

Ex post evaluation – India

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Sector: 2327000 Biogas/biomass (power & heat)
Project: Use of biomass to generate energy (BMZ no.: 2003 66 757*)
Implementing agency: Indian Renewable Energy Development Agency Limited (IREDA)



Ex post evaluation report: 2019

All figures in EUR million	Project A (Planned)	Project A (Actual)
Investment costs (total)	35.20	31.70
Counterpart contribution	15.23	11.73
Funding	19.97	19.97
of which budget funds (BMZ)	19.97	19.97

*) Random sample 2018

Summary: The aim of the programme was to promote innovative projects for generating energy from biomass based on solid organic waste. To do this, a credit line was set up for refinancing sub-loans from the state-owned Indian Renewable Energy Development Agency Limited (IREDA) for investments in exemplary biomass plants. An ideas competition was set up and five projects were selected. Depending on the degree of innovation, the winners received reduced interest rates compared to IREDA’s standard conditions. Project concepts were classed as innovative if they were not particularly widespread in India at that point or if their technological, institutional and organisational aspects were innovative. This applied to project concepts that involved sugar cooperatives, aimed to apply previously seldom used types of biomass (agricultural waste or certain types of industrial waste) or employed technology that is rarely used in India to generate power (e.g. biogas technology).

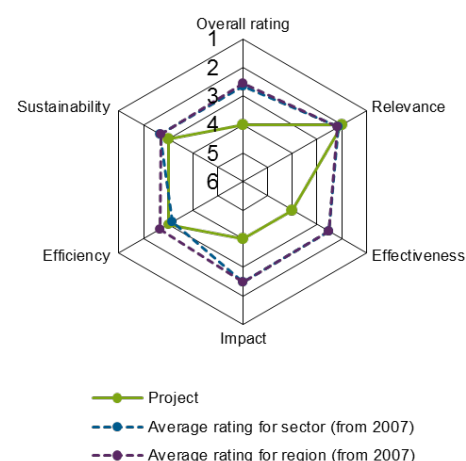
Development objectives: The outcome-level goal defined during the ex post evaluation (EPE) was the promotion and use of power produced in a technically and economically efficient manner from organic waste – as an important energy source in the expansion of renewable energy. This goal was to be achieved by providing IREDA with refinancing. For the same purpose, IREDA was then to pass this funding onto investors at favourable conditions, enabling them to invest in innovative and thus riskier projects. Beyond creating an ecologically sustainable energy supply, the impact-level objective was to contribute to environmentally friendly economic growth with wide-scale effects and to also contribute to protecting the climate.

Target group: The target groups were IREDA and the investors in the biomass projects, and, in the sense of climate protection as a global good, the Indian population and the global community.

Overall rating: 4

Rationale: A total of five projects were financed under the programme. Due to difficulties relating to the availability of biomass and its quality and due to unfavourable general conditions (the efficiency of wind and solar technology rose rapidly during the same period, unlike the efficiency of biomass), only three of the five projects are able to repay their loans as planned. Power production is also significantly below expectations. Thus no spill-over effect has been identified for the programme.

Highlights: The huge reduction in costs for solar and wind power over recent years has meant that “waste-to-energy” projects as technology for avoiding greenhouse gases and generating electrical energy from renewables no longer play a decisive role nowadays.



Rating according to DAC criteria

Overall rating: 4

Ratings:

Relevance	2
Effectiveness	4
Efficiency	3
Impact	4
Sustainability	3

Relevance

The goal of financing projects to increase the production of power from biomass waste as a renewable and non-polluting resource in an effort to save CO₂ was in line with the Indian Ministry for Renewable Energy's (MNRE) development plan that explicitly set out (and still aims) to increase the amount of energy generated from biomass. It also complied with the DC programme objective for India. For German Development Cooperation, India was and is an important partner in the battle against climate change (focal sector). Due to its long-standing cooperation with German FC and its central role in the financing of renewable energy in India, IREDA was the ideal partner for achieving the targets. The programme was the third project with IREDA; the first of these projects was considered to have a positive impact in an ex post evaluation from 2003 (BMZ no.: 1997 65 538). IREDA was and still is supported by multiple multilateral and bilateral financial institutions (AFD, ADB, World Bank). During the implementation of the technical support to improve internal credit processes and establish a management system to comply with international environmental and social standards, all institutions worked closely together to achieve an integral solution that incorporated the requirements for each individual institution.

