

# Ex-post evaluation

## Market development for renewable energy sources, Mexico

<b>Title</b>	FC programme for market development of renewable energy sources in Mexico		
<b>Sector and CRS code</b>	Energy generation, renewable sources (CRS code: 2321000)		
<b>Project number</b>	2013 67 010		
<b>Commissioned by</b>	Federal Ministry for Economic Cooperation and Development (BMZ)		
<b>Recipient/Project-executing agency</b>	Banco Nacional de Comercio Exterior (Bancomext)		
<b>Project volume/ Financing instrument</b>	USD 90.4 million low-interest loan		
<b>Project duration</b>	2016 to 2020		
<b>Year of report</b>	2023	<b>Year of random sample</b>	2023

### Objectives and project outline

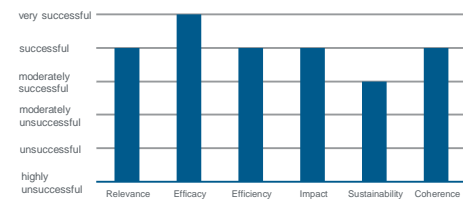
The objective at outcome level was to reduce carbon emissions through efficient, ecologically and socially responsible generation of electrical energy and to contribute to introducing a technology for global climate action to the market in Mexico that had not yet been established (at the time the programme proposal was drafted). At impact level, the objective was to improve the sustainability of Mexico's energy system. The FC Development Loan was used to fund loans from the project-executing agency for the construction of four grid-connected PV power plants.

### Key findings

The project demonstrated development effectiveness, but its sustainability at sector level is jeopardised due to political developments in Mexico. The project has been rated "successful" for the following reasons:

- The financing of grid-connected, private PV power plants laid the foundation for the further expansion of this technology in Mexico and also contributed to the achievement of the Mexican emission reduction targets.
- The project also contributed to mobilising private capital by providing additional debt capital for financing the power plants.
- The financed power plants are characterised by good effectiveness. The amount of electricity generated meets expectations, the supply to the Mexican grid was largely uninterrupted. The financed power plants were part of the issued state tenders for renewable energy sources and could therefore be built cost-efficiently. Compared to wind energy, the cost per MWh was significantly lower.
- Since the change of government in 2018, the further expansion of private PV power plants has come to a halt. The government plans that further expansion of renewable energy sources should be done exclusively by the state energy supplier. At the same time, existing private PV power plants are put at a disadvantage, as state power plants are given priority when feeding into the power grid.

Overall rating:  
**successful**



### Conclusions

- FC financed further PV power plants in Mexico following this first project, and Bancomext has also significantly expanded its PV portfolio in the meantime.
- The close support of the project by GIZ helped to strengthen important actors from politics and business.
- At the level of the individual power plants, sustainability is very good. Political developments severely limit sustainability at sector level.
- The capacity of the electricity grid is insufficient for further expansion of renewable energy sources in some regions of Mexico suitable for PV power plants.

## Ex post evaluation – rating according to OECD-DAC criteria

### Overview of sub-ratings:

Relevance	2
Coherence	2
Effectiveness	1
Efficiency	2
Impact	2
Sustainability	3
<b>Overall rating:</b>	<b>2</b>

### General conditions and classification of the project

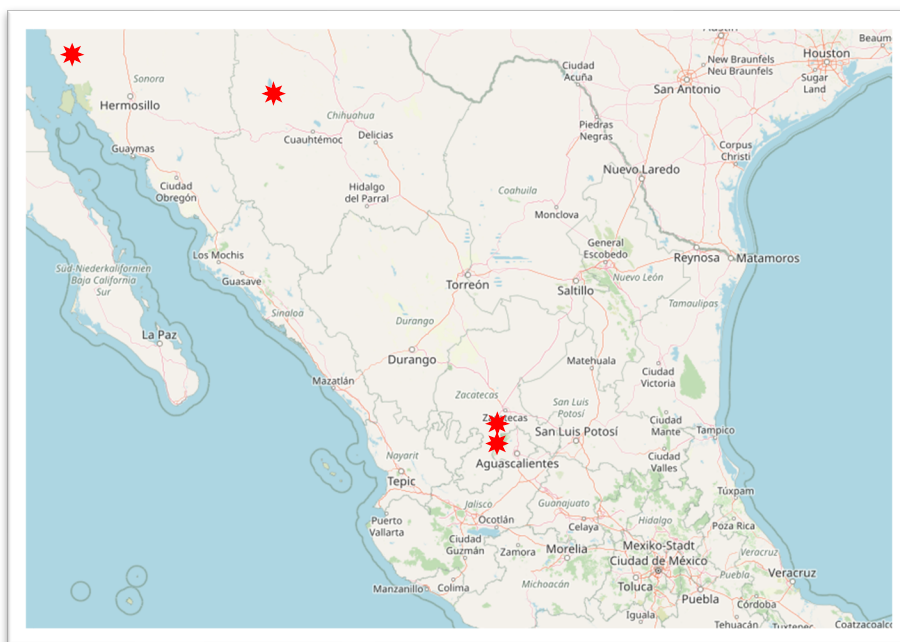
At the time of the project appraisal in 2015, Mexico played a leading role in terms of global responsibility for climate action. The “Global Climate Change Act” was passed back in 2012, as part of which Mexico was one of the first countries in the world to set carbon emission reduction targets. However, grid-connected PV power plants have not yet been able to establish themselves on the market in spite of Mexico’s very favourable geographical location in the Sun Belt due to a number of investment barriers and uncertainties.

