

Ex post evaluation

Renewable energy and energy efficiency programme, Central America



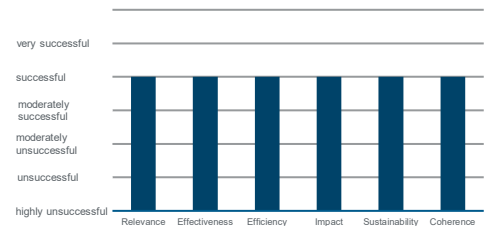
Title	Renewable energy and energy efficiency programme I+II		
Sector and CRS code	23210 Energy generation, renewable sources – multiple technologies		
Project number	2004 66 292, 2007 66 451		
Commissioned by	Federal Ministry for Economic Cooperation and Development (BMZ)		
Recipient/Project-executing agency	Central American Bank for Economic Integration BCIE (Banco Centroamericano de Integración Económica)		
Project volume/Financing instrument	61.1 million EUR / IVF (development loan)		
Project duration	12/2007 – 11/2018 (Phase I+II)		
Year of report	2021	Year of random sample	2020

Overall rating:
successful

Objectives and project outline

The outcome-level objective used as a basis for the ex-post evaluation was to help increase the prevalence of renewable energy sources (RE) and an environmentally friendly, need-based and reliable power supply. This was to contribute to diversifying the electricity mix in Central America and to protection of the global environment and climate change mitigation (objective at impact level).

Phases I and II included development loans to the BCIE. These were used to (partially) finance seven individual projects in the field of renewable energies (wind, hydropower and geothermal) in Central America, primarily in the private sector.



Key findings

Phases I and II of the project are playing an important part in diversifying the electricity mix and in climate change mitigation (overarching developmental impact). This is because of the direct savings in greenhouse gases and the signalling effect from the project as regards the financing of RE projects. The project is rated as successful for the following reasons:

- The project has tackled core problems in the region in terms of development policy: the use and expanding use of fossil fuels, and insufficient financing options for investors of renewable energy projects through national/regional capital markets. The concept and its underlying logic of effects were suitable for helping to resolve the core problem.
- The BCIE have expanded the financing of renewable energy projects considerably, thus helping to increase the prevalence of renewable energies. Through the (partially) financed individual projects, a direct contribution to a reliable power supply has also been made.
- Critical elements behind the project’s high efficiency were the profitability of the plants, along with the implementation with the BCIE as the central project-executing agency, as well as the contribution to increasing the prevalence of RE technologies.
- The impacts in terms of development policy are considered to be sustainable, both on the level of the BCIE as the established financier of RE projects, as well as at individual project level in view of the good operations and maintenance.

Conclusions

- Renewable energy projects can require particular financing conditions which may not be covered by (national) capital markets.
- The refinancing of regional development banks provides opportunities and incentives for financing and implementing renewable energy projects, especially if investors have insufficient access to (national) capital markets due to the conditions.
- Cooperation with regional established development banks and their involvement in financing renewable energy projects has great potential for having far-reaching effects when it comes to promoting renewable energy projects.

Rating according to DAC criteria

Overall rating*: 2 (both phases)

Ratings:

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

* Separate ratings are not provided as Phases I and II were managed as one project during their implementation.

Relevance

Before the project started, the electricity supply in Central America had a strong upward trend towards imported crude oil derivatives. In the period between 1990 and 2005, the proportion of fossil fuels in the electricity mix increased from 9% to 43%. During the Phase I project appraisal (PA) in 2006, the electricity mix was strongly characterised by fossil fuels, above all in Nicaragua with 77% and Honduras with 70%.¹ The main problem of the region being highly dependent on imported crude oil derivatives, the associated foreign exchange spending and the negative impact on the environment was therefore correctly identified. The increasing/strongly fluctuating oil and gas prices also posed a risk to a reliable power supply. According to the project appraisal report (PAR), the capacity for generating power was generally too low or had largely reached its limits. Economic activities were restricted by the, sometimes chronic, shortages and the associated power cuts and rationing of energy. Given that, at the time, electricity demand was expected to grow at 5% p.a. for the following decade, the Phase II PAR expected the problem to become exacerbated in the majority of countries in the region.

