unsatisfactory level of flood protection could damage the dam facility and cause major damage downstream. It is assumed, however, that relevant risks are being addressed by the World Bank-supported *"Dam Rehabilitation and Improvement Project"* and dealt with accordingly.

Overall the sustainability has been rated as satisfactory.

Sub-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:

1	Very good result that clearly exceeds expectations
2	Good result, fully in line with expectations and without any significant shortcomings
3	Satisfactory result – project falls short of expectations but the positive results dominate
4	Unsatisfactory result – significantly below expectations, with negative results dominating despite discernible positive results
5	Clearly inadequate result – despite some positive partial results, the negative results clearly dominate
6	The project has no impact or the situation has actually deteriorated

Ratings 1-3 denote a positive or successful assessment while ratings 4-6 denote a not positive or unsuccessful 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. Ratings 1-3 of the overall rating denote a "successful" project while ratings 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" (rating 3).