### Brief description of the project

The aim of the project was to contribute to the introduction of a technology for global climate protection to the Mexican market that had not yet been established in Mexico, to avoid additional carbon emissions (module objective) and, as a result, to increase the sustainability of the energy system in Mexico (programme objective). With an FC development loan amounting to USD 90.4 million (equivalent to EUR 80 million) to the Mexican state development bank Banco Nacional de Comercio Exterior S.N.C. (Bancomext), a total of four grid-connected PV power plants were financed at low interest rates together with other public and private investors. Two of the financed plants are located around 20km east of the city of Aguascalientes in Central Mexico. The other two plants are located in the North Mexican states of Sonora and Chihuahua. The project was intended to create financial incentives to overcome the existing barriers to investments in renewable energy sources and to contribute to the establishment of renewable electricity generation from grid-connected PV power plants.

The target group in the narrower sense was the project developers of the grid-connected PV power plants, who acted as ultimate borrowers. The FC development loan supported the project-executing agency Bancomext in overcoming existing investment barriers in providing favourable financing conditions to the ultimate borrowers. The broader target group was the total population of Mexico, because the expansion of renewable energy sources contributes to improving the energy supply in Mexico, which is a basis for sustainable economic growth.

### Project country map



Source: OpenStreetMap

### Breakdown of total costs

		Inv. (planned)	Inv. (actual)
<b>Investment costs (total)</b>	<b>EUR million</b>	<b>605</b>	<b>605</b>
Counterpart contribution	EUR million	4.4	4.4
Debt financing	EUR million	600.6	600.6
<i>Of which budget funds</i>	<i>EUR million</i>	<i>80</i>	<i>80</i>

## Rating according to OECD-DAC criteria

### Relevance

#### *Policy and priority focus*

The objectives of the measure were in line with the then Millennium Development Goals of the German Federal Government and the current 2030 Agenda. In that context, the project contributes to Sustainable Development Goals 7, 9 and 13. At the same time, it was in line with the German DC priorities in Mexico, which are documented in the 2007 sector concept “Sustainable Energy for Development”, among other things. During the appraisal of the project in 2015, Mexico assumed a pioneering role in terms of global responsibility for climate action.

In 2012, the “Global Climate Change Act” was passed, which Mexico used to set itself specific carbon emission reduction targets as one of the first countries in the world. The expansion of renewable energy sources is expected to make an important contribution to achieving Mexico’s ambitious climate policy targets and improving its energy security. The aim is that at least 35% of energy production will come from renewable or clean (including nuclear) sources by 2024. To this end, the energy market should be open to the private sector and organised in a way that encourages competition. Energy auctions with guaranteed purchase prices for private producers were a central part of the Mexican government’s reform efforts. In addition, climate certificates were introduced, which were intended to be another source of income for producers of energy from renewable sources.

Mexico also published its Intended Nationally Determined Contribution (INDC) in 2015. These required an unconditional reduction of 25% in greenhouse gas (GHG) emissions by 2030. Mexico also proposed a 40% reduction by 2030, subject to global agreements and international support arrangements meeting certain requirements. Other positive elements of the Mexican INDC included the fact that a macroeconomic emission reduction target was defined and unconditional and conditional reductions were specified. The INDC was also based on a comprehensive assessment of all sectoral GHG sources.

The proposed measures were therefore in line with the priorities and policies of both the German and Mexican governments.

#### *Focus on needs and capacities of participants and stakeholders*

At the time of the project appraisal, Mexico had generation capacity from renewable sources of energy amounting to around 17GW. This corresponded to around a quarter of the total installed generation capacity. At the time, renewable generation from photovoltaic power plants had a small share of only 1.65% of the total generation capacity from renewable energy sources at 287MW. Mexico already had extensive experience from wind energy expansion (capacity 2006: 84MW; 2015; 3.2GW, which represents around one fifth of generation capacity from renewables). The project-executing agency Bancomext was involved in the financing of two wind power projects in 2012. Hydro power represented the largest renewable generation capacity with a share of 70%.