The programme's approach of financing innovative technologies and promoting their implementation with a mixture of an ideas competition and specific incentives corresponds in principle to the idea behind the promotional business at a development bank like IREDA. In view of the fact that IREDA had already received a development loan as part of a previous project to promote established forms of renewable energy (hydro, solar and wind energy), the focus on innovative projects in a market segment without much experience in India was very consistent in light of the loan's high subsidy content (IDA conditions).

While the impact logic of the project was plausible at the time, a project for recycling organic waste to achieve the aforementioned goals (increase energy production, reduce greenhouse gases) would no longer be relevant from today's perspective. The reason for this is the huge reduction in costs for producing energy from solar and wind power that has been observed across the globe. In comparison, the CO₂ avoidance costs are now too high for projects based on organic waste as the energy source. Furthermore, projects involving solar and wind power as free and natural energy sources have much lower external risks than biomass projects, where the input may be subject to increasingly unforeseeable fluctuations in price and quantity.

However, this does not mean that the project is no longer relevant. Rather, the goal of recycling solid waste and the resulting positive environmental effects (and not the production of electricity) would be more in the spotlight from today's perspective. However, the debate surrounding the use of biomass waste for the purposes of protecting the environment is still in its early stages and the underlying conditions in India are not yet explicitly set up for this objective. In light of the increasing level of awareness in India concerning the need to look after the environment, this could still change in the future if suitable incentives are established.

Relevance rating: 2

Effectiveness

The outcome-level goal defined during the EPE is the promotion and use of power produced in a technically and economically efficient manner from organic waste – as an important energy source in the expansion of renewable energy.

From the 22 projects submitted for the programme, five projects with different business models were selected (see Efficiency) and financed:

- (1) Production of biogas (anaerobic biogas reactor, enterprise with German venture capitalists) from the solid waste produced by a sugar cooperative and refill of the gas (no vertical integration). The biogas is then sold on to other businesses; two loans: EUR 1.0 million / EUR 0.7 million.
- (2) Production of electrical energy (biomass gasification) on the basis of waste wood from a nearby plywood factory (no vertical integration). The power is fed into the grid to supply companies from the same corporation at other sites; loan: EUR 0.37 million.
- (3) Production of electrical energy (anaerobic biogas reactor) using the solid waste from a maize cooperative. Energy is used to secure a portion of the cooperative's power supply (vertical integration); loan: EUR 0.37 million.
- (4) Production of electrical energy (production of power from biomass) on the basis of solid waste from the local cotton and peanut industries. Power is fed into the grid (no vertical integration); loan: EUR 5.17 million.
- (5) Construction of a co-generation plant to generate power from sugar cane waste in a sugar cooperative. The energy and heat generated is used directly by the cooperative (vertical integration); loan: EUR 12.66 million.

The achievement of the aforementioned outcome-level goal can be summarised as follows:

Indicator	Ex post evaluation
Financing of 5–7 biomass plants from the FC credit line with a production capacity of roughly 49 MW and the electricity production of roughly 272,000 MWh per year	Not achieved (due to lower power production and MW): - Five biomass plants were financed with six loans. - The production capacity of all five plants was 44.03 MW (90 % of the target, biogas energy converted) - The power production per year was 94,466 MWh (35 % of the defined indicator). If the biogas production from sub-project 1) is counted as thermal energy, the result increases by 37,000 MWh to 54 % of the target.
The biomass plants are successful commercial operations, which means that the revenue per sold unit of energy exceeds the total costs per produced unit of energy.	Not achieved: Cost-covering and profitable: Project (3) + (5) Cost-covering but not profitable: Project (2) Almost cost-covering, loan restructured: Project (1) Does not cover costs, loan defaulted: Project (4)

It is worth noting that the only successful projects were the ones that were vertically integrated into the waste-generating company, i.e. projects in which the biomass did not have to be bought in. On the one hand, these projects can effectively reduce the risks described below, and on the other hand, the acceptance of a fixed amount of power is guaranteed (at an internal price). Administrative costs and the costs for staff can also be combined with the needs of the industrial operation. The companies that invested in projects without vertical integration encountered extensive problems that they were unable to overcome to a satisfactory extent and that are responsible for the lower power production in relation to the capacity created:

- (i) The prices for the provision of solid waste or its collection were subject to heavy fluctuations in some cases, and the companies were unable to influence this.

- (ii) The amount of solid waste depended on the waste-generating industry's production capacity, over which the investors also had little influence.
- (iii) In some cases, the quality of the solid waste varied greatly (e.g. in periods of drought), which made its recycling and the operation of the plants more difficult.
- (iv) The price of the energy or biogas produced changed during the project term due to a drop in oil prices, which put the companies at a disadvantage. Furthermore, there were no guaranteed feed-in tariffs for waste-to-energy projects (in contrast to wind and solar power). Only project (2) was able to avoid losses when feeding power into the grid as some of the power was consumed by the corporation's own grid.

The quality of the infrastructure built and its maintenance varies greatly, and the same applies to compliance with occupational safety standards and elements related to the protection of the environment. While project (3) is currently a commercial success, the condition of the plants is unsatisfactory due to a lack of maintenance. Occupational safety standards were only observed on a wide scale in project (1).¹ The operator of project (2) is slowly beginning to introduce occupational safety measures, primarily due to international competition.

Based on various factors, including its experience with this project, German FC has begun establishing a special management system at the implementing agency IREDA; the aim of which is to support compliance with occupational safety standards. Despite making good progress, this process is not yet complete and further phases of technical support in the field of environmental and social matters to enhance institutional development are currently being prepared by the Asian Development Bank. Enforcing occupational safety standards in rural areas – particularly at cooperatives, some of which are political constructs and not subject to market forces – is a major challenge. While an important impact can be achieved in this area in some cases, the full-scale tracking of all required standards is not possible over the short- to medium-term.

Effectiveness rating: 4

Efficiency

From the evaluation team's perspective, the implementation of an ideas competition to select the projects in question and the subsequent evaluation of the submitted proposals were not expedient in every regard. In addition to technical criteria (IREDA assessed the financial criteria itself), other development policy criteria – such as the future participation of women in management roles, the willingness to pay more than the minimum wage, and other corporate social responsibility measures – were also factored into the assessment. Even though these objectives are welcomed in principle, they meant that the selection process was overloaded with too many different issues. This made the implementation process more complicated. For this reason, IREDA no longer applies this type of selection process. An evaluation of the concept as announced in the project appraisal report appears not to have been conducted.

At EUR 700,000/MW, the total costs for the financed projects are appropriate for plants used to produce power from biomass in India (a direct comparison is difficult for projects that do not generate power directly).

Furthermore, in retrospect it is clear that the consulting team who supported IREDA during the selection process should also have supervised the projects' implementation for the duration, due to the complexity and high level of investment of the financed projects and in view of IREDA's lack of experience.

In light of the fact that interest rates were in the low two-digit range, the reduction in interest (in the range of between one and two percentage points) was enough of an innovation incentive and therefore an efficient method for promoting more innovative projects.

IREDA's risk management system is fundamentally suitable for a promotional bank and works largely according to international standards. Employees' technical knowledge is also considered high. During the project implementation phase, the non-performing assets (NPA) quota was 3.9% in 2013, for example,

^{1c} While the team did not visit project 5, the project documentation in this case also contains reports of insufficient occupational safety standards. This point is not currently relevant for project 4 as it is not running at the moment.

and was therefore significantly lower than the level of Indian commercial banks, even though the line of business is limited exclusively to renewable energy sources.

In terms of efficiently achieving an increase in power production and a reduction in the emission of greenhouse gases, the project was not the most cost-effective alternative from today's perspective as the CO₂ avoidance costs for wind and solar power are significantly lower from a macro-economic perspective. However, this is counteracted by additional positive effects in the form of protection for the environment, the creation of new knowledge about biomass projects and the generation of potential that could be tapped should the underlying conditions in India change (see Relevance). Ultimately, at least 25 % of the investment funds were used for a project that was not viable. While a higher level of risk is generally acceptable and desirable for innovative projects in particular, the overall efficiency of the project is merely satisfactory, even when taking into account the innovative nature of the individual projects.

Efficiency rating: 3

Impact

The impact-level objective was to contribute to environmentally friendly economic growth with wide-scale effects and to also contribute to protecting the climate. The achievement of the objective at impact level can be summarised as follows:

Indicator	Ex post evaluation
A total of 217,000 tonnes of CO ₂ are saved annually one year after completion of the infrastructure	Not achieved. Only 95,000 tonnes of CO ₂ are saved annually due to the low production figures. This calculation also includes the CO ₂ savings generated by not diverting the solid waste into nature. A review of the CDM ² documents where the CO ₂ savings and environmental effects are described (only available for projects (1) and (3)) showed that the savings were very small.

² CDM stands for Clean Development Mechanism. This compensation mechanism enables emission credits to be generated and traded by projects that reduce emissions.

On the whole, it can be assumed that the project had positive effects on protecting the environment and climate; however, because the initial situation was not recorded properly, these effects cannot be presented in full and can only be quantified in terms of CO₂ savings.

Data regarding the waste flows' harmful environmental effects was not recorded by the consultant as it concentrated primarily on CO₂ savings. The CDM documentation can be used as an example of a possible source of information. The CDM documents for project (3) only assume a very small positive impact on the environment resulting from the reuse of biomass since the previous treatment basins did not generate a waste flow that was much more harmful than the biogas plant now used in project (3). In this case, the only positive effect is the reduced odour from the fermentation process. The CDM document for project (1) does not assume any additional environmental effect at all. However, the evaluation team assumes that the fermentation of solid waste and the sealing of the ground (at the storage facilities of the fermented solids and subsequently moistened solids) at least prevents that the waste stream transfers into the ground water. However, this fact is not mentioned in the CDM document. The odours produced by the plant are also less strong than before. While the project contributed to environmentally friendly growth and climate protection in terms of its CO₂ savings, it remains considerably below the target values (see table above).

One positive aspect worth highlighting is the project's employment effects, particularly in rural areas. Between 10 and 40 people are currently employed at every plant. However, due to the lack of occupational safety measures at some of the plants at least, there is some doubt over whether these jobs meet the definition of the International Labour Organisation's (ILO) Decent Work Agenda. In one case, positive effects on economic growth can also be assumed due to a spill-over effect as the company from project (2) now successfully sells the plants outside India.

The evaluation team was unable to ascertain whether the financed technology and business models led to the technology being replicated, thus causing a spill-over effect at other companies. Following its experience with this credit line, IREDA has not financed any other biomass projects in the past five years. While the company from project (2) now exports its technology abroad (Europe, Asia, Africa), it has not built any more power plants in the complicated Indian market (lack of feed-in tariffs) due to poor profitability. The evaluation was unable to verify whether the foreign projects actually used the plants to produce energy from solid waste or whether they used unsustainable channels (e.g. by using felled timber). Project (1) had ambitious plans to expand but did not even manage to cover its costs due to the low price of gas in recent years; at the time of the evaluation, it was looking for new investors. There has yet to be a technology spill-over at the cooperatives. The individual projects ultimately did not have any wide-scale effects in the target group.

Impact rating: 4

Sustainability

At individual project level, sustainability is limited to a certain extent due to the insufficient quality of the building design and maintenance and due to the lower capacity utilisation levels.

Based on its experience with financing biomass projects, IREDA has not financed any more projects in this area over the last 5 years. Biomass projects are seen as too risky, particularly in comparison to solar and wind projects. This in itself is a positive sign as it means that IREDA studied the projects closely as an institution and drew its own conclusions from the results. From a technical perspective, however, it shows that the effects did not unfold as hoped, and also will not do so in the future due to the lower efficiency of biomass compared to solar and wind power.

Nevertheless, the project unlocked new knowledge and a certain degree of production potential for biomass projects in India. This potential could also be tapped into for more positive effects if the underlying conditions were to improve (e.g. if oil prices were to rise). A change to the Indian government's subsidy policy could also have a positive impact in future as waste-to-energy projects have positive environmental effects too, in addition to the actual climate-related goal; the promotion of these projects is currently being analysed by the Indian government.

Even though non-performing loans weaken IREDA's financial sustainability, the recovered funds in the second application are also invested in other projects; looking at the whole portfolio, IREDA has so far invested in successful projects in the field of renewables. In view of the high standard of IREDA's portfolio, it can therefore be assumed that these funds will continue to be used sensibly and to positive effect. IREDA's promotional mandate remains very important in India as one of the largest emitters of CO₂.

Despite the somewhat limited sustainability at individual project level, the knowledge and potential generated in relation to biomass projects and IREDA's successful implementation of projects in the field of renewables mean that sustainability is rated as just satisfactory.

Sustainability rating: 3

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

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

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

Rating levels 1-3 denote a positive assessment or successful project while rating levels 4-6 denote a negative assessment.

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

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

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

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

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

The **overall rating** on the six-point scale is compiled from a weighting of all five individual criteria as appropriate to the project in question. Rating levels 1-3 of the overall rating denote a "successful" project while rating levels 4-6 denote an "unsuccessful" project. It should be noted that a project can generally be considered developmentally "successful" only if the achievement of the project objective ("effectiveness"), the impact on the overall objective ("overarching developmental impact") and the sustainability are rated at least "satisfactory" (level 3).