KfW Development Bank

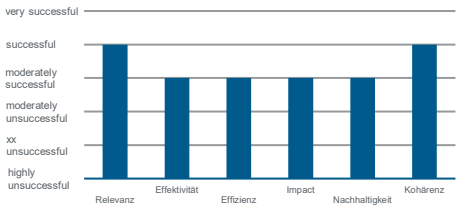
Ex post evaluation of REC Energy Efficiency Programme II, India

Title	REC Energy Efficiency Programme II		
Sector and CRS code	CRS 23		
Project number	2006 66 115		
Commissioned by	Federal Ministry for Economic Cooperation and Development (BMZ)		
Recipient/project-executing agency	Rural Electrification Corporation (REC)		
Project volume/ financing instrument	EUR 70 million / development loan		
Project duration	2008–2016		
Year of report	2022	**Year of random sample**	2019

Objectives and project outline

The objective at outcome level was to increase energy efficiency in electricity distribution (outcome objective) in rural Haryana and in doing so, contribute to promoting economic growth and climate protection (impact level). To this end, existing low-voltage lines were to be modernised and run at a higher voltage (11kV instead of 0.4kV) in order to reduce technical losses as well as illegal connections and the associated electricity theft.

Overall rating:
moderately successful



Key findings

The project was highly relevant and displayed developmental effectiveness while maintaining an acceptable level of sustainability. The project is rated as “moderately successful” for the following reasons:

– A lack of energy efficiency, especially in distribution lines, was a major obstacle for the Indian economy at the time of the project appraisal. The measure was implemented in cooperation with other donors and the Indian partner country and was in line with their objectives.

– However, efficiency and effectiveness were only just barely satisfactory in the implementation. The previously stated objective of reducing power losses to 15 per cent or less was not met. However, the measures were implemented relatively cost-effectively.

– A satellite data analysis has shown a trend towards a beneficial effect on economic growth in the districts where the measures were implemented.

– Although there are indications that the ultimate borrower is recording increased income due to the project, there are doubts about the sustainability if this income is not used for repairs soon.

Conclusions

– By reducing energy losses, power distribution lines can have a long-term beneficial effect on economic growth.

– Satellite data can assist in finding evidence of the impact of the measure on the target group.

– To enhance sustainability, a complementary measure that also takes a long-term view and benefits the partner should be designed.

– Energy efficiency measures work well as a complement to other energy sector projects that promote renewable energy sources.”

Rating according to DAC criteria

Overall rating: 3

Ratings:

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

Relevance

As early as 2002, a report by the International Energy Agency (IEA) noted problems in the Indian energy sector due to high losses in energy transmission and distribution.[1] These were approx. 30 per cent in India in 2001. By comparison, the average for all other non-OECD countries was 14%.[2] The situation in the state of Haryana was similar at the time of the project appraisal in 2008: average aggregate technical and non-technical losses of 31 per cent were found. Overall, the lack of a functioning energy sector with an insufficient energy supply was seen as an obstacle to potential economic growth. In addition to increasing the energy supply, reducing energy losses and thus promoting energy efficiency in the energy supply was and still is a sensible measure. This also effectively counteracted one of the biggest problems in addition to technical losses, namely electricity theft.

The programme proposal originally envisaged financing urban energy efficiency projects in northern Haryana. However, this was changed over the course of the project so that in the end, rural areas in the two northern districts of Haryana were promoted. The reason for this was that pooling two districts reduced transaction costs. The ultimate borrower, Uttar Haryana Bijli Vitran Nigam Limited (UHBVN), was provided with sub-loans to finance energy efficiency measures via a credit line to the state-owned Rural Electrification Corporation (REC), which acted as the project-executing agency. The implementation of these energy efficiency measures includes the supply of agricultural pumps at a modified, higher voltage level – i.e. medium voltage instead of low voltage. The increased voltage also makes illegal power tapping considerably more difficult. The results chain was assumed to be as follows:

Credit line to REC -> forward to UHBVN -> implementation of energy efficiency measures for electricity distribution in the agricultural sector -> reduction in electricity losses -> more reliable electricity supply -> better use of irrigation systems and other technical equipment -> higher agricultural yields -> higher income at household level -> higher economic growth and contribution to climate change mitigation by reducing CO_2 emissions.

