KfW Development Bank

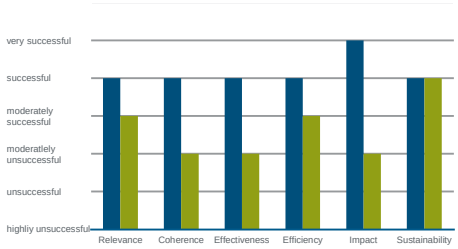
Ex-post evalution
Energy effciency in public buildings, infrastruktur and energy intensive sectors, India

Title	Energy efficiency in public buildings and infrastructure (phase II) (EESL I) / in energy intensive sectors (EESL II)		
Sector and CRS code	EESL I: energy policy and -administrative management (23110) / EESL II: demand-side efficiency (23183)		
Project number	EESL I: 2010 66 265; 2010 70 366 (accompanying measure) / EESL II: 2015 67 981		
Commissioned by	Federal Ministry for Economic Cooperation and Development (BMZ)		
Recipient/Implementing agency	Energy Efficiency Services Limited (EESL)		
Project volume/ financing instrument	EESL I: 50 million euros / EESL II: 200 million euros (interest-reduced loans)		
Project duration	EESL I: 2014 to 2021; EESL II: 2017 to 2024		
Year of report	2024	**Year of random sample**	2024 (EESL I)

Objectives and project outline

At the outcome level, the objective was a more efficient use of energy in selected energy-intensive sectors in India. At the impact level, the objective was to achieve a more sustainable, technically and economically efficient, socially and environmentally friendly energy supply in India. To this end, investments in efficient LED household and street lighting systems as well as four photovoltaic systems were financed. The accompanying measure served to further build up and support EESL as project executing agency. The project has been implemented in two phases. The phase II loan volume was only partially disbursed.

Overall rating:
Successful/moderately unsuccessful



Key findings

The evaluation of the two phases led to different results. While phase I is rated as successful, phase II is rated as moderately unsuccessful, due in particular to its limited effectiveness and limited impact.

- While the relevance of the first phase was high due to the high demand of the direct and indirect target groups for energy-efficient lightning, the relevance of the second phase decreased especially due to reduced demand and overfunding of EESL by various donors in the lightning sector. This is due to insufficient donor coordination, which also led to a moderately unsuccessful rating of phase II coherence.
- The planned outputs and impacts of phase I were exceeded. Fully utilising the total loan amount of phase II loan would have allowed for much higher outputs and impacts.
- A major weakness of both phases was that the indicators were based on model data. As a result, the real behaviour of users and the actual energy savings induced by the financed measures in the lighting sector are only inadequately reflected. This tends to overestimate energy and emissions savings.
- The achieved price reductions for LED lamps under phase I have far exceeded expectations for impact.
- The monitoring of the disposal of replaced lamps was largely omitted, which was a weak point in both phases.

Conclusions

- Pooling demand for energy efficiency technologies can lead to significant price reductions and to broad impacts beyond the scope of the project.
- For projects that intend to increase demand-side energy efficiency, de facto measured instead of modelled energy consumption reflects the actual achieved effects more adequately.
- Relative, technology-specific energy savings and absolute energy savings in combination can be adequate indicators.
- If equipment containing harmful substances, is replaced, careful monitoring of the disposal is indispensable in order to minimize the risk of possible environmental damage.

Ex post evaluation – Rating according to DAC criteria

Overview of rating

	EESL I	EESL II
Relevance	2	3
Coherence	2	4
Effectiveness	2	4
Efficiency	2	3
Impact	1	4
Sustainability	2	2
Overall rating:	**2**	**4**

List of abbreviations

ADB	Asian Development Bank
AFD	Agence Française de Développement
AK	Final Inspection (Abschlusskontrolle)
BEE	Bureau of Energy Efficiency
BMZ	Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung
CFL	Compact fluorescent lamp
CIM	Centre for International Migration and Development
DAC	Development Assistance Committee
DC	Development Cooperation
DKTI	German Climate Technology Initiative
EESL	Energy Efficiency Services Limited
EHSS	Environmental, Occupational Health & Safety, and Social
EPE	Ex post evaluation
ESIA	Environment and Social Impact Analysis
EUR	Euro
FC	Financial Cooperation
FZ E	FZ Evaluation
GNP	Gross national product
GW	Gigawatt
GWh	Gigawatt-hours
IEA	International Energy Agency

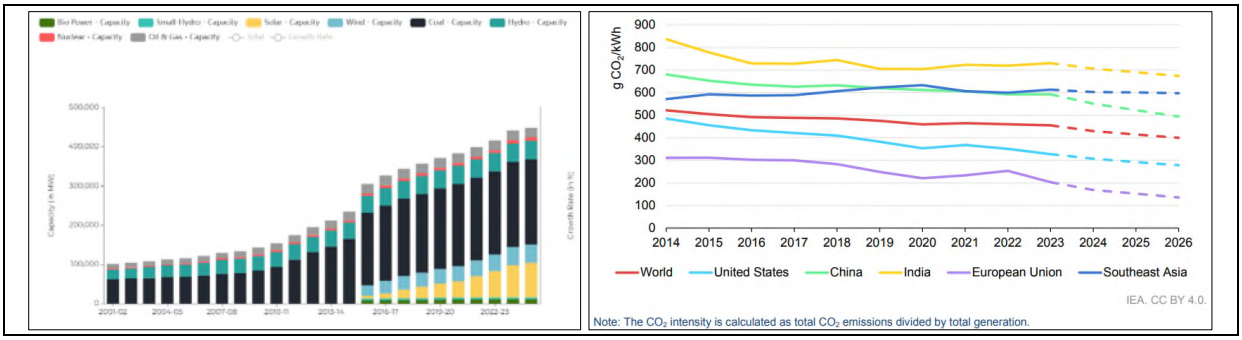
IGEF	Indo-German Energy Forum
IKLU	German Climate and Environment Initiative
kWh	kilowatt-hours
LED	light-emitting diode
MDGs	Millennium Development Goals
MSEDCL	Maharashtra State Electricity Distribution Co. Ltd
MV	Project Appraisal Report (Modulvorschlag)
MW_p	Megawatt (peak)
MWh	Megawatt-hours
NAPCC	National Action Plan on Climate Change
NDCs	Nationally Determined Contributions
NMEEE	National Mission on Enhanced Energy Efficiency
PA	Project appraisal
PV	Photovoltaic
SDGs	Sustainable Development Goals
SECO	Swiss State Secretariat for Economic Affairs
SLNP	Street Light National Programme
TWh	Terawatt-hours
TC	Technical Cooperation
UJALA	Unnat Jyoti by Affordable LEDs for All
USD	US Dollar

Overall context

India is the world's fourth largest producer and consumer of electricity in absolute terms after China, the USA and the European Union. At the same time its specific per capita consumption is very low due to its population of around 1.4 billion. Against the background of population growth and solid economic growth, a strong increase in energy demand is forecast with a corresponding increase in CO_2-emissions. The resulting negative environmental and climate impacts pose major local challenges for India and are of significant global importance.

Both the electricity generation capacity installed in India and the Indian electricity consumption have been growing steadily in recent decades (with the 2020 exception due to the COVID-19 pandemic). Installed electricity generation capacity increased from around 100 GW (2001/2002) to around 448 GW in 2024. Electricity consumption grew seven-fold from 1991 to 2023 to around 1,400 TWh.[1] The International Energy Agency (IEA) expects electricity consumption to increase further by more than 6 % annually from 2024 to 2026 (in these three years this is the current annual electricity consumption of the United Kingdom). In addition to expected economic growth, the reasons cited are the sharply increasing spread of air conditioning systems.[2] The IEA estimates that around 68 % of electricity generation will continue to be based on coal in 2026 (compared to 74 % in 2023). Against this background, India has one of the highest CO_2-intensities in the power generation sector in the world (see Figure 1).

Figure 1: Installed electricity generation capacity in India and CO_2-intensity of the electricity generation sector in India



Source: left: Climate and Energy Dashboard; right: IEA: Electricity 2024 - Analysis and forecast to 2026, S. 69.

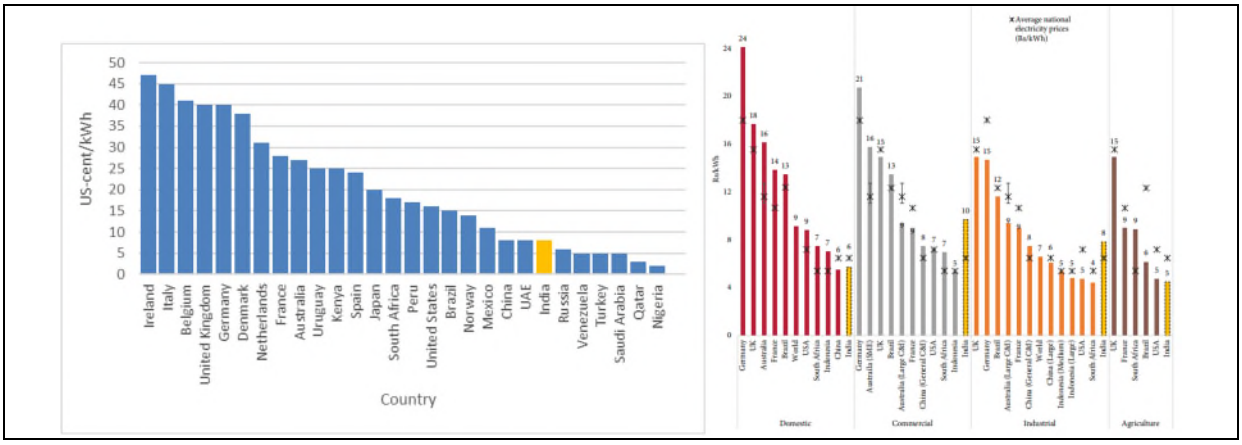
India's energy saving potential is untapped and potential annual savings are estimated at around 17 % of total electricity generation in 2019, according to the Asian Development Bank (ADB). This is particularly due to low electricity prices. Electricity prices in India vary within the country and tend to be in the lower range compared to other countries for household customers at around 8 $cents_{US}$/kWh (Figure 2).[3] Taking into account that a) the procurement costs on the Indian wholesale electricity market alone amounted to around 6,8 $cents_{US}$/kWh in 2023, which according to IEA were roughly twice as high as in 2019 due to high demand and relatively scarce supply, and b) the additional transmission and distribution costs, electricity prices are mostly not cost covering. Electricity prices thus provide little incentive to save energy on the demand side.

1 Data from: India Climate and Energy Dashboard Installed Capacity mix (niti.gov.in).

2 See IEA: Electricity 2024 - Analysis and forecast to 2026 (iea.blob.core.windows.net); p. 9 and 93f.

3 For a detailed overview see e.g. Gokarn/Tyagi/Tongia: A Granular Comparison of International Electricity Prices and Implications for India; CSEP Working Paper-30, June 2022: A-Granular-Comparison-of-International-Electricity.pdf (csep.org), or: Statisa: Electricity price by country 2023 | Statista.

Figure 2: Comparison of electricity prices for households worldwide in 2023 (left) and for different sectors in 2019 (right)



Sources: left: Data from Electricity price by country 2023 | Statista, right: Gokarn/Tyagi/Tongia, p.13.

The project under evaluation consisted of two phases. Phase I (BMZ No. 2010 66 265) was implemented between 2014 and 2021 and included an accompanying measure (BMZ No. 2010 70 366). Phase II (BMZ No. 2015 67 981) was started in 2017 and ended prematurely in 2022 due to the effects of the COVID-19 pandemic and an update of the EESL business strategy. Both phases were used to finance LED lamps in the household sector. While in Phase I LED public street lighting was also financed, in Phase II smaller photovoltaic systems on substations of a power distribution company in addition to LED lamps for households were financed. Despite the similar activities, the two phases are assessed as much as possible separately below. The present evaluation must be based on a data base which is in part only marginal, since more extensive data could not be obtained with reasonable effort.

Project summary

Under the two phases of the project, credit lines were provided to the state-owned company Energy Efficiency Services Limited (EESL) to structure, finance and implement energy efficiency measures. The aim of both phases was a more efficient use of energy in selected energy-intensive sectors in India. Phase I financed investments in nine different individual projects: (a) five street lighting projects, where municipalities replaced traditional streetlights with LED lights; and (b) four projects in cooperation with electricity distribution companies, where households in several locations received energy-efficient LED lights. As part of an accompanying measure, various measures were implemented to build up and strengthen EESL. In Phase II, the activities in the household component continued and photovoltaic (PV) systems were built in selected substations of an energy supply company. The PV systems serve agricultural customers. The target group of the two phases of the project are public and private institutions that want to carry out investments in energy efficiency with the involvement of energy service companies (ESCOs). The indirect target group of the project is the electricity consumers in the respective project regions.

Total costs

The investments were financed by means of loans at reduced interest rates, the accompanying measure of Phase I was financed by a budgetary grant (Table 1).

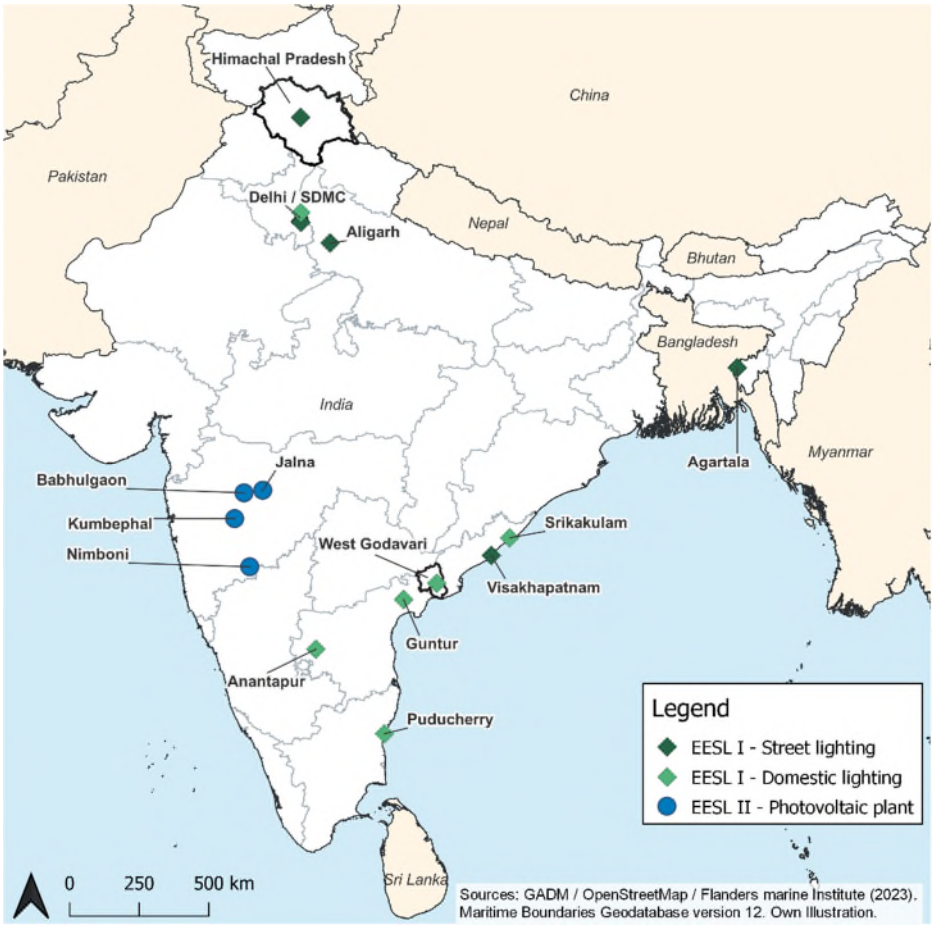
Table 1: Total costs

In millions of euros	EESL I (Phase I)				EESL II (Phase II)	
	Inv. (plan)	Inv. (actual)	AM (plan)	AM (actual)	Inv. (plan)	Inv. (actual)
Investment costs (total)	**60**	**69.5**	**1.5**	**1.43**	**240**	**16.67**
Counterpart contribution	10	19.5	0	0.19	40	7.15
Debt financing	50	50	1.5	1.24	200	8.88
of which BMZ budget funds	*50*	*50*	*1.5*	*1.24*	*200*	*8.88*

Map of the project country incl. project area and locations

Figure 3 shows the project areas and project locations of the project.

Figure 3: Map of the project country incl. project area and locations of lighting measures of phase I and the PV-plants of phase II



Source: Own illustration, map base see map legend.

Rating according to OECD-DAC criteria

Relevance

1. Alignment with policies and priorities

India's energy and electricity consumption forecast at the time of the project's assessment increased significantly, which is still the case at the time of the evaluation (see section "Overall context"). In order to meet the demand, it was and is not only important to expand production capacities, but in particular to increase energy efficiency on the demand side. This reflected Indian policy, including through the Energy Conservation Act of 2001 (completed in 2010 and 2022), the then five-year plan (2012-2017) and the adoption of the National Mission on Enhanced Energy Efficiency (NMEEE) in 2010.[4]

In addition to increasing potential savings in street lighting, among other things, one of the NMEEE's priorities was the development of a market for energy services[5] by ESCOs.[6] This reflected the project's design. In addition, both phases were consistent with the national programmes "Unnat Jyoti by Affordable LEDs for All (UJALA)"[7] and "Street Light National Programme (SLNP)"[8] launched in 2015. In March 2023, the Government of India adopted four new energy efficiency directives for energy applications in the household sector, in order to contribute to India's CO_2-emissions savings target in this sector. The financing of PV installations in substations of electricity distribution companies for solar power supply to agricultural consumers was included in the national programme 'PM-KUSUM' and in the programme 'Mukhyamantri Saur Krushi Vahini Yojana' of the State of Maharashtra.[9] At the United Nations Climate Change Conference 2021 (COP26), India announced that it would become climate neutral by 2070. In the Nationally Determined Contributions (NDCs), updated in August 2022, India committed to reducing its gross national product (GNP) emission intensity by 45 % by 2030.[10] The project is thus aligned with India's policies and priorities both at the time of conception and at the time of the evaluation.

The project was implemented as part of the German Climate and Environment Initiative (IKLU) and the German Climate Technology Initiative (DKTI). In both phases, it contributed to the then DC-programme target in the energy focus of Indo-German cooperation, among other things through the intended CO_2-emission reductions. This also applies to the DC programme "Sustainable and Inclusive Energy Transition India", which was in force at the time of the evaluation. The aim of the project was in line with the sector concepts of the BMZ at the time, namely "Sustainable Energy for Development".[11]

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4 The "National Mission for Enhanced Energy Efficiency (NMEEE)" is one of so-called "Missions" of the "National Action Plan on Climate Change (NAPCC)".

5 Formally, the concept of 'energy service' is defined inter alia in EU Directive 2006/32/EC, and in simplified terms, an energy service is the advantage resulting from the use of energy-efficient technologies and/or measures aimed at saving or using primary energy more efficiently. An energy service is provided on the basis of a contract, is guaranteed by the supplier and is verifiable.

6 For the ESCO-concept see e.g., Energy Service Companies (ESCOs) – Analysis - IEA. Energy Service Companies (ESCOs) generally offer (large) energy consumers comprehensive services on the subject of energy, such as planning, financing, implementation and support of energy saving measures. According to the NMEEE, the successful implementation of the ESCO model in India was subject to considerable restrictions. In particular, these were limited access to adequate financing, as the service companies concerned were usually unable to provide collateral security as required by Indian banks. Further restrictions on market development included high transaction costs in preparing and implementing relatively small energy efficiency investments, the lack of public procurement guidelines and adapted models for ESCO contracts, and appropriate methods for measuring and verifying energy savings.

7 See: UJALA - Energy Efficiency Services Limited.

8 See: https://energyportal.in/energy-efficiency/street-lighting-national-programme-slnp.

9 See e.g.: National Portal for PM-KUSUM und Maharashtra State Electricity Distribution Co. Ltd. An analysis of the programme in Maharashtra was carried out by the Institute of Rural Management Anand, Gujarat: A-Quick-Assessment-of-the-Mukhyamantri-Saur-Krishi-Vahini-Yojana-MSKVY-in-Maharashtra-IRMA-1.pdf

10 In addition, by 2030, 50 % of cumulative electricity generation capacity will be based on non-fossil energy resources. India aims for carbon neutrality by 2070, see: NDC-India.

11 See (i) Strategy paper of BMZ „BMZ Concept 145 – Sector Concept Sustainable energy for development" (01/2007) and (ii) BMZ-Information: „ Sustainable energy for development" (01/2014).

Furthermore, the objective of the project then and now is in line with (a) the current objective of the German Federal Government to protect the global climate and the environment, (b) the priority "Renewable Energy and Energy Efficiency" agreed within the framework of Indo-German development cooperation, and (c) the current core thematic strategy "Responsibility for our Planet - Climate and Energy" of the BMZ (action areas 1 "Climate Protection and Adaptation to Climate Change" and 2 "Renewable Energy and Energy Efficiency").[12] The core thematic strategy envisages meeting the growing energy demand with a climate-neutral energy supply and contributing to a complete net decarbonisation of the energy sector by 2050. In addition, the project's objective is and was in line with the then goals of the Millennium Development Goals (in particular MDG 7 'Securing Environmental Sustainability'), the Sustainable Development Goals (in particular SDG 7 'Affordable and Clean Energy' and SDG 13 'Climate Action'), the Paris Climate Agreement of 2015 and the corresponding follow-up agreements, as it aims at reducing greenhouse gases and saving energy at impact level.

2. Alignment with needs and capacities of persons concerned

A core problem was not explicitly stated in the respective project appraisal reports of the individual phases. Implicitly, the low efficiency at the level of final energy use for selected consumer groups and the underdevelopment of a market for energy services, while at the same time a very high market potential for energy efficiency measures, are described as major problems. While the lack of efficiency in energy end-use remains a key issue at the time of the evaluation, the shortcomings of an Indian energy services market are not, from today's perspective, a key factor in India's more sustainable energy supply and use.

The target group of the two phases of the project are public and private institutions, which want to carry out investments in energy efficiency with the involvement of ESCOs (phase I) or investments in energy efficiency in cooperation with EESL as an energy services company (phase II). In addition, the project executing agency, which was established in 2009 as an ESCO, should be strengthened and further institutionalised as part of the accompanying measure of phase I. The indirect target group of the project are all electricity consumers in the respective project regions.

EESL's direct customers included municipalities and electricity distribution companies (DISCOMs): municipalities have incentives to cooperate with EESL to use electricity savings to renew street lighting and improve its service quality.[13] Electricity distribution companies can use the distribution of energy-saving LED lamps to decrease electricity supplies to households and sell the respective electricity to customers with higher electricity tariffs. EESL can achieve price reduction effects by bundling purchases of LED lamps and then passing them on to its partners. End-users have an incentive to implement energy efficiency measures through potential savings depending on energy consumption and energy costs. However, incentives are highly dependent on the related costs of energy efficiency technologies and the financial savings potential. The latter is in India mostly rather low because of the very low electricity tariffs, especially for household and agricultural customers. With around 28 % of household electricity consumption for lighting, the replacement of conventional lamps (around 60 W per lamp) with LED lamps (around 7-9 W per lamp) offered a high technical savings potential. The incentive for DISCOM to implement decentralised PV systems lies in the avoidance of losses in upstream networks and thus in cheaper power procurement for feeding into the power distribution networks.

Vulnerable or disadvantaged parts of the indirect target group (population in the project regions) were not explicitly taken into account in the design of the project. However, by providing a free exchange of conventional lamps for LED lamps in phase I, poorer parts of the population were also able to benefit from the project, even if their financial benefits appear to be negligible due to the low electricity consumption and the low cost savings that this entails. Phase II enabled customers to pay for LED bulbs in instalments via the electricity bill. This mechanism also allowed lower-income households to purchase LED lamps.

According to the United Nations, work still needs to be done in India to achieve gender equality.[14] The energy is historically a male-dominated sector.[15] When designing the project no negative effects on gender equality were expected. Therefore, no specific measures to promote gender equality were foreseen. However, it was agreed with the project executing agency to develop guidelines on social standards as part of the accompanying

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12 BMZ Thematic core strategy: „Verantwortung für unseren Planeten – Klima und Energie" as of June 2021.

13 In 2013, street lighting accounted for around 1.5 % of India's total electricity consumption of around 8.5 GWh. The share of municipal spending on lighting in India varies between 10-15 %.

14 On the basic state of women's rights in India, see, inter alia Country Fact Sheet | UN Women Data Hub.

15 See Gender and Energy Data Explorer – Data Tools - IEA.

measure. In general, women in particular can be expected to benefit from improved, more efficient street lighting.[16] Overall, the project's design should be considered gender neutral. Supporting gender equality strategies within EESL would have allowed positive gender effects to be achieved earlier (see also chapter "Effectiveness").

3. Suitability of project concept

Both phases of the project were based on a theory of change, which was slightly adapted during the evaluation: on the one hand, energy efficiency measures are implemented in selected sectors through the provision of financing for energy efficiency measures and the strengthening of the personal and technical capacities of EESL under the Phase I accompanying measure (input) and, on the other hand, EESL is in a position to offer corresponding energy services on the market as a professional energy service company (output). Thus, (i) concrete energy saving effects should be achieved and (ii) EESL should carry out other economically viable energy services (Outcome). As an overarching development effect, greenhouse gas emissions are reduced and price reductions for selected energy efficiency technologies (LED lamps) are achieved, so that India's energy supply is more sustainable, technically and economically efficient, social and environmentally friendly (impact).

In principle, the concept was appropriate in order to contribute to the solution of the core problem. During the appraisals of the two phases of the project, the underlying assumptions were accurately presented retrospectively. Ex-post adjustments to the objectives and indicators were made. In principle, EESL, which was founded in 2009, was chosen as the appropriate project executing agency. It should be noted however that in the selection process, the financial viability that EESL has to provide as an ESCO was underestimated at the outset (see also chapter "Sustainability").

Both phases of the project were rated with an ESIA identifier 'B'. It has been assumed that possible negative effects can be largely avoided by appropriate standard measures. The accompanying measure should enable EESL to carry out ESCO projects efficiently and effectively and support other ESCOs in their investments. EESL was also supported in integrating environmental and social standards into the project cycle. Classification in ESIA category B also appears appropriate at the time of the evaluation.

4. Reaction to changes / adaptability

The design of both phases envisages investments in sectors with significant energy saving potential. Examples include public infrastructure/buildings, agriculture and households (phase I) and, in addition, industry (phase II). The eligibility criteria for individual investments were defined as (i) a final energy saving of at least 20 % and (ii) an internal rate of return of at least 10 %. Individual decisions for further projects have been authorised. These conditions gave the project a high degree of adaptability to changes in the market for energy efficiency.

During the implementation of Phase I, no adjustments had to be made to the original project design. In the course of the implementation of Phase II, the initial focus was significantly changed: street lighting projects were not financed as expected, as, among other things, large funds from other donors[17] were available (and used by EESL), the demand from municipalities was overestimated and there was a change in the financial risk appetite of EESL in the context of municipal street lighting projects. Some of EESL's public customers were unable to meet their payment obligations to EESL, or were late in doing so, so EESL refrained from expanding the (donor-funded) street lighting programmes. As an alternative, the project looked at ways of financing PV systems to strengthen DISCOMs and the supply of agricultural customers. In particular, due to delays in procurement processes (due in part to the COVID-19 pandemic) as well as changes in the economic environment (partly due to significantly higher prices for PV modules after the pandemic), only around EUR 8,9 million of the initially planned loan amount of EUR 200 million was disbursed by the end of the disbursement period set out in the contract. Subsequently, India and Germany jointly decided not to extend the disbursement deadline and to terminate the project prematurely. In addition to the reduction of the FZ loan, loan contracts between EESL and AFD and the World Bank[18] were not fully called up.

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16 See also the evaluation results of a comparable AFD project: Evaluation summary Ex-Post Decentralized Evaluation – CIN 1070 Energy Efficiency India.pdf.

17 See chapter on „Coherence".

18 See: IEG Review Team: India - India Energy Efficiency Scale-up Program (English). Washington, D.C.: World Bank Group. World Bank Document.

Rating Summary

Both phases of the project were stringently aligned with Indian and German policies and priorities. The first phase of the project was highly relevant at the time of the planning due to (i) the low efficiency in energy use, especially in the areas of domestic lighting as well as street lighting and (ii) EESL's need for support at its early stage of development. Due to the reduced demand for efficiency measures in the public and private lighting sectors, the supply of additional donor funds and the change in EESL's commercial policy, the design of Phase II of the project was no longer as relevant as Phase I, despite the envisaged flexibilization possibilities. The project's basic design was based on the core problem and was fundamentally capable of contributing to its solution. Overall, the relevance of Phase I of the project is assessed as successful. Although the relevance of Phase II was still given at the time of appraisal, this changed during implementation. Therefore, the relevance of Phase II is assessed as moderately successful.

Relevance: EESL I: 2 / EESL II: 3

Coherence

5. Internal coherence

Both phases of the project were part of the respective valid country strategies and contributed to the achievement of the objectives of the Indo-German development cooperation programmes in the energy sector valid at the time of the respective appraisals. They will also be integrated into the current DC programme / country strategy at the time of the evaluation. The project is also in line with the activities and objectives of the Indo-German Energy Forum (IGEF)[19].

The Indo-German bilateral cooperation in the energy sector involves a large number of projects within the framework of both technical and financial cooperation. The Technical Cooperation (TC) supported in particular the Indian Bureau of Energy Efficiency (BEE) which, under the auspices of the Ministry of Power, is developing policies and strategies based on the Energy Conservation Act[20] with the aim of reducing the energy intensity of the Indian economy. These are then to be implemented by EESL, among others. Specifically, a CIM (Centre for International Migration and Development) expert in EESL was appointed as part of the TC, and she was taken over as a member of staff in 2015. Existing potential synergies between FC and TC activities were exploited.

The implementation of the project is in line with the 2015 Paris climate agreement and subsequent agreements. At the time of the planning of Phase I, there was neither a binding human rights concept nor the corresponding BMZ guidelines, which were published in 2011 and 2013 respectively, and they were taken into account as part of Phase II, where relevant.

6. External coherence

EESL was founded in 2009. The project's FC loan was the first international loan granted to EESL. At the time of the planning of Phase I, there were no other international donors specifically cooperating with EESL. The World Bank planned (i) a project supported by the Global Environment Facility to finance cooling devices and (ii) in cooperation with a further Indian partner a risk fund, which was intended inter alia to secure investments for potential EESL customers. Based on the success of the first phase of the FC project, EESL has also received further loans from the World Bank, Agence Française de Développement (AFD) and Asian Development Bank (ADB). These projects were implemented during the period of phase II of the FC project. However, coordination was insufficient: international donors overestimated the pipeline of viable energy efficiency projects, so that, for example, only around 77 % of the AFD loan was used, and only 85 % of the World Bank's. No comprehensive donor coordination has been or is taking place on a broader level. In the implementation of Phase II of the project, international donors did not use harmonised reporting, procurement, environmental and social standards. This entails the risk of allocating existing EESL investment projects to donor loans, which have lower environmental and social standards. A more realistic project design in this regard would have been possible according to the evaluation mission.

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19 For further information see: The Indo-German Energy Forum | India Energy Partnership.

20 See: BUREAU OF ENERGY EFFICIENCY, Government of India, Ministry of Power.

EESL provided substantial own contributions. They represented 28 % (phase I) and 43 % (phase II) of the respective investment volumes (see also Table 1). The subsidiarity principle is therefore respected.

Rating summary

The project complemented and supported India's own efforts and made use of existing national structures. Both phases of the project were integrated into the country strategies, the focus on energy and the current DC programmes, complemented the commitment of the DC instruments and were characterised by synergistic cooperation between FC and TC, especially during phase I (high internal coherence). At the beginning of Phase I, there was no significant need for coordination with other donors. The coherence of Phase I is therefore considered successful. The external coherence of phase II is insufficient due to the lack of coordination with the relevant international donors at the time, and the potential for using common systems or standards has not been exhausted. Overall, therefore, the coherence of Phase II is assessed as moderately unsuccessful.

Coherence: EESL I: 2 / EESL II: 4

Effectiveness

7. Achievement of (intended) goals

The objective adjusted in the evaluation for both phases of the project was a more efficient use of energy in selected energy-intensive sectors in India. The number and formulation of the initial indicators selected at project appraisal were partially adjusted and refined for both phases during the evaluation. The achievement of the targets at the outcome level can be summarised as shown in Table 2 (Phase I) and Table 3 (Phase II).

Table 2: Target achievement at outcome level – Phase I

Indicators	Status at PA	Target value at PA/EPE	Actual value at final inspection	Actual value at EPE
1: average reduction in final energy consumption by EESL investments in energy efficiency measures financed by the project	0 %	50 %	80 %	80 % (on average 54 % for street lighting projects and 86 % for household lighting) Indicator fulfilled
2: Net return from ESCO operations of EESL (including all ESCO-related costs and overheads)	-	> 0 % no later than five years after the first disbursement of the FC loan	> 0 %	> 0 % Indicator fulfilled

Table 3: Target achievement at outcome level – Phase II

Indicators	Status at PA	Target value at PA/EPE	Actual value at final inspection	Actual value at EPE
1: average reduction in final energy consumption by EESL investments in energy efficiency measures financed by the project	0 %	45 %	82 % (on average 85 % for household projects and 20 % for solar energy installations)	82 % (85% on average for household lighting and 20% for solar power plants) Indicator fulfilled
2: Net return from ESCO operations of EESL (including all ESCO-related costs and overheads)	-	> 0 %	10.11 % (no year given)	2020: 7 % 2021: 3 % 2022: -13 % 2023: -23 % Indicator not fulfilled

8. Contribution to goal achievement

Within phase I, a total of nine lighting projects were financed by EESL. This includes five street lighting projects with municipalities and four household lighting projects in cooperation with electricity distribution companies at different locations. A total of around 6.3 million household LED lamps and around 390,000 streetlamps were financed. The accompanying measure provided training to the EESL staff on key aspects of the ESCO business and supported them in active market and project development as well as project implementation. Overall, the planned Phase I outputs were fully achieved.

The output outlined in the design of phase II was achieved qualitatively, but not quantitatively. Based on phase I around 9.8 million old lighting devices were replaced by LED lamps and in addition four decentralised solar power systems with a total capacity of around 10.2 MWp were installed. This achieves the defined output indicator (energy efficiency measures with energy savings of at least 20 % and a positive cash flow are implemented), but a much higher output could have been achieved in case of a fully utilised the loan.

Indicators 1 (phases I and II): reduction of final energy consumption

The energy saving effect in the lighting projects results from the reduction of the capacity of the lighting means while at the same time preserving or improving the lighting quality. In the household sector, old light bulbs with a capacity between 37 and 70 W have been replaced by modern LED lights with a capacity of 7 W. The weighted average of the replaced old lamps was calculated to a capacity of around 50 W. The calculated saving effect for the same useful life (assumed to be approximately 3.5 hours per day for 300 days per year) was approximately 85 % (electricity consumption for lighting before replacing the lamps: 744 GWh, after replacing 104 GWh). In the area of street lighting, conventional high-pressure vapour lamps with a (weighted) average capacity of approximately 119 W were replaced by LED lighting systems with a (weighted) average capacity of approximately 55 W in the various regional sub-projects. This corresponds to a saving of around 54 % (energy consumption previously around 184 GWh, after replacement around 85 GWh) for the same useful life (assuming an average of 11 hours on 365 days per year).

It should be noted critically that the calculations are based on simple modelling rather than fully measured values. The modelling neglects, for example, the exact usage behaviour by the end customers. Only at the beginning of the project a small sample was used to measure the length of time the new light bulbs were used. It was determined that the illumination time in the households was similar to that prior to the replacement of the lighting device. In addition, for household LED lamps, the energy savings achieved also depend in particular on whether (a) the distributed/sold LED lamps replace old light bulbs or compact fluorescent lamps (CFL) lamps or (b) the new LED lamps are additionally used in the household and/or are used for longer periods (rebound effect). At the beginning of phase I, LED lamps were only supplied to households in exchange for old lighting means. In the further course of the implementation, the LED lamps were only distributed and were no longer replaced. According to information provided, this was due to the high political pressure of the implementation of the UJALA project. Against this background, the extent of the rebound effect cannot be specified, but it is likely to play a not insignificant role. The evaluation was not able to determine whether and to what extent only old, 60 W incandescent bulbs or also 13-15 W CFL lamps were replaced, with consequently a considerably lower saving potential. However, an independent study of the entire UJALA programme in three different cities from 2017 suggests this effect.[21] On the positive side, at least at the beginning of the project, awareness campaigns for households were carried out by the electricity distribution companies in the distribution of LED lamps in order to inform the population about the benefits of LED lamps.

During phase II, around 9.8 million LED lamps were sold to households (in cooperation with electricity distribution companies). There has been no direct replacement of old bulbs with the new LED bulbs. Overall, a saving of 50 W per LED lamp was assumed (replacement of an old lamp with an average capacity of 59 W by a 9 W LED lamp). This corresponds to a modelled saving of 82 % per lamp exchanged. With an assumed daily service life of 7 hours, energy savings of around 1,272 GWh were calculated during the final check. However, the assumption of 7 hours per day is considered too high from the evaluation point of view, e.g. the UNFCCC methodology assumes 3,5 hours per day.[22] A significant rebound effect can also be assumed in phase II, which overall leads to

[21] See Understanding the impacts of India's LED bulb programme, "UJALA", p. ix.

[22] See inter alia CDM: Demand-side activities for efficient lighting technologies --- Version 8.0 (p. 9): If the assumption deviates from 3.5 hours of use per day, a continuous measurement over a period of 90 days is prescribed. The UJALA programme study has estimated a useful life of 4-6 hours.

an expected lower than modelled actual energy savings. At the same time, it is critical to question why, in contrast to phase I, a doubling of the useful life was originally expected. Overall, as regards phase II of the project, the specific energy saving objective (indicator 1) has been achieved as the indicator was formulated as a relative size, i.e. as a percentage. Nevertheless, due to the only fragmentary disbursement of the loan the effectiveness achieved in absolute values remains far below expectations.

Overall, it can be assumed that the majority of LED lamps are still in use, both in the household and street lighting sectors. Even low-quality LED lamps in the domestic sector are assumed to have a useful life of 15,000 hours, which in the case of the above-mentioned usage behaviour means far more than 10 years of service life with decreasing but still acceptable light quality. It remains critical to note that systematic and representative project-based monitoring or validation (both actual energy savings values and assumptions for framework conditions) has not been carried out for the beneficiaries of the LED lamp programmes.

The evaluation did not identify any concrete, recent data to calculate the energy savings from PV installations installed in phase II on or near substations of the power distribution company Maharashtra State Electricity Distribution Co. Ltd (MSEDCL). The plausible calculations made as part of the consulting mission at the final inspection were used. The calculated savings are achieved through decentralised feed-in at substation level by avoiding losses at the transmission level up to the 11-kV-level (around 14 %) and around 6 % in substations themselves. This results in a total saving of around 20 %.

Indicators 2 (phases I and II): net return

The report of the final inspection mission and related consulting reports indicate that the net returns on ESCO activities of EESL are positive. Specific data are missing or had been provided without an indication of the year. As part of the evaluation, EESL provided relevant data for the years 2020 to 2023. On the basis of these data (excluding overheads), the return in these years is consistently positive. However, due to the sharp increase in overheads in 2022 and 2023 and their pro-rata allocation to ESCO activities, the net return on ESCO activities, including overheads, deteriorates significantly and turns negative in these two years. Phase I indicator is expected to be reached five years after the first disbursement, i.e. for 2019/2020. The net return, including overheads, is positive for this period and therefore the indicator is considered to be fulfilled. Phase II indicator was met in 2020 and 2021, but not in subsequent years, as in those years the net return is negative, taking into account overheads. This is due, among other things, to effects outside the scope of the project (including the COVID-19 pandemic).

The evaluation of the UJALA programme cited above, based on household surveys, finds that 47 % to 73 % of households have purchased a LED lamp only because of the support of the UJALA programme (see also Figure 5 in the “Sustainability” chapter). This suggests that the evaluated project implemented under the UJALA programme has contributed to the achievement of the objectives. A differentiation into different customer groups, e.g. according to age, income, gender, etc., was not made during the survey.

EESL itself did not have an explicit gender strategy at the time of planning, but it will be submitted to the Board for adoption at the time of evaluation. In 2017, an "Environmental, Occupational Health & Safety, and Social (EHSS) Manual" was adopted, which includes explicit measures to promote women. A "Gender Action Plan" was developed in cooperation with the Asian Development Bank (ADB). A first gender report was published in 2019, the same year EESL joined the WePOWER network.[23] In 2019, the share of women employed by ESL was 15 %, which was significantly higher than the average of other Indian public enterprises (10.2 %). On the basis of the five-year plan, a 25 % rate should be reached by 2023. However, at the time of the evaluation, the proportion of women was only around 11 %.

9. Quality of implementation

As part of the evaluation, a visual inspection of selected street lighting systems took place. The street lighting inspected was installed to the satisfaction of the municipally responsible institution, and the municipality was also satisfied with the maintenance. An analysis of the failure rates of the LED household lamps in the UJALA programme shows failure rates between two and 14 percent. Due to the weather conditions, an on-site visit could

[23] WePower is a voluntary women’s professional network in the energy and power sector in South Asia that supports women's participation in energy projects and institutions and promotes normative change regarding women in Science, Technology, Engineering, and Mathematics (STEM) education.

not be carried out to examine the installed PV systems on the premises of the power distribution company. However, the on-site visit carried out during the final inspection in summer 2023 showed that the PV installations visited were of high quality.

The project monitoring could mostly only be carried out remotely due to the COVID-19 pandemic-related travel restrictions during phase II. However, this also had weaknesses. More precise monitoring would have been necessary in order to detect irregularities in the implementation of the PV measures: it could have been noticed that two of the four PV plants were installed outside the fenced area of the substations in a different way than planned. This would have meant that potential retroactive environmental and social impact aspects for these sites should have been examined more closely. Concerning the monitoring it should also be noted critically that it was no longer possible during the evaluation to precisely understand in what form the LED lamps were actually distributed to households (with or without replacement for the previous lighting means) and whether and how the exchanged lighting means were disposed of properly.[24]

10. Unintended effects (positive or negative)

Neither positive nor negative material non-intended effects could be identified during the evaluation. It should be noted that the evaluation did not make it possible to ascertain whether the disposal of the replaced old lamps was carried out correctly.

Rating summary

The project was able to meet all its objectives at the outcome level, in particular in the first phase. In phase II, the planned relative reduction in energy consumption was achieved, but the absolute values fall far short of expectations due to the low use of funds. Overall, it is critical to note that the calculations of energy savings in the household and street lighting sectors are based only on modelling and no real energy consumption data was used. Any changes in usage behaviour, e.g. at household level, are therefore not covered. It is plausible to assume that the real energy savings are lower than those modelled. Due to high overheads for 2022 and 2023, a positive net return on the EESL-ESCO business was only achieved until 2021 and therefore the target for the respective indicator of phase II was not met. In principle, the quality of the implementation was good, more precise monitoring would have been helpful. Overall, the effectiveness of Phase I is assessed as successful, while that of Phase II is assessed as moderately unsuccessful.

Effectiveness: EESL I: 2 / EESL II: 4

Efficiency

11. Production efficiency

Contrary to the plan, the total costs of phase I for specific project activities increased from EUR 60 million to EUR 69.5 million. The additional costs were financed by increasing the contribution of the project executing agency from EUR 10 million to EUR 19.5 million. The costs of the accompanying measure decreased marginally. The consultancy costs of the first phase, amounting to EUR 1.43 million, were covered by the accompanying measure. At around 2 % of the total cost, they were below that of comparable projects in the international context. The total costs of phase II were estimated at EUR 240 million at the design stage, but in fact only EUR 16.7 million were incurred. 53 % of these were financed by the FC and 47 % by the executing agency. Consultancy services were not foreseen in phase II.

The energy efficiency projects within the two phases have been efficiently implemented. The procurement was made through public tenders, which generally showed a high degree of competition. Bulk procurement of lighting equipment achieved large economies of scale and contributed to a significant drop in the prices of LED lamps and LED street lighting (see also chapter “Impact”).

[24] In principle, India has regulation of e-waste, see 1035e_eng.pdf and also CPCB | Central Pollution Control Board.

While there were only minor delays during Phase I, Phase II was characterised by significant delays. In line with AFD's experience[25], this concerned both the implementation of lighting measures and the procurement of photovoltaic systems: In view of the lack of a sufficient pipeline for lighting projects and an adaptation of EESL's general business strategy, the partners of the project agreed to focus more on the financing of PV systems with the aim of loss reduction of electricity distribution companies in the supply of agricultural customers.[26] However, the related bidding processes were heavily influenced by the COVID-19 pandemic, which led to significant price jumps for PV installations. As a result, several rounds of bidding were necessary to cover costs.

12. Allocation efficiency

The project aimed at increasing energy efficiency in the use of energy in selected sectors and building an ESCO market. The focus was on street lighting, household lighting and in phase II on solar power supply for agriculture and the associated avoidance of power transmission and distribution losses. This was appropriate both at the time of the design of the project and at the time of the evaluation. The achievable savings through improved lighting are cost-effective compared to alternative energy saving measures, e.g. in other, less homogeneous sectors. An alternative design of the project could have envisaged the commercialisation and distribution of LED lamps through private actors such as lamp manufacturers or distributors. However, it is doubtful that this alternative approach could have enhanced equivalent effects and/or achieved them more cost-effectively with the existing resources.[27] A further alternative approach of achieving analogue savings or improving the supply of electricity through purely demand-side energy efficiency measures or increasing the supply of electricity through the construction of new power plants appears to be less cost-effective even without specific calculations. Overall, it is reasonable that no alternative measures could be identified with the available resources at the time of the design of the project to achieve the intended results and effects. This is also considered to be understandable retrospectively.

EESL has provided proportionally significant own resources. The use of public funds to achieve the desired effects therefore seems justified. It is also important to note that it does not appear efficient to subsidise energy efficiency measures by public funds to compensate for the lack of incentives for energy efficiency measures resulting from subsidised low electricity prices.[28]

Rating summary

Sowohl die Produktions- als auch die Allokationseffizienz beider Vorhaben ist positiv. Insgesamt wird die Effizienz der beiden Phasen dennoch unterschiedlich bewertet: Während die Effizienz der Phase I als erfolgreich einzustufen ist, wird die Effizienz der Phase II als eingeschränkt erfolgreich bewertet. Grund dafür sind die erheblichen, insbesondere COVID-19-Pandemie bedingten Verzögerungen, die dazu führten, dass die Effizienz unter den Erwartungen liegt. Analog der Bewertung des Kriteriums der Effektivität wird der geringe Mittelabfluss im Rahmen der Phase II an dieser Stelle nicht berücksichtigt.

Efficiency: EESL I: 2 / EESL II: 3

Impact

13. Overarching (Intended) developmental changes

The objective, slightly adapted in the context of the evaluation, for both phases of the project at impact level was a more sustainable, technically and economically efficient, socially and environmentally friendly energy supply in India. Achievement of the objectives through the indicators reformulated and partly shifted from outcome to impact level in the evaluation can be summarised as shown in Table 4 (phase I) and Table 5 (phase II).

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25 The evaluation of the AFD project also showed significant delays in its implementation, see: Evaluation summary Ex-Post Decentralized Evaluation – CIN 1070 Energy Efficiency India.pdf

26 See EESL-Annual Report 2022/2023: DSPPP - Energy Efficiency Services Limited and A. Ghambir / S. Dixit: Solar-Agricultural-Feeders-in-Maharashtra.pdf (April 2019).

27 See for example also results from an evaluation of a comparable project in Morocco (in German).

28 See also comments on low electricity prices in various parts of the report.

Table 4: Achievement of the objective at impact level – Phase I

Indicators	Status at PA	Target value at PA/EPE	Actual value at final inspection	Actual value at EPE
(1) Reduction of CO_2-emissions	0	PA: 25,000 t CO_2 p.a. EPE: 600,000 t CO_2 p.a.	600,000 t CO_2 p.a. (2018)	605,964 t p.a. (2018) Indicator fulfilled
(2) Price reductions of a. LED lamps (6-9 W) b. LED streetlights	a. 0 % (2014) b. 0 % (2014)	PA: n.a. EPE: a. 50 % (2018) b. 50 % (2019)	n.a.	a. 87 % (2018) b. ~ 80 % (2019 and 2024) Indicator fulfilled

Table 5: Achievement of the objective at impact level – Phase II

Indicators	Status at PA	Target value at PA/EPE	Actual value at final inspection	Actual value at EPE
(1) Reduction of CO_2-emissions	0	PP: 1,000,000 t CO_2 p.a. EPE: 2,000,000 t CO_2 p.a.	1,041,675 t CO_2 p.a. (according to final inspection)	605.000 t p.a. Indicator <u>not</u> fulfilled
(2) Price reduction of LED lamps (6-9 W)	0 % (2015)	50 % (2019)	n.a.	62 % (2019) Indicator fulfilled

14. Contribution to overarching (intended) developmental changes

Impact is measured by two indicators: First, the reduction of CO_2-emissions as part of the environmental component of sustainability (indicators 1). The reduction is directly derived from energy savings (see chapter “Effectiveness”). Second, the price reductions for LED lamps (in the household and street lighting sectors) resulting from the bulk purchase of LED lamps on the Indian market. These effects on price reductions are reflected in indicators 2.

<u>Indicators 1</u>

Upon the final determination of the measures to be financed in phase I, the CO_2-emissions target was correctly adjusted. The quantities are obtained by multiplying the amount of energy saved (see chapter “Effectiveness”) by the corresponding specific CO_2-emissions per amount of energy produced (in kg CO_2/kWh). Calculations in concrete projects was based on the average Indian grid emission factor of 0.82 kg CO_2/kWh, as published by the Indian Central Electricity Authority. This is a high value by international comparison and is due to the high proportion of coal-fired electricity in the Indian grid. Although the value can vary depending on the specific project location, an average is plausible for comparability. Overall, in phase I, calculated CO_2-emissions savings amounted to around 606,000 tons (around 87 % through household activities and around 13 % through street lighting projects). The target value was thus achieved by calculation, but the same basic considerations and limitations apply as those already stated in the calculation of the modelled energy savings amounts (see chapter “Effectiveness”).

During phase II, around 9.8 million LED lamps were distributed. Contrary to the assumption made in the report of the final inspection, the evaluation assumes a daily life of LED lamps based on the study of the UJALA project of 5 hours on 300 days per year. On the basis of the above-mentioned Indian grid emission factor of 0.82 kg CO_2/kWh, emissions reductions of only about 602,000 t CO_2 p.a. are therefore achieved for the lighting component. Added to around 2,300 tons of CO_2-emissions savings per year from the installed photovoltaic systems[29],

[29] The total annual production of the four plants is around 14.2 GWh. It is assumed that the local PV power generation and feed-in to the so-called "solar feeders" will prevent electricity losses of 20 %, i.e. around 2.8 GWh p.a. Only these loss reductions and not the total amount of solar power generation are included in the calculation of the avoided CO_2-emissions,

the project will generate emissions savings of around 605,000 tons of CO_2-emissions per year. This is well below the measured target value of the initially planned volume of loans, which is due in particular to the only low disbursement of the FC-loan.

Indicators 2

Prices for LED household lamps were relatively high at the start of phase I. By bundling demand in the context of various tenders for LED lamps, EESL was able to use its market power and induce corresponding price reductions. The high level of demand induced by the project, among other things, has guaranteed high volumes for the producers, which in turn have enabled the lower offer prices. The evolution of prices of household LED lamps in EESL tenders is shown in Figure 4.

Figure 4: Price developments LED household lamps in the context of EESL tenders

Source: data EESL, own illustration.

Whereas the procurement prices of LED lamps in January 2014 (phase I) and January 2015 (phase II) were around INR 310 and INR 104 per LED lamp, they fell to around INR 39 by June 2018 and to around INR 40 by August 2019. In the last tender up to the time of the evaluation, the purchase price fell to around INR 38,5. Between 2014 (phase I) and 2015 (phase II) and 2018 and 2024, the price reductions were around 87 % (phase I) and 62 % (phase II), respectively. This represents a significant over-achievement of the indicator targets, in particular for phase I. This price reduction effect is not only beneficial to the participating beneficiaries of the project. Market prices for LED lamps throughout the Indian market have fallen from around 595 INR (January 2014) to 110 INR (August 2019), according to the report of the final inspection. This shows that all consumers benefit from EESL activities. This effect is mainly due to the UJALA project.[30] EESL's energy-efficient household lighting programmes, some of which were initiated and financed by the project evaluated here, have contributed significantly to the increased market penetration and diffusion of energy-efficient lighting. Phase I also developed broader impact through its pilot character, which attracted funding from other donors to the whole UJALA programme through ESL.

as the agricultural water pumps would not be operated, so the additional PV power generation does not lead to the displacement of additional generation.

30 See also the publication of the analysis of the UJALA programme by A. Chunekar: Impact of India's large-scale LED bulp programme, June 2019: (PDF) Impact of India's large-scale LED bulb program.

Particularly vulnerable, mostly rural, consumer groups, will not benefit from these effects, or will benefit only negligibly due to their low electricity consumption for lighting and the high prices for LED lamps compared to their disposable income.

Price data for LED streetlamps were not available to a comparable extent. According to EESL, the purchase price for an LED streetlamp was around 10,000 INR in early 2014 and fell to around 2,000 INR by 2019. In February 2024, a tender resulted in procurement prices of 800 - 2,300 INR for various LED lamps with a capacity between 18 and 110 W. As a result, a price reduction of around 80 % was achieved between 2014 and 2019, according to the data, which is well above the target indicator value.

15. Contribution to overarching (unintended) developmental changes

It is plausible to assume that the project has contributed to a reduction in road accidents and to an increase in safety by improving street lighting and by preventing robbery and further criminal offences. While the evaluation did not provide quantitative calculations, beneficiaries claimed that improved street lighting allowed longer opening hours for stalls, which generated additional revenue. Furthermore, it can be assumed that the improved lighting quality in households leads to positive health effects and enables improved learning. Overall, it can be assumed that Phase I in particular showed high development additionality.

The evaluation did not identify or quantify any specific adverse environmental impacts caused by the inappropriate disposal of replaced compact fluorescent lamps containing mercury. However, it can be assumed that those lamps that were not disposed of centrally in the replacement process were not disposed of properly. The failure to take account of actual disposal and the lack of monitoring in this regard are a weak point of the project.

Rating summary

Phase I of the project significantly exceeded the respective targets for the overall development impact, both in terms of CO_2-emission savings and price reductions achieved for LED lamps. The measures in phase I of the project have been instrumental in bringing about a sharp drop in LED lamp prices for all Indian consumers. This was due to the bulk purchases of EESL on the Indian market. Phase I of the project was characterised by a high degree of widespread effectiveness. While further price reductions were achieved under phase II, the contribution of phase II of the project is considered to be very small. The target for CO_2-emission savings, as initially agreed, was missed by a wide margin. The decisive factor, as in other criteria, was the only very small disbursement of the FC-loan, which is taken into account when assessing the impact. In summary, the overarching developmental impacts of phase I are considered very successful despite the lack of information on the disposal of the old lamps, while phase II is considered moderately unsuccessful.

Impact: EESL I: 1 / EESL II: 4

Sustainability

16. Capacities of persons concerned

The LED lamps distributed to the target group in the two phases do not require maintenance in the narrower sense. Even simple variants have a durability of 15,000 switching processes and a utilisation time of at least 15,000 hours. For the maintenance of the street lighting systems financed by the project, EESL and the participating municipal utilities or the municipally responsible institutions have concluded contracts with special maintenance companies for a period of 7 years. According to EESL, until the time of the evaluation there was no negative experience with the maintenance of the street lighting. However, due to the longer technical duration of the systems, there is a sustainability risk after the initial maintenance contracts have expired. The maintenance and reinvestment extension agreements are the responsibility of the respective municipal utilities, whose financial strength depends on external factors and the respective budget allocations. EESL is currently working on so-called Smart Street Lightning concepts, which enable intelligent control of individual streetlights and extend any necessary maintenance intervals.

According to EESL, the maintenance of the PV installations installed during phase II is going well and major outages with the need for replacement investments did not occur until the time of the evaluation. Overall, the

impression was given that EESL generally has a high level of ownership and motivation with regard to the implemented measures and their effect.

EESL's staff demonstrate high levels of ownership and professional capacity. However, financial aspects as well as human resources are fundamental challenges for EESL. According to EESL, it does not have sufficient expertise to implement and expand the planned activities, which entails a risk for the basic EESL activity.[31] The actions under the two phases of the project have been completed and are no longer subject to this risk.

The financial risk of the street lighting measures should be assessed differently. On the one hand, the maintenance and reinvestment of these sub-projects after the initial maintenance contracts have expired will depend on the financial capabilities of the locally responsible institutions. This has an impact on the sustainability of the measures financed by the project. In the course of the project, it was also clear that EESL's original business model was in part subject to high financial risks. Some of the loans granted to the municipal institutions were or are not serviced for longer periods, which led to high outstanding debts and liquidity problems for EESLs.[32] This was one of the reasons for the redesign of EESL's business model and a drastic reduction of street lighting measures in cooperation with municipal institutions.

17. Contribution to support for sustainable capacities

Prior to the project appraisal of the phase I, EESL did not have fully sufficient practical experience necessary for the implementation of ESCO projects. However, the first pilot projects in the areas of street lighting and water pumps in agriculture were being implemented at project appraisal. EESL was focused on building up its ESCO business. With the support of an FC-funded consultant, a comprehensive business plan for this business area had also been drawn up before project appraisal. In addition, a large number of measures for EESL's reinforcement were carried out within the scope of the accompanying measure. In cooperation with other donors, EESL has set up a Sustainable Development Unit and developed gender plans and other social and environmental standards. According to EESL, there were no incidents related to sexual assault in the fiscal year of 2022-2023. No further information in this respect became known during the evaluation.

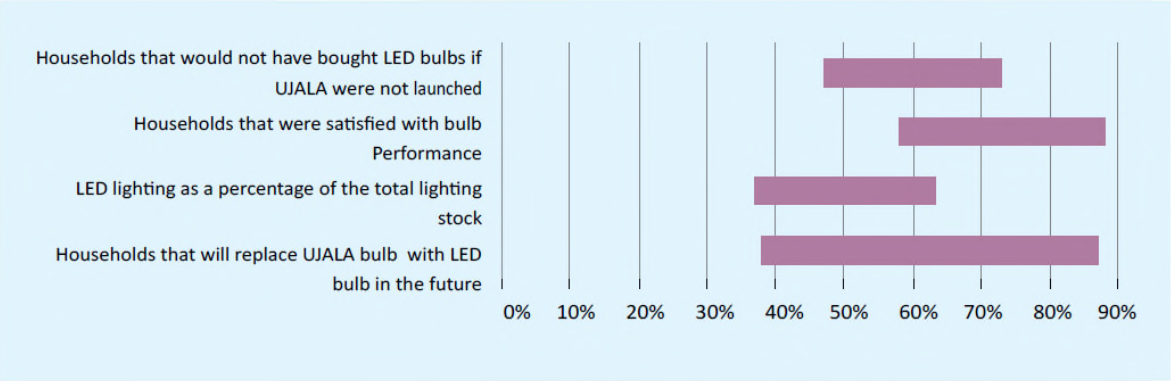
EESL's overall business has expanded significantly since its inception. EESL is also active as ESCO after the completion of both phases of the project and has a strategy to aggregate demand for different products or energy efficiency solutions in order to reduce prices as far as possible. The main focus is currently on high-efficiency fans and air-conditioning systems, smart meters and electric buses, etc.