Making use of the great potential of locally available renewable energy (RE) sources to meet the increasing demand for energy was deemed to be an appropriate developmental approach at the time and remains so from today's perspective. Within this context, the PA also identified the additional key issue of investors not receiving adequate access to national capital markets, as these only offered loans with long terms and foreign currency loans to a very limited extent. Furthermore, since the opening in the nineties, the electricity market in Central America has seen greater investment from the private sector with an increased demand for financing options.

At the time of the PA, the Central American Bank for Economic Integration (Banco Centroamericano de Integración Económica – BCIE) was already established as a supranational development bank and key financier for Central America. Due to its reliable range of long-term loans and mobilisation of foreign capital, the BCIE was considered one of the main (re)financing sources for long-term investments in Central America. Consequently, the project addressed financing the expansion of RE sources via the BCIE, which was able to play a part in bridging the financial gap by providing long-term financing. The provision of FC funds with low interest rates enabled the BCIE for the first time to offer financing for projects in the field of RE that it had not been able to offer up to that point due to its commercial refinancing base. The project is based on the following chain of effects: (partial) financing with need-based terms and passing on the refinancing benefit of the BCIE through FC funds to ultimate borrowers → contribution to bridging the financial gap → contribution to the expansion of sustainable RE technologies by implementing individual projects with direct financing → reliable energy supply and reduced harmful emissions.

Both at the time and today, the underlying logic concerning the effects and conception were considered to be plausible and were suitable for helping to solve the main problems. Due to the fact that the national financial institutions did not have any experience with RE back then, and because of the significance of

¹ <https://www.un.org/en/chronicle/article/road-sustainable-energy-future-central-america>, BloombergNEF Climatescope

the BCIE in the region, the BCIE's involvement in financing RE projects was expected to have a signalling effect. This also applied for other donors and the private sector. On the one hand, in retrospect, it is not possible to assess conclusively whether the projects would still have been financed by the BCIE without FC financing. But on the other, the German FC was named a strategic partner in the BCIE's energy sector strategy at the time (Estrategia y plan de inversiones 2005–2010 para respaldar el desarrollo del sector energía en C.A.).

Even at the time of the PA, a reliable and sustainable energy supply was a political priority. In 2007, energy ministers in the SICA countries (Sistema de la Integración Centroamericana, Central American Integration System) ratified the "Central American Sustainable Energy Strategy 2020", which included measures to reduce the dependency on fossil fuels and to lower greenhouse gas emissions. The measures in the FC module were in line with these objectives.

The project was in keeping with the objectives of the German Federal Government, which had defined environmental and climate action to be a regional priority for cooperating with Latin America and the Caribbean. Furthermore, the project complied with the aim of promoting an unspoilt environment from the German Federal Government's "Aktionsprogramm 2015" (Action Programme 2015). From today's perspective, the objective is consistent with the Federal Ministry for Economic Cooperation and Development's core issue strategy "Responsibility for our planet – climate and energy", which is aiming to completely decarbonise the energy sector by 2050, among other things (action point 2).

Given the plausible chain of effects and coherent concept for resolving the correctly identified core problems, the project's relevance is regarded as good.

Relevance rating: 2

Coherence

The project was part of the DC programme "Renewable Energies and Energy Efficiency in Central America". It was supplemented by the TC module on the promotion of renewable energy sources and energy efficiency 4E I (2009–2014) and 4E II (2014–2018). Synergies were created as regards the DC programme, in particular because the TC modules focused on improving the general conditions for promoting RE, and because the integration of variable renewable energies in the power grid was promoted. Part of the measures mentioned above to improve the general conditions included qualification measures for the financial sector. The aim here was to increase the success rate for loan applications for RE projects. The TC module also cooperated with the BCIE on conducting energy management training. At the same time as the project, the FC supported the BCIE by using a Studies and Experts Fund for developing and introducing an environmental and social management system (ESMS). This system is used to identify, assess, and manage the corresponding risks – since 2016 in accordance with World Bank standards. From the perspective of the ex-post evaluation, the involvement of the FC and TC outlined before contributed in a complementary way to achieving the DC programme's objective of a reliable power supply by increasing the use of RE, as well as a reduction in greenhouse gases.

At the time of the PA, the project was in line with the Millennium Development Goals (above all goal seven "Ensure environmental sustainability") due to the provision of efficient energy services. From today's perspective, the FC module also complies with the overarching Sustainable Development Goals (SDGs) of the 2030 Agenda: Affordable and Clean Energy (7) and Measures for Environmental Protection (13). Furthermore, all countries in the region have now decided on nationally determined contributions (NDCs) for reducing greenhouse gas emissions in line with the Paris Agreement – also with the aim of expanding the use of renewable energies.

There was also coherence with national energy sector strategies, and any objectives set within these on greater use of renewable energies. Some of the programme's individual projects were explicitly named in the national energy strategies.

Through the cooperation with the Central American development bank BCIE, structures in the region were used and (technical) skills were strengthened, for example through support in introducing an ESMS. By implementing seven power generation plants (wind, hydropower and geothermal), the project supported the BCIE in realising the problem-solving approach described in the BCIE energy sector strategy (2005-

2010) mentioned above. This included the promotion of renewable energies (RE) and energy efficiency (EE).

According to the project's final reporting, there is still no clear division of tasks today. The different stakeholders mainly coordinate at project level. In its role as the vehicle for investment finance, the BCIE maintains cooperations with the different stakeholders in the energy sector, meaning that a certain level of indirect coordination can be presumed.

Due to the complementary involvement of the German DC and the use and/or promotion of existing structures, the coherence of the project is considered to be good.

Coherence rating: 2

Effectiveness

The outcome-level objective used as a basis for the ex-post evaluation was to help increase the prevalence of renewable energies and help create an environmentally friendly, need-based and reliable power supply.

Target achievement at outcome level is assessed using the following indicators:

Indicator	Status PA/ target value PA	Ex-post evaluation
(1) Increase in the net loan portfolio of the BCIE for financing RE up to the time of the last disbursement (in USD millions)	131 / 380	966.3 (2014) ¹⁾ 866.9 (2020)
(2) Default (> 90 days) of the renewable energy/energy efficiency loan portfolio (%)	0 / < 2	Achieved (2020)
(3) Availability of the plants (after taking account of the technology-specific/plant-specific operation and maintenance downtimes; average of all operating years in %)	0 / > 97 ²⁾	97.8 (2020) ³⁾
(4) Installed capacity (MW)	0 / 123.6 ⁴⁾	123.6
(5) Secured annual power generation (GWh/a)	0 / 661 ⁴⁾	586 ⁵⁾

1) Last disbursement in November 2014

2) International reference value

3) Data from the random sample (4 plants visited)

4) Project planning value (excluding the measures implemented in conjunction with the project)

5) Average annual generation in the period 2017–2020, for which generation data from all plants was available.

The target value of the net loan portfolio of the BCIE in the RE sector was achieved. Since the last disbursement (2014) it has been considerably above the target value. However, the annual loan approvals for renewable energy/energy efficiency projects fluctuated strongly. In the period between 2010 and 2020 they made up 0% to 23% of the overall total commitment of the BCIE; in 2018 and 2019 no loans were approved for renewable energy/energy efficiency projects.

In terms of the prevalence of renewable-energy based technologies, statements from the plant owners of the implemented projects suggest that there was a crucial signalling effect from the financial contribution of the BCIE, which has extended beyond the projects realised. This also seems plausible against the backdrop of the BCIE providing almost 50% of financing for all the energy-based investment projects in the region between 2008 and 2016, according to their own information.

There were no arrears at any time for the seven plants. During ex-post evaluation, several plants had already completely paid off their loans.

The electromechanical and control-based components of the four plants visited (of the seven plants in total) were in excellent condition, with the exception of isolated, smaller issues. The operators followed up on and rectified malfunctions. Furthermore, the comprehensive spare-parts stock demonstrated a high level of autonomy of the plant operators in the event of failure. Further proof of the quality of the plants visited was the high availability factors above the international reference value of 97%. Larger-scale, scheduled maintenance is performed at the times of the year where electricity generation is naturally limited, based on the seasonal fluctuations in wind and water volumes. The modular structure of renewable energy plants, with the exception of geothermal plants, also helps to reduce non-availability due to maintenance work.

The installed capacity of the seven individual projects meets the planned 123.6 MW. In the period under consideration (2017–2020), on average, the seven plants generated 586 GWh per year. This is below the target value. The power generation data shows, however, that there is a strong fluctuation for the renewable energy sources of wind and hydropower. For some plants, this was considerably below what was forecasted. Due to the relatively short operating period, we cannot yet finally assess at the ex-post evaluation stage whether the generation values below the target value are a temporary fluctuation or a permanent trend. According to an expert assessment, it can already be assumed that one of the plants will permanently be below the forecast.

With the exception of the annual generation that is below the target value, all indicators were completely met. Overall, the programme demonstrates good effectiveness as regards the prevalence of RE technologies, along with the electricity supply from renewable sources.

Effectiveness rating: 2

Efficiency

In the context of the joint implementation of the phases (which were originally planned one after the other), there was a considerable delay in the total timeframe. However, overall the delays in installing and commissioning the plants are still considered acceptable.

The investment costs are to be assessed differently for the projects. When constructing RE plants in Central America, the costs are generally higher than the global average. The specific costs (production efficiency) varied both between and within the individual renewable energy technologies. They were sometimes over and sometimes under the technology-specific comparison values determined for the region.² Overall, the production efficiency is rated as satisfactory.

According to the BCIE, the internal rate of return for five of the seven plants for which information was available was in the two-digit range, and therefore above the 8% typical for the sector. The feed-in tariffs agreed in the Power Purchase Agreements concluded are in part considerably higher than the regional and technology-specific electricity generation costs and nationally specified guidance tariffs. They are an indication of rentability; however, macroeconomic inefficiencies may also result. The effect of the individual projects on the entire sector cannot be assessed conclusively.

Areas to be highlighted are the positive effects when it comes to the impact achieved in comparison to the costs (allocation efficiency) through the project's contribution to making RE technologies prevalent (see Effectiveness), as well as reinforcing local implementation structures (see Coherence). Furthermore, by going through the BCIE there are gains in efficiency through lower transaction costs in comparison to implementing individual projects.

In light of the good allocation efficiency, the efficiency is still rated as good overall, despite delays and the satisfactory production efficiency.

Efficiency rating: 2

² IRENA, Renewable Power Generation Costs in 2020

Overarching developmental impact

The impact-level objective used as a basis for the EPE was to contribute to diversifying the electricity mix in Central America and to protecting the environment and climate around the world.

The following indicator is used to assess impact-level target achievement:

Indicator	Status PA/ target value EPE	Ex-post evaluation
(1) Reduction in harmful emissions (in t CO ₂ equivalent p.a.)	- / 150,000*	160,035**/**

*) Based on: IPCC Working Group III – Mitigation of Climate Change, Annex II Metrics and Methodology, Table A.III.2, 2014, Median Lifecycle Emissions, assumption: petroleum 600 gCO₂/kWh

**) Based on average annual generation 2017–2020, for which generation data was available from all plants.

Even though the secured annual power generation was lower than planned (see Effectiveness), the target value for avoiding CO₂ emissions (t/year) was reached. With regard to the FC's financing share of the project costs, this results in a reduction of 27,926 tCO₂/year. It should be noted that the absolute reduction in tCO₂ p.a. is substantially lower than originally estimated due to the adjustment of the specific CO₂ coefficients of the respective countries carried out as part of the ex-post evaluation.

The project's contribution to global environmental and climate action goes beyond the emissions reduction (which is directly attributable to the project) considering its plausible contribution to the prevalence of RE technologies (see Effectiveness). In contrast to Costa Rica, where only part of the electricity sector was opened up to private investors, in Nicaragua and Honduras the electricity sectors were opened up to the private sector in the 90s – to differing degrees – in particular with incentives for private investments in the field of renewable power generation. This meant that primarily the private sector profited from the (partial) financing of renewable energy plants. This ultimately meant six of the seven plants were associated with the private sector. The percentage share of the implemented plants to national power generation varies greatly between countries. In 2020, it was a low 0.26% in Costa Rica and 1.49% in Honduras. In Nicaragua on the other hand, in 2020 the implemented plants generated a total of 8.5% of the overall electricity production with the corresponding noticeable impacts of the project. In Nicaragua there was a region that already had a wind power plant and another one was installed as part of the project. During the EPE, it was noted that four wind power plants are now being operated in the area. The project also played a leading role in terms of the private exploitation of geothermal energy. As regards Costa Rica and Honduras, from the perspective of the EPE, the contribution towards achieving impact-level objectives is primarily derived from the signalling effect of the financing of EE projects. In Honduras, the first privately financed, more powerful hydropower station was implemented as part of the project. The project is also helping to ensure stability of the grid, something which has been confirmed by the local operators. This is because 80% of the power generated by the implemented RE plants is based on hydropower and geothermal energy. In contrast to fluctuating wind power, these are capable of providing baseload power.