Even from today's perspective, the results chain is plausible, assuming that the reduced losses will cause less electricity to be produced and so reduce CO_2 emissions accordingly.

In terms of achieving economic goals, the importance of energy efficiency on the power grid was emphasised by the Indian government in several instances and was part of a long-term strategy.

India began developing an Integrated Energy Policy Plan in 2004. This was approved by the government at the time of the project appraisal (2008).[3] For the first time, this plan brought together all the different parts of the energy sector and developed a holistic vision. An important part of this involved increasing energy efficiency: "The IEP also addresses multifaceted energy problems the country must resolve to

[1] IEA.2002. Electricity in India – providing power for the millions. Paris.

[2] US Energy Information Administration. 2015. India aims to reduce high electricity transmission and distribution system losses, available online: India aims to reduce high electricity transmission and distribution system losses – Today in Energy – U.S. Energy Information Administration (EIA).

[3] IEA. 2012. Understanding Energy Challenges in India, Paris.

ensure efficient and sustainable use of energy".[4] Energy efficiency has also been a key issue since the Energy Conservation Act of 2001, when the Bureau of Energy Efficiency (BEE) was created. The project thus made a relevant, complementary contribution to the partner country's efforts.

Overall, it can be stated that the project was based on a results chain that is still current today, addressed a relevant problem and was implemented in accordance with the partner country's strategy. The criterion of relevance is therefore rated as good.

Relevance rating: 2

Coherence

The project is linked to Financial Cooperation (FC) measure "Energy Efficiency Programme" (Federal Ministry for Economic Cooperation and Development (BMZ) no.: 2005 66 638), which included the establishment of a credit line at REC to increase energy efficiency in electricity distribution in the state of Andhra Pradesh. In this sense, it is a follow-up phase involving the same executing agency but in another state, Haryana. In Haryana itself, other donors support similar approaches to improving energy efficiency in electricity distribution. Overall, the topic of "energy efficiency" was one of the main global objectives of German development cooperation (DC) at the time of the project appraisal.[5] Energy is also a key theme of bilateral cooperation between Germany and India. The specific programme objective of German DC in the energy sector in India is to contribute to a broad-based energy supply that is both technologically and economically efficient as well as environmentally and socially sustainable. The focus is on improving energy efficiency and the use of renewable energies. This is based on the assumption that the greatest possible structural effects can be achieved there by using comparative advantages. Although GIZ also implemented energy efficiency projects in India, it had largely focused on energy customers, i.e. consumers.

As part of international efforts, the project can be classified according to the Sustainable Development Goals and Goal 7: "Ensure access to affordable, reliable, sustainable and modern energy for all". One of the sub-objectives mentioned there is the promotion of energy efficiency. As part of the Millennium Development Goals prevailing at the time of the project appraisal, it can be classified under MDG 7, "Ensure environmental sustainability".

There was some donor coordination with the World Bank. In 2009, the World Bank also allocated funds to strengthen and improve electricity distribution in Haryana. However, the World Bank project concentrated on three districts in southern Haryana, while the project under evaluation ultimately focused on two districts in northern Haryana. Further specific donor coordination could not be identified during the ex post evaluation. This is probably due to the fact that many donors focused on promoting the expansion of renewable energies.

The measure was coherent with the German efforts under the German-Indian partnership and coordinated with the World Bank in Haryana. The coherence criterion is rated as good.

Coherence rating: 2

Effectiveness

Achievement of the objective of increasing energy efficiency at outcome level is summarised in the table below:

Indicator	Status PA, target PA	Ex post evaluation
(1) Technical and non-technical distribution losses	Time of PA: average losses of 31% PA target value: maximum 15%	Approx. 16–25%

[4] IEA. 2012. Understanding Energy Challenges in India, Paris, p. 22.