18. Durability of effects over time

The study on the UJALA programme already cited above showed, among other things, that between around 40 % and 87 % of household customers who received a LED lamp in the programme want to replace it with an LED lamp even after the programme has expired (see Figure 5). This gives reason to assume that the effects of the project will continue after the technical lifetime of the household LED bulbs. In view of the cost savings to be achieved by municipal institutions through the use of LED lighting systems, it is reasonable to assume that they will continue to use modern, energy-efficient technologies after the end of the technical lifetime of LED lighting systems. A prerequisite would be sufficient funding.

[31] See EESL Annual Report 2022/2023, p. 38.
[32] See EESL Annual Report 2022/2023, p. 39.

Figure 5: Results of a household survey on the effects of the UJALA Programme



Source: A. Chunekar / S. Mulay / M. Kelkar: Understanding the impacts of India's LED bulb programme, "UJALA", S. viii.

The development of electricity prices in India has a significant influence on the sustainability of the effects. Electricity prices in India do not (yet) cover costs in many sectors (see chapter "Overall context"), which reduces incentives for the efficient use of electricity. By contrast, higher electricity prices lead to higher incentives for implementing energy efficiency measures in the private and public sectors. This can increase the demand for EESL services and lead to a more sustainable power supply system overall.

Rating summary

The installed technologies require low maintenance, so far no significant losses have been disclosed. The staff of EESL shows a high level of ownership and professional capacity. There is a risk to the ongoing and future activities of EESL in terms of financial and human bottlenecks, which do not, however, concern the actions financed under the project. A survey of user groups in the household sector has shown that between around 40 % and 87 % purchase LED bulbs even after the completion of the project. Overall, the sustainability of both phases can be assessed as successful.

Sustainability: EESL I: 2 / EESL II: 2

Overall rating: Phase I: 2 - Phase II: 4

The two-phase project aimed at a more efficient use of energy in different sectors and was well-suited to the policies and preferences of India and Germany. Mainly, LED lamps in the household and street lighting sectors as well as small, decentralized PV plants were financed. While the relevance of the first phase was high due to the high demand of the direct and indirect target groups, the relevance of the second phase decreased for a variety of reasons. The difference in the assessment of the two phases in terms of coherence is even stronger: Phase I showed synergistic cooperation between FC and TC, while Phase II lacked decisive coordination between different donors of the EESL, which led to overfunding of activities. Possible common standards have not been implemented. The planned outputs of phase I were reached. A full utilization of the total loan amount of phase II would have allowed a much higher output.

The objective and all phase I outcome indicators have been achieved, while the objective of phase II and its indicators have been only partially met, in particular the low use of funds in phase II has led to the achievement of absolute energy savings well below expectations. A major weakness of both phases was that the indicators are based on model data. Thus, the real behaviour of users and the actual energy savings induced by the financed measures in the lighting sector are only inadequately reflected. This tends to overestimate energy and emissions savings. Adequate monitoring for actual energy use changes has not been carried out. While phase I effectiveness is still considered to be successful, phase II is moderately unsuccessful as some of the indicators are not fully met, however mostly due to external effects.

The efficiency of the two phases is positive, with the efficiency of phase II having been assessed as moderately successful due to delays also due to the COVID-19 pandemic. Despite the lack of information on the disposal of replaced lamps and the resulting inability to assess whether unintentional environmental damage occurred, the

measures of Phase I had a high overarching developmental impact. The price reductions for LED lamps achieved in this context had a broad impact and benefited all Indian electricity consumers. Due to the only fragmentary utilisation of the total loan amount, the overarching developmental impact of Phase II is significantly below expectations. The sustainability of both phases is rated as successful. However, the analysis showed that the ESCO business entails financial risks that may influence the impact of possible future EESL activities.

In summary, phase I of the project is considered successful and phase II moderately unsuccessful, which can bei attributable to externalities such as the COVID-19 pandemic and the related economic environment.

Overall rating: EESL I: 2 / EESL II: 4

Contributions to the Agenda 2030

The global community has agreed on the Sustainable Development developments goals (SDGs) of the 2030 Agenda (UN, 2015) and the implementation of the Paris Climate Agreement (UNFCCC, 2015). SDG 13 on climate action includes measures to combat climate change and SDG 7 includes measures to ensure access to affordable, reliable, sustainable and modern energy for all. The objective of the Paris agreement and its successor agreements is to limit global warming to well below 2°C and preferably below 1.5°C compared to the pre-industrial era. The rise of demand-side energy efficiency will reduce energy-related CO_2-emissions. The project therefore contributes to the above-mentioned SDGs.

Project specific strengths / weaknesses and general conclusions / lessons learned

The strengths and weaknesses of the project include in particular:

a) The project addressed an important sector for a greener energy supply of India, as it conceptually aimed to reduce energy consumption for lighting in the household and street lighting sector while strengthening EESL as an important institution for implementing India's energy efficiency policy.

b) In particular, the project was embedded in two national energy efficiency programmes, the "UJALA programme" in the household sector and the "Street Light National programme" in the street lighting sector. This strengthened the already high ownership of the project at the project executing agency EESL, and at the same time led to high political pressure to implement it.

c) By bundling demand for LED lamps and LED street lighting systems through EESL, significant price reductions have been achieved over time. The price reductions in household LEDs lamps benefited not only those who participated in the programme, but all Indian electricity consumers.

d) While phase I of the project was pioneering and attracted further donor funding, Phase II of the project lacked much-needed donor coordination and the use of common procedures. This resulted in over-financing: both the FC loan and parallel loans of the AFD and the World Bank were not fully disbursed.

e) A major weakness of the project, which could not be observed only in this project, was the use of so-called "deemed savings": energy savings were made on the basis of static model calculations and neglected actual changes in energy consumption or behaviour of energy consumers (rebound effect). In most cases, this results in actual energy savings being lower than the modelled values.

f) The monitoring of the project could have been improved. Reliable and continuous data on the disposal of old lamps were not collected, so that the monitoring of proper disposal was not possible. Due to the impact of the COVID-19 pandemic, the PV plants could not be visited regularly. Differences from the originally agreed sites could have been noticed by remote monitoring, e.g. via satellite data, and potential necessary environmental and social measures could have been taken.

g) ESCO business models based on customer energy cost savings and related debt financing can pose significant financial risks to the ESCO if customers fail to meet their payment obligations. Bank-standard hedging of these risks was not agreed between the parties to the knowledge of the evaluation.

The main conclusions and lessons learned include:

- Pooling demand for energy efficiency technologies can lead to significant price reductions and to broad impacts beyond the scope of the project.
- For projects that intend to increase demand-side energy efficiency, de facto measured instead of modelled energy consumption reflects the actual achieved effects more adequately.
- Relative, technology-specific energy savings and absolute energy savings in combination can be adequate indicators.
- If technical equipment, e.g. lamps containing harmful substances, are replaced, careful monitoring of the disposal is indispensable in order to minimize the risk of possible environmental damage.

Evaluation approach and methodology

Ex post evaluation methodology

Ex post evaluations follow the approach of a rapid appraisal, i.e. a data-supported, qualitative contribution analysis resulting in an expert opinion. Effects are attributed to the project considering plausibilities, based on thorough analysis of documents, facts and impressions. This includes – if possible – the use of advanced technology (e.g. satellite imagery, online interviews, geocoding). There is a follow-up on possible conflicting information, attempting to eliminate inconsistencies and to base the rating on information that – to the extent possible – has been confirmed through different sources (triangulation).

Documents:
project reports from other donors (World Bank), secondary specialist literature, strategy papers, context, country and sector analyses, similar evaluation reports (World Bank).

Data sources and tools for analysis:
World Bank, International Energy Agentur (IEA) and further databases, data collection on site, interviews

Interview partners:
Representatives of the executing agency, the target group, other donors and consultant

The analysis of project effects is based on the theory of change defined at project appraisal and documented within the impact matrix, which may be updated for the purposes of the evaluation. The evaluation report argues which factors contributed to the observed effects and why – as well as the probable extent of the project´s contribution (contribution analysis). The context of the project is taken into account concerning its influence on the results. The conclusions are put into perspective regarding the availability and accuracy of the available data. The framework of the evaluation is established by the evaluation conception.

This method provides a balance between cost and usefulness, generating evaluation findings with appropriate effort and expense. Also, it allows for a systematic success rating across the FC projects. Thus, an isolated ex post evaluation cannot fulfil the requirements of a scientific assessment in the sense of a strict causality analysis.

The evaluation was limited by the availability of continuous data (e.g., price developments of selected energy saving equipment.

Rating methodology

Projects are rated on a six-point scale for each of the OECD DAC criteria. 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

The overall rating on the six-point-scale is compiled by weighting 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 overall objective (“Impact”) and the sustainability are rated at least “moderately successful” (level 3).

The annex to this report is available upon request.

About this publication

Responsible
FC E
Evaluation unit of KfW Development Bank
FZ-Evaluierung@kfw.de

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KfW Group
Palmengartenstrasse 5–9
60325 Frankfurt am Main, Germany