As a populous emerging economy with strong economic development, Mexico plays a special role in sustainable development in Latin America (particularly for Central America and the Caribbean). Against the backdrop of depleting fossil fuel reserves, Mexico’s increasing dependence on energy imports, and the growing environmental and climate impact of conventional energy supply, the great potential for the use of renewables has so far been insufficiently exploited. The climatic conditions, especially for the use of wind and solar energy, are among the best in the world. At the same time, the PV modules required to generate electricity from solar energy have become increasingly cheaper.

Despite Mexico’s favourable geographical location in what is known as the “Sun Belt”, grid-connected PV power plants could not yet be established on the market at the time due to a number of investment barriers. These include, in particular, the high regulatory and financial risks arising from the uncertainty surrounding the restructuring of the Mexican electricity market in the course of the adopted energy reform. At that time, the project developers and investors did not have any reliable commitments with regard to electricity purchase prices, so the development of new PV projects was subject to major financial risks. In addition, at the time of the project appraisal, the executing agency Bancomext had little experience in connection with the credit analysis and structuring of

financing projects in the area of solar PV. This also applied to the evaluation and mitigation of risks in the area of environmental and social sustainability.

Since power generation and its feed-in into the national grid are measures that are not aimed at certain target groups, there is no specific target group benefiting from the project in the narrower sense in which the needs and capacities of particularly disadvantaged or vulnerable groups would have been taken into account. This also applies to gender impact potential. No further potential can be identified ex post due to a different conceptual design.

The core problem of inadequate exploitation of the potential for renewable energy sources, in particular in the field of photovoltaics, was subsequently correctly identified. The project addressed the existing investment barriers by providing long-term financing at favourable loan conditions. It was thus able to contribute to solving the core problem. This was appropriate at the time as well as now. As a result, the development of generation capacity from grid-connected PV power plants increased significantly.

### ***Appropriateness of design***

The granting of a low-interest FC development loan for eligible grid-connected PV power plants was intended to create financial incentives to overcome the existing investment barriers and to demonstrate that electricity generation with photovoltaic solar power plants in Mexico is technically feasible and economically viable.

The project was therefore in line with the strategy and objectives of the Mexican government and was conceptually suitable for contributing to the reduction of global greenhouse gas emissions and the establishment of grid-connected PV power plants in the Mexican market.

However, the objective of “reducing carbon emissions” defined in the module proposal does not appear appropriate, as it was not expected, even at the time of the project appraisal, that electricity generation from fossil sources – and thus the aforementioned carbon reduction – would accompany the development of renewable capacities. As part of the ex post evaluation, the target was therefore adjusted so that the focus is now on avoiding additional carbon emissions by avoiding the alternative expansion of fossil generation capacity.

For the project, the following theory of change was assumed during the appraisal: Awarding of low-interest loans for the construction of solar PV power plants (input) → Grid-connected solar PV power plants are properly planned, built and operated (output) → Avoidance of additional carbon emissions through the efficient, ecologically and socially responsible generation of electrical energy and contribution to introducing a technology for global climate protection to the market that has not yet been established in Mexico (outcome) → The sustainability of the energy system in Mexico is increased (impact). Apart from the objective of reducing carbon emissions, the underlying theory of change and its impact relationships were plausible at the time of the appraisal and the ex post evaluation (EPE).

### ***Response to changes/adaptability***

At the conceptual level, there was no need for adjustments to be made during the course of the project. The FC development loan was fully disbursed to Bancomext, and repayment was made according to plan.

### ***Summary of the rating:***

In summary, the relevance of the project was high at the time of the project appraisal and from today's perspective. It was aligned with the priorities and objectives of the partners and the German Federal Government, and was aligned with the needs of the Mexican energy sector.

**Relevance: 2**

## Coherence

### *Internal coherence*

The project was part of the DC programme “Sustainable Energy in Mexico” of German development cooperation with Mexico. It was closely flanked by the TC project “Solar Energy Program Mexico (DKTI Solar)”, which supported important players from politics, science and business in the development and implementation of strategies to increase the share of solar energy. In addition, the GIZ project strengthened Bancomext’s institutional capacity. The Bancomext employees relevant to the project were supported and trained in the analysis, risk assessment and structuring of grid-connected PV projects. In addition, GIZ provided consulting services to improve methods for the economic and financial analysis of PV projects. The German Federal Ministry for Economic Cooperation and Development (BMZ) country strategy in effect at the time explicitly provided for the promotion of renewable energy sources as a focal point of the cooperation. The project was also embedded in the German Federal Ministry for Economic Cooperation and Development (BMZ) sector concept: “Sustainable development for energy”. The development of renewable generation capacity, including through solar energy, was explicitly mentioned there as a field of assistance.