In the overall framework of the impacts outlined, the project clearly helped to achieve the DC programme objective of a reliable energy supply by increasing renewable energies and reducing greenhouse gas emissions. In comparison to the base year 2006, the proportion of renewable energy in the installed generation capacity in Honduras increased significantly from 36.3% to 61.5%. In Costa Rica it increased from 79.8% to 86.7% and in Nicaragua from 41.1% to 45.2%.³ The operation periods of fossil-fuel plants were reduced in Nicaragua in particular. Since the start of the project, the increase in electricity production from RE has been +5.15% Costa Rica, +22.6% in Honduras, and +33.8% in Nicaragua.

In addition to the reduction in harmful emissions mentioned above, increasing the nationally generated power from RE also helped to reduce the dependency on importing fossil fuels. No negative environmental impacts from the project could be determined as part of the EPE. For the plants inspected as part of the EPE, any physical intervention in the natural environment went hand in hand with compensating

³ OLADE, 2006–2019

measures, and the recording and documenting of important key figures. The impact of the ESMS introduced with FC support was demonstrated here (see Coherence).

In the surroundings of the plants visited as part of the EPE, positive socioeconomic effects could also be observed in the mostly rural, underdeveloped regions. These effects are based on the social endeavours of the plant operators: predominantly local staff are employed, qualification measures are carried out, and school education is promoted. At the plant operators' initiative, local residents were also occasionally connected to the power grid.

As outlined above, the project made both a direct and indirect contribution to reducing CO₂ emissions. The overarching developmental impact of the project is therefore assessed as good.

Overarching developmental impact rating: 2

Sustainability

The sustainability of the project applies to both the specific RE plants as well as the continued involvement of the BCIE in financing renewable energies.

The high level of availability suggests the plants are high quality and in good condition. It was also possible to confirm this during the on-site visits (see Effectiveness). No obvious defects that could impact the service life and power generation of the plants was observed. The plants inspected are maintained on the basis of state of the art and manufacturer's specifications. All of the plants visited had appropriate workshops and tools. The operators have also recognised the risk of long delivery times for important plant components and placed a high priority on stocking the spare parts warehouse. Functionally relevant components, such as electricity generators, water turbines and wind turbine rotor blades, are stored redundantly. The stocking of expensive plant parts is also indicative of the financially sound set-up and liquidity of the plant operators and ensures operation and maintenance in the proper way.

In terms of number and field of expertise, the personnel structures for proper operations are considered to be appropriate in the EPE. According to the plant operators, technical qualification measures and training on occupational health and safety are regularly carried out. This can also be seen from documents viewed on-site. The low staff turnover determined during the on-site visits also makes stable knowledge management possible within the workforce. The people spoken to had had their jobs for several years. This is particularly noteworthy, especially considering that there were multiple changes of ownership in some places. The proper and qualified rectification of any occurring malfunctions also speaks for the specialist skills and management skills of the applicable staff.

The fact that the power generation falls short of the target value for the observation period (see Effectiveness) does not enable us to conclude that there was a shift because of climate change. This is because of the short observation period. However, changes in the climate may have a critical impact on wind and water volumes and may prove a risk for the sustainability of the projects in the long term. To what extent this can be expected for the technical service life of the plants cannot be assessed conclusively.

In line with the agreements, the BCIE also performed monitoring after commissioning right up to repayment. Since PA, the BCIE has – as intended and integrated in its institutional strategy (Estrategia Institucional 2020-2024) – consolidated commitments in the renewable energy sector as a key business field (see Effectiveness). In 2018 and 2019, loan approvals were, however, low compared to overall loan approvals in absolute and relative terms. However, as an established stakeholder in the financing of renewable energies in Central America, who according to its own information has a substantial role in financing the regional energy infrastructure, it can be presumed that the BCIE will continue to be involved. This is also manifested through the continuation of the collaboration between the BCIE and the FC in a third phase of the project. The BCIE stands on a solid financial basis. Capital was increased in 2020.

The good sustainability evaluation is a result of the plants, their quality, operations, and qualification – which indicate they will be operational for a long time – and of the concrete involvement of the BCIE in the field of renewable energies.

Sustainability rating: 2

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

Projects are evaluated on a six-point scale, the criteria being **relevance, coherence, effectiveness, efficiency, overarching developmental impact** and **sustainability**. 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.

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).