[5] BMZ 2007: Sector concept: Sustainable energy for development, https://www.bmz.de/de/mediathek/publikationen/reihen/strategiepapiere/konzept145

The only indicator was selected and populated on the basis of the Indian R-APDRP (Restructured Accelerated Power Development and Reform Programme), which was rolled out from 2003 onwards. Among other things, this programme aimed to reduce technical and commercial electricity losses in heavily deficient distribution companies from over 30 per cent to 15 per cent.

From today's perspective, the choice of the indicator appears to be understandable, especially because it was selected on the basis of the R-APDRP programme. Due to the lack of precise baseline values at the start of the project, it is not possible to precisely quantify any reduction. The lack of baseline data may have led to an overambitious target for reduction, as this depends directly on the initial value before the start of the project. During the project implementation, the power company Uttar Haryana Bijli Vitran Nigam Limited (UHBVNL) did not collect any data at the level of the individual projects. A cost-benefit analysis prepared by Deloitte on behalf of UHBVNL was therefore used as part of the project completion report for the project. For a grab sample of 15 individual projects (four of which were financed under the REC II project), a loss reduction of 13% on average was determined. No other data were available in the project completion report or during the evaluation, so the target achievement cannot be clearly specified at the time of the ex post evaluation (EPE). However, the following indications suggest that the distribution losses at this point in time are greater than 15% and the indicator was not achieved:

- The total technical and commercial distribution losses of UHBVNL amounted to 24.8% at the time of the EPE. This includes the agricultural sector losses;
- As in other Indian states, energy costs for agricultural use are subsidised in Haryana. As part of a negotiation process between the government of the state and the two distribution companies in Haryana, a loss of 16% was agreed for the agricultural sector. It can be assumed that the actual losses are within the range or slightly higher.

In addition to the indicator above, additional indicators would have been desirable but cannot be obtained retrospectively due to a lack of data. Examples of these include the frequency of malfunctions in the newly installed transformers, and the monitoring of and reduction in cases of power theft. However, no such information is available. In the case of reducing electricity theft, it can at least be assumed that this was almost completely achieved for two reasons:

1. Switching from 0.4kV low-voltage to 11kV medium-voltage power made it difficult to tap electricity from the line.
2. Relocating end consumers' electricity meters to the transmission towers has generally reduced the incentives for electricity theft, as a household now pays for the electricity delivered directly to the line. Even if electricity were then diverted from a neighbouring household, the original electricity consumer household and not the UHBVNL would still have to pay for it. This means that electricity theft by households from UHBVNL is no longer possible. It is now only possible among households but is considered to be unlikely.

Overall, it should be noted that the target of reducing technical and non-technical losses to below 15% with estimated loss values of 16–25% was missed, but is still below the level at the project appraisal stage. At the same time, there are signs that other project objectives, such as reducing electricity theft, have been achieved. Effectiveness is therefore rated as only just satisfactory overall.

Effectiveness rating: 3

Efficiency

The investments were estimated at EUR 90 million during the project appraisal in 2008, of which EUR 70 million was to be financed via a low-interest loan. Ultimately, all individual projects financed under the credit line amounted to approx. EUR 86 million. The costs were therefore slightly below the planned value. The financing of a complementary measure via a grant of EUR 0.5 million was also originally envisaged. However, with the exception of one consulting service, this was not called upon and the funds were almost completely cut back. The reason for this is that the initial focus was supposed to be on supporting the introduction of a clean development mechanism with the partner. However, this was no longer desired by the executing agency at the time of implementation.

The investment costs financed the following:

- the switch from 0.4kV low-voltage lines to 11kV medium-voltage lines totalling 4,365km in length in rural regions
- the replacement of 49,087 distribution transformers and
- relocating end consumers' electricity meters to transmission towers

The financed investment measures are considered standard investments in the Indian context. During the project appraisal, no technical alternatives to the HVDS (high-voltage distribution system) were discussed and it was no longer possible to determine within the scope of the EPE whether alternatives had been considered by UHBVNL.

The slightly lower costs are surprising in that some delays occurred during the course of the project. While a construction period of six months had originally been assumed, it ultimately took a total of 26 months before the measures were completed. These were procured at a very low price level following a local tender in India. However, this was accompanied by a very low quality in the installed products and services provided. Although it was not possible to bring the line losses to the target level (see Effectiveness criterion), they decreased by around 10 percentage points. This suggests that production efficiency is still satisfactory.

Statements on allocation efficiency are difficult. Taking into account a reduction in losses of around 10 percentage points (see Effectiveness criterion), these can be allocated to the reduced costs per power unit, in principle. Theoretically, these drop by approx. 33 per cent. Comparatively, this is a reasonable but not outstanding value in terms of allocation efficiency. Application of this scenario to potential CO_2 savings is discussed under the “Impact” criterion.

Overall, the efficiency criterion is rated as satisfactory.

Efficiency rating: 3

Impact

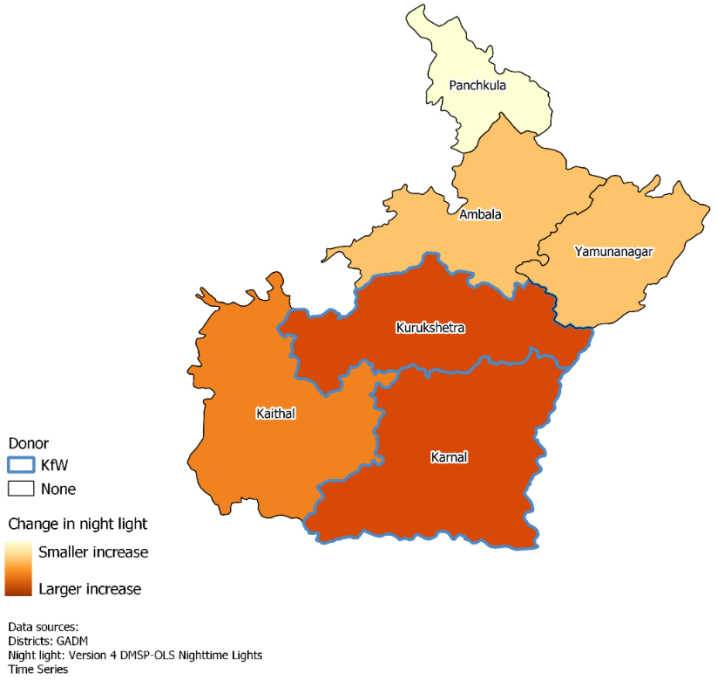
The development policy objective of the FC measure was to contribute to promoting economic growth and climate change mitigation by increasing energy efficiency in electricity distribution in rural Haryana (impact objective)

Contribution to promoting economic growth

No indicator was set for the “Promoting economic growth” objective. This is understandable because it is difficult to identify causality for an FC contribution to such an indicator. Nevertheless, there are some indications that this type of positive contribution exists. This assessment involved both interviews with beneficiaries and the analysis of satellite data. The households and farmers who benefited from the measures mentioned anecdotally that the electricity supply was more reliable than previously. They quantified an average increase in crop yields of around 20–25 per cent over the course of the measures. Although these absolute figures should be treated with caution, this would mean a significant positive impact.

The satellite data were analysed to validate the results. These were based on the fact that the FC measures were originally to be implemented in all the northern districts of Haryana. Ultimately, however, they were only implemented in two out of six districts, namely Kurukshetra and Karnal, so that these two districts can be compared with the other four districts in the north where no FC measures took place. A comparison of the FC project regions prior to the completion of the construction measures in 2010 with the year of the project completion report in 2013 shows that an increase in economic activity in the districts of the FC projects can be assumed when measured in terms of nocturnal light intensity. This follows the scientific evidence that increased light intensity correlates with increased economic activity. This does not answer the causal question of what impact the FC project had in this context. Nonetheless, on average, there are signs of a positive trend in the FC project regions.

Change in Nightlight 2010 - 2013 in selected districts of Haryana, India



The downside of the improved electricity supply and increased productivity is an increased demand for water, combined with state-guaranteed purchase prices in profitable rice production. The increased agricultural water demand, which in some places leads to a sharp drop in the groundwater level, among other things, is an increasing problem that UHBVNL and the government of the federal state are aware of. UHBVNL has already declared certain areas in Haryana to be so vulnerable that no new irrigation systems will not be connected to the grid and existing systems will not be equipped with more powerful motors there. Various stakeholders seem to be aware that rice cultivation is not sustainable due to the groundwater situation.

Contribution to climate action

The achievement of the measure's objective of contributing to climate action can be quantified as follows:

Indicator	Status PA, target PA	Ex post evaluation
(1) Avoidance of 150,000t p.a.of CO_2 emissions	N/A	Less than 150,000t p.a.

The objective of contributing to climate action is quantified by the indicator on the avoidance of 150,000 metric tonnes of CO_2 emissions per year compared to a business-as-usual scenario without any measures. Although there are no precise data available, it can be assumed that the target has not been achieved. During the EPE discussions, it became clear that the project's loss savings were in the area of approx. 10 percentage points. The total consumption in the project region can thus theoretically be converted to an energy value that results in CO_2 savings. However, this is offset by the project-induced increase in energy consumption. This is because the more reliable electricity supply led to an increase in electricity demand. As India has a large share of fossil fuels in the energy mix in order to meet the growing demand for energy, this ultimately did not lead to the avoidance of CO_2 emissions compared to a situation where there was no rehabilitation. The project-executing agency UHBVNL confirmed this qualitative assessment. In principle, the increased energy efficiency compared to a business-as-usual scenario can be

the basis for future CO_2 savings. But these savings can only materialise when the energy mix in India changes as planned.

Overall, the development policy results for the target group and its economic development are to be regarded as positive, while the climate impacts are rated as neutral or unfavourable. The “impact” criterion is therefore rated as satisfactory.

Impact rating: 3

Sustainability

All installed systems and components were functioning at the time of the EPE. At the same time, the expected useful life for standard HVDS investments is 20–25 years; this is not expected to be achieved in the present case due to the poor quality of the components and the low to poor quality of the implementation (construction work and installation). According to the technical expert, a service life of 10–15 years is more realistic. The random sample of plants chosen for on-site inspections have been in operation for 8–9 years. They were functional but in a comparatively poor technical condition. Rust was found on the equipment, some of the plants were manufactured poorly and with inferior materials and the safety clearance between live lines and people was insufficient. This drastically increases the likelihood of accidents. The poor quality and lack of maintenance indicate a reduction in the maximum possible functionality of the equipment in terms of time. Furthermore, a visit to UHBVNL’s repair and storage site revealed that there is a risk of environmental damage due to transformer oil leaching.

Although nominally high standards apply to the execution of construction work in REC-financed projects, REC saw no opportunity in its role as a financier to encourage UHBVNL to comply with higher technical standards during implementation. The funds of the complementary measure in the amount of EUR 0.45 million (the amount that remained after EUR 0.05 million had been used for measures in connection with a previous project) would have been most useful for training and strengthening UHBVN institutions in matters of quality assurance and control in tendering and building different facilities in order to achieve a lasting effect.

The energy supply model for farmers is heavily subsidised at 84 per cent. This makes it impossible to operate the energy supply economically. However, this is a constant problem for utilities in the Indian context. It is assumed that the subsidies will continue to exist and that the energy supplier will therefore be sustainable.

In this context, the project had a positive impact on the financial situation of the supplier, UHBVNL. The supplier now has a billing efficiency of around 90 per cent compared to 72.4 per cent before the start of the project. In turn, this increased billing efficiency has an impact on revenues and can thus also free up money for the maintenance of in-house systems and components.

Overall, sustainability is only just rated as 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**, **coherence**, **effectiveness**, **efficiency**, **impact and sustainability**. The ratings are also used to arrive at a **final assessment** of a project's 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 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 development objective ("impact") **and** the sustainability are rated at least "moderately successful"
(level 3).