### *External coherence*

The project was in line with the Mexican government’s strategy and objectives at the time and was conceptually suitable for contributing to reducing global greenhouse gas emissions. In 2015, the Mexican government passed the Energy Transition Act, which stipulates that 35% of the energy produced should come from non-fossil sources by 2024 (50% by 2050). Bancomext’s business plan for the period 2013–2018 specifically provided for support to the private sector in general and for long-term financing of renewable energy projects in particular. The four PV power plants financed and built as part of the project were financed in cooperation with various private and public co-financiers such as NAFIN, Banobras, NADB and IFC, which also underlines the successful mobilisation of private capital through the FC loan. The power plants were built in accordance with the “IFC Performance Standards”. From today’s perspective, the project would no longer be compatible with the Mexican government’s objectives, as electricity generation from renewable energy sources is now to be performed almost exclusively by the state energy supplier Comisión Federal de Electricidad (CFE), and private actors are increasingly disadvantaged.

### *Summary of the rating:*

The internal and external coherence of the project were good. The project was characterised by its precise embedding in Mexico’s climate strategy goals in general and Bancomext’s business plan in particular. It pursued development policy objectives that were explicitly mentioned both in the German Federal Ministry for Economic Cooperation and Development (BMZ) country strategy relevant at the time and in the relevant German Federal Ministry for Economic Cooperation and Development (BMZ) sector concept. Furthermore, the project was appropriately supported by the GIZ project “Solar Energy Program Mexico (DKTI Solar)”, which supported important actors from politics, science and business in the development and implementation of strategies to increase the share of solar energy (DC from a single source). Last but not least, the four PV power plants relevant to the project were financed in cooperation with various public development banks.

**Coherence: 2**

## Effectiveness

The goal adjusted as part of the EPE was to avoid additional carbon emissions through efficient, ecologically and socially responsible generation of electrical energy and to contribute to introducing a technology for global climate protection to the market in Mexico that had not yet been established.

The target achievement at outcome level is summarised in the table below:

Indicator	Status during PA	Target value acc. to PA/EPE	Actual value at final inspection (optional)	Actual value at EPE (if relevant, FC share)
(1) Installed power generation capacity of the financed PV power plants	0MW	120MW	666MWpeak	Total: 692.2MWpeak 563MWac  FC share: 153.3MWpeak 124.9MWac <b>Achieved</b>
(2) Average annual electricity production of the financed PV power plants	0MWh	240,000MWh	1,441,919MWh	Total: 1,518,035MWh/year  FC share: 336,700MWh <b>Achieved</b>
(3) Avoidance of annual carbon emissions from the financed PV power plants	0tCO <sub>2</sub> e/year	130,000tCO <sub>2</sub> e/year	761,333 tCo <sub>2</sub> e/year	Total: 713,125tCO <sub>2</sub> e/year  FC share: 158,171tCO <sub>2</sub> e/year <b>Achieved</b>
(4) Mobilisation of private financing (equity of project developers and debt capital of commercial banks) for investments in grid-connected PV power plants.	EUR 0	EUR 60 million	EUR 156.4 million	EUR 179 million <b>Achieved</b>
(5) Provision of financing for investments in grid-connected PV power plants by public banks.	EUR 0	EUR 160 million	–	EUR 290 million <b>Achieved</b>
(6) The electricity produced is fed into the grid and remunerated.	No	Yes	Yes	Yes <b>Achieved</b>
(7) Leverage of the total investment mobilised by FC	0	5	0	6.7 <b>Achieved</b>

### **Contribution to achieving targets**

The indicators for measuring the installed output, annual energy production and the avoidance of carbon emissions by the four financed PV power plants were all achieved. This also applies after the actual values have been reduced to the share of the power plants financed by the FC loan calculated as part of the EPE. In total, the

construction of the four PV plants generated 692.2MW<sub>peak</sub> (563MW<sub>ac</sub><sup>1</sup>) of newly installed output. With regard to the share of the total investment financed by the FC Development Loan, 153.3MW<sub>peak</sub> (124.9MW<sub>ac</sub>) remained, exceeding the target value of 120MW. The four power plants produce 1,518,035MWh of electricity per year (average value 2020 to 2022), of which 336,700MWh can be attributed to FC financing. The target of 240,000MWh was thus exceeded. Climate-neutral electricity production has contributed overall to avoiding 713,125tCO<sub>2e</sub><sup>2</sup> per year (FC share 158,171tCO<sub>2e</sub> per year), with a target value of 130,000tCO<sub>2e</sub>.

The target values for the mobilisation of public (EUR 160 million) and private (EUR 60 million) funds were significantly exceeded with actual values of EUR 290 million and EUR 179 million, respectively. The funds provided by KfW Development Bank were leveraged by a factor of 6.7 through additional public and private funds. Since commissioning, all power plants have been able to feed the generated electricity into the national grid with hardly any interruptions, with the exception of a few days at the start of commissioning.

Two of the four power plants financed in this project were also co-financed by private lenders. In addition, the project developers clearly met the minimum requirement for the equity to be contributed in the amount of 20%.

### ***Quality of implementation***

The close support the project received from the GIZ project “Solar Energy Program Mexico (DKTI Solar)”, as well as the SBF-financed measure to strengthen the project-executing agency, helped Bancomext to develop guidelines and procedures for evaluating the environmental and social impacts and to improve the analytical competence for evaluating financing projects in the renewable energy sector.

All inspected plants are operated and maintained by professional O&M companies on the basis of long-term contracts. The staff were well trained in their relevant areas of expertise. All three plants were constructed with steel beams driven vertically into the soil. The substations belonging to the PV plants are of high quality, taking into account international and electrical safety standards. The visited plants are equipped with a protective fence around the entire facility, including a video surveillance system. All plants have a fully equipped weather station and are additionally equipped with decentralised anemometers, which are intended to place the modules in a horizontal protective position to protect against squalls.

The project did not have a gender-specific component. Nearly 120 staff members are employed in the operation and maintenance of the power plants at the four locations. Around 70% of these employees come from the surrounding communities, and around 15% of the employees are women.

### ***Unintended effects***

The owners of the PV power plants have developed social investment plans for the local communities around the installed power plants. For example, there is a cooperation with the University of Hermosillo, where students are trained in renewable energy sources. In addition, regular material donations, including PV modules, are made to the university.

The flora removed when building the plants was replanted in the area surrounding the power plants. In addition, there are further afforestation plans at the sites, which are already being implemented.

All three plant locations visited are located in areas with excellent solar irradiation values. However, temperatures at the La Orejana site are increasingly reaching 50 degrees Celsius in the summer, which greatly reduces the efficiency of the modules. Nevertheless, all plants exceed the calculated generation capacity by a factor in double-digit percentages.

### ***Summary of the rating:***

The defined target values for all seven indicators for measuring success were exceeded – in some cases dramatically. The quality of the implementation was also very good. The financed PV power plants that were visited are characterised by very high quality in the areas of construction material, operation and maintenance. Last but not

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<sup>1</sup> By converting from direct to alternative current and transforming to medium/high voltage, 563MW can actually be used in the power grid.

<sup>2</sup> Basis: grid emission factor Mexico.



least, the private power plant owners have social investment plans for the surrounding communities. Overall, the effectiveness is rated as very successful.

### Effectiveness: 1

## Efficiency

### *Production efficiency*

The total costs of the four financed PV power plants in the solar farms amounted to USD 605 million. Of this, EUR 90.4 million was financed to Bancomext from the loan under financial cooperation. The loan from KfW Development Bank was used in full. Bancomext has also provided its own funds in the amount of around USD 5 million for financing the four power plants. The minimum requirement of 20% equity of the project developers was met for all plants. The construction work was tendered cost-effectively on the basis of an international competition. The cost per MW of installed capacity of the four power plants ranged from USD 1.044 million to USD 1.112 million. This meant that they were around USD 100 more expensive per MWh than the current average, now that prices for PV modules have since decreased significantly. The price differences between the individual plants result, among other things, from the fact that two PV power plants were erected in the direct vicinity of each other. In this case, the first power plant to be built also bore the costs for the necessary substation, which is also used by the second power plant. In addition, the transmission capacity of an existing power transmission line had to be expanded in order to ensure uninterrupted grid feed-in of the generated power. Last but not least, the land for construction was purchased at two plants, and leased at the other two plants.

For all financed PV power plants, any necessary expansion of the grid infrastructure, including the substation, had to be carried out and financed by the respective power plant project, but after commissioning became the property of the state energy supplier CFE. In one of the installed substations, a capacitive compensation system was identified, which was a stipulation of the state energy supplier. This plant should be used for any necessary reactive power compensation, but is not necessary, as the inverters of the PV plant already contain the functionality of reactive power compensation.

The KfW Development Bank loan was signed by Bancomext in April 2016. The loan agreements between Bancomext and the project-executing agencies were first concluded in August and September 2017. The main reason for the delay was that the framework conditions for the planned public tenders for renewable energy sources had not yet been definitively published at this time and the private project developers were therefore not able to further develop the projects.

The loan conditions and the support from Bancomext in the preparatory phase were highlighted positively by the project-executing agencies.

### *Allocation efficiency*

The four financed PV power plants were part of the issued state tenders for renewable energy sources. A total of three tender rounds were carried out in 2016 and 2017. A total of around 3,400MW of generation capacity was awarded. Even at the first auction in 2016, the bidders demonstrated the most interest in solar energy. The four financed power plants were awarded the contract during the second round of tenders. 54% of the capacity issued in this round was allocated to PV power plants. The average price per MWh achieved by the PV bidders was USD 25. By way of comparison, the average price for one MWh of wind power was close to USD 36. Generation from PV power plants was thus significantly cheaper than generation from wind power plants. The average price per MWh fell from around USD 45 in the first auction to around USD 20 in the third round of auctions.

### *Summary of the rating:*

On the basis of the very favourable prices per MW, which were achieved not least through the use of the auction-based public tendering procedure, very good efficiency was generally achieved. However, only good overall efficiency was achieved due to the forced transition of infrastructure to state property and the forced construction of unnecessary compensation systems.

### Efficiency: 2

## Impact

### Overarching developmental changes (intended)

The objective adopted without changes as part of the EPE was to contribute to increasing the sustainability of the energy system in Mexico.

Target achievement at the impact level can be summarised as follows:

Indicator	Status PA	Target value at PA	(Optional) actual value at final inspection	Actual value at EPE FC share
(1) Increase in annual generation of primary energy from renewable energy sources	0GWh/year	More than 0GWh/year	–	Total: 1,518GWh/year  FC share: 336.7GWh/year <b>Achieved</b>
(2) Increase in annually avoided greenhouse gas emissions	0tCO2e/year	More than 0tCO2e/year	–	Total: 713,125tCO2e/year  FC share: 158,171tCO2e/year <b>Achieved</b>

The installed capacity of PV power plants in Mexico increased from 287MW in 2015 to 9,339MW in 2022, which means that around 9% of the total national electricity generation capacity in 2022 came from PV power plants (2015: 0.42%). The share of renewable energy in total capacity was 31.2% in 2022. The project contributed to this development by financing plants with a total generation capacity of 563MW (approx. 7.5% of the capacity increase). Compared to alternative renewable generation from wind power plants, the expansion of grid-connected PV power plants took place significantly more quickly. While the generation capacity from wind power plants was still more than 11x higher than the generation from PV power plants in 2015, the installed capacity from PV power plants in 2022 is around 27% higher than wind-based generation capacity. The following table shows the development of the expansion of renewable generation capacity in Mexico from the time of the project appraisal to today.

Installed output by RE technology in MW	2015	2022	Change
<b>Solar PV</b>	<b>287</b>	<b>9,339</b>	<b>+ 3,154%</b>
Wind	3,271	7,313	+ 124%
Hydroelectric power	12,223	13,303	+ 9%
Other (biomass, geothermal, CSP, etc.)	1,634	1,999	+ 22%
<i>Total RE</i>	<i>17,415</i>	<i>31,954</i>	<i>+ 83%</i>
<i>Total</i>	<i>67,763</i>	<i>102,417</i>	<i>+ 51%</i>

Source: IRENA Renewable Energy Statistics 2023

### ***Contribution to overarching developmental changes (intended)***

The target values for the two impact indicators were achieved. The actual values were reduced to the FC financing share. Through the commissioning of the financed power plants, electricity was generated from renewable sources and fed into the national Mexican electricity grid. At the same time, it was possible to avoid alternative generation from fossil sources and thus the emission of corresponding greenhouse gases. The four plants financed from the KfW development loan increased the energy generated from renewable energy sources in Mexico by 1.518GWh (FC share 336.7MWh) per year and led to avoided carbon emissions from alternative generation from fossil sources of 713,125 tonnes of CO<sub>2</sub> (FC proportionately 158,171tCO<sub>2</sub>) per year. The project thus contributed to improving the sustainability of Mexico's energy system. However, the target values defined as part of the module proposal are not very ambitious. In addition, there was apparently no comparison with the analogously defined targets and corresponding target values at outcome level.

The project also paved the way for financing further grid-connected PV power plants by KfW Development Bank (via Mexican development banks) as well as by other public and private donors. The project-executing agency Bancomext alone has expanded its portfolio of financing for grid-connected PV power plants to 25 plants with a financing volume of more than USD 545 million. Today, Bancomext is one of the most active financiers of PV power plants in Mexico. Building on these first steps through the project, commercial banks have also developed a strong interest in financing grid-connected PV power plants.

### ***Contribution to (unintended) overarching developmental changes***

No positive or negative unintended overarching developmental changes could be identified as part of the EPE.

### ***Summary of the rating:***

The project paved the way for the construction of further grid-connected PV power plants, in particular with regard to the further activities of the project-executing agency Bancomext, but also with regard to nationwide development. The project's positive developmental impacts thus go far beyond the direct impacts of the project and are rated as "successful". The four PV power plants were built at a time when this type of power plant was only just established in Mexico, both in terms of the new regulatory environment and from a technical and credit perspective. Despite these hurdles, all four power plants were able to be built and put into operation on time and on budget, and constantly feed the generated energy into the nationwide power grid. The power plants provided a positive signal for other private investors to become involved in the sector since then.

In summary, the project successfully contributed to achieving the overarching developmental changes.

**Impact: 2**

## **Sustainability**

### ***Capacities of participants and stakeholders***

The ongoing operation of the constructed turbines is guaranteed both technically and financially on a permanent basis. All four plants have long-term power purchase agreements (PPAs) with the state energy supplier CFE in order to be able to feed the majority of the electricity produced into the nationwide interconnected grid at a contractually guaranteed tariff. At least the three plants visited are operated and maintained by professional maintenance and operating staff by means of an O&M contract. All three plants have spare parts warehouses, there are regular maintenance schedules and it is also possible to carry out unscheduled maintenance work for the three plants. The facilities are monitored by security teams and by video. In addition, there are technical protective measures that can put the plants into safe operating states in the event of storms and other weather influences. All flora removed for the building of the power plants was reforested in the vicinity of the respective power plant location

### ***Contribution to supporting sustainable capacities***

FC supported its partner bank Bancomext with environmental and social impact assessment (ESIA) as part of project preparation and implementation using consultants financed by the Study and Consultancy Fund (SBF). In

In addition, Bancomext received support from SBF-funded measures in the further development of an institution-wide environmental and social management system for compliance with international standards. GIZ supported these measures with consulting services to improve the methods for the economic and financial analysis of PV projects. The project-executing agency Bancomext is now involved in the financing of a total of 25 solar farms with a volume of lending amounting to more than USD 545 million. This makes Bancomext one of the most active Mexican financiers of PV power plants. Thanks to the project evaluated ex post here, Bancomext became a pioneer in financing projects in the area of renewable energy sources in Mexico. The majority of subsequent financing of grid-connected PV power plants took place between 2017 and 2021, mostly via KfW Development Bank's other financing lines. Following this project, KfW Development Bank has also granted loans to other Mexican development banks, in addition to Bancomext, to finance new PV power plants.

The PV modules are cleaned one to three times a year, depending on contamination levels. The water required for this comes from wells located a maximum of 20km away from the respective plant, and the water is transported from those wells by truck. A water-saving procedure is used for cleaning the modules, which limits the water requirement for cleaning one module to 1/2 litre of water. With over 1 million modules per system, 500 cubic metres of water are sufficient for each cleaning. There is an official permit for the extraction of water in far more than the required quantity. Defective PV modules are disposed of properly by subcontractors. The relevant laws and regulations are taken into account.

### ***Durability of impacts over time***

All three visited plant sites are located in areas with excellent solar irradiation values. However, temperatures at the La Orejana site reach up to 50 degrees Celsius in the summer, which greatly reduces the efficiency of the modules. The La Orejana and Santa Maria plants were built in areas where there is a lot of sunlight, but the electricity grid is not sufficiently developed. Further expansion of energy generation capacities in these areas can lead to bottlenecks in the feed-in of the generated energy. Specifically, a new 1,000MW PV power plant from the state-owned energy supplier CFE is currently being built. This is just like the La Orejana power plant financed by KfW Development Bank in the state of Sonora, which only has insufficient electricity transmission infrastructure. Here, there is a risk that the La Orejana power plant will no longer be able to feed in uninterrupted electricity in the future. The state-owned energy transmission company CFE does not currently have the necessary funds to expand the grid. This problem could be exacerbated by the Mexican government's decision to feed electricity from power plants of the state-owned energy supplier CFE into the grid as a priority.

Since the change of government in 2018, the further expansion of private grid-connected PV power plants has largely come to a halt. No further tender rounds have been started and no new licences have been issued. The further expansion is now to be carried out exclusively by the state-owned electricity supplier CFE. However, apart from the aforementioned 1,000MW power plant in Puerto Peñasco, no further expansion plans are currently known. At least it will probably be possible for the private plants currently under construction to be put into operation in the future.

Private electricity generation from PV plants with a capacity of less than 500kW is still possible and is growing steadily. However, large plants may only be operated by the state energy supplier CFE. Although the Mexican government has committed to reducing carbon emissions by up to 50% by 2050 as part of the renewal of its NDCs, the way forward is largely uncertain. In addition, the government's decision to classify gas-fired combined power plants as climate-neutral in order to achieve the climate targets appears questionable.

### ***Summary of the rating:***

With regard to the sustainability of the project, a distinction must be made between sustainability at the level of the financed power plants and sustainability at the level of the Mexican energy sector.

Sustainability is successful at the level of the four power plants. The quality of the power plants' construction is good and they are operated and maintained sustainably. The generation and supply of electricity is largely disruption-free and thus also enables financially sustainable operation for the owners. The project-executing agency Bancomext has established itself as a financier of PV power plants and has significantly expanded its portfolio.

At sector level, some aspects speak against successful sustainability, as illustrated. The policy of the government that came into power in 2018 prevents the further expansion of private energy production from renewable

sources and also puts existing power plants at a disadvantage by prioritising government electricity production in the feed-in. As a result, sustainability is more at risk at sector level.

Overall, the project's sustainability is rated as moderately successful.

### Sustainability: 3

## Overall rating: 2

By providing favourable financing conditions, the project made a visible contribution to the market introduction and, as a result, the establishment of grid-connected PV power plants in Mexico. At the time of the project appraisal, production capacities from PV power plants of just 287MW existed in Mexico. This capacity was more than tripled by the project's four co-financed power plants. In 2021, the total installed capacity of PV power plants in Mexico was 9,339MW, more than thirtyfold since the time of the project appraisal. In addition to simply financing the power plants, a complementary SBF-financed measure also contributed to strengthening the personnel capacities of the project-executing agency Bancomext in the area of environmental and social sustainability management. Last but not least, the FC project was closely supported by a GIZ-financed measure to advise important political, scientific and economic actors on the development and implementation of strategies to increase the share of solar energy and to strengthen Bancomext's institutional capacity in the analysis, risk assessment and structuring of grid-connected PV power plants. As a result, 25 PV power plants have now been financed by Bancomext, partly with financial support from FC. The construction of the four financed power plants was of good quality and they are operated well, which results in expectations that disruption-free electricity generation can be expected in the future, as well. It was possible to feed in the generated power at any time since commissioning – apart from minor initial disturbances. In summary, without considering the political developments that have a negative impact on the renewable energy sector, one could speak of a very good overall result.

Unfortunately, the change of government in 2018 caused Mexico's energy and climate policy priorities to change significantly. On the one hand, there was a departure from the involvement of the private sector in the expansion of (renewable) generation capacity. The expansion is expected to be driven forward solely by the state energy supplier CFE. On the other hand, existing private renewable generation has been put at a disadvantage compared to state production, as state-generated power is allowed to feed into the electricity grid as a priority. To date, this has not resulted in the four power plants financed under the project being unable to feed in their production. In the future, however, in regions with insufficient grid expansion, corresponding hurdles are to be expected. As a result, we rate the overall success of the project as good.

## Contributions to the 2030 Agenda

The project's contribution to the national implementation of the 2030 Agenda relates to the Sustainable Development Goals (SDGs) 7 (Affordable and Clean Energy) and 13 (Climate Action), which specifically refer to increasing the share of renewable energy sources and combating global climate change by reducing GHG emissions. The installation of grid-connected PV power plants increases annual primary energy generation from new renewable energy sources. In addition to reducing carbon emissions, which benefits the global population as a whole, the project also contributes to modernising the electricity supply and sustainably increasing economic growth in Mexico.

## Project-specific strengths and weaknesses as well as cross-project conclusions and lessons learned

The project had the following strengths and weaknesses in particular:

### Strengths:

- Good alignment with the country's political priorities
- Close integration with the corresponding GIZ activities
- The construction of the financed PV power plants was of good quality and the plants visited are in good condition.

- Following this project, KfW Development Bank has granted further loans to the Mexican development banks Bancomext and NAFIN to fund PV power plants.
- Private banks have provided additional debt capital to fund the PV power plants, and the project has therefore also contributed to mobilising private capital.

Weaknesses:

- Since the change of government in 2018, the further expansion of private PV power plants has come to a halt. Grid-connected renewable generation is to be expanded solely by the state-owned energy supplier CFE. In addition, existing private solar power plants are put at a disadvantage, as generation and feed-in from state power plants now take priority.

## Conclusions and lessons learned:

The project undoubtedly contributed to the introduction and establishment of grid-connected PV power plants in Bancomext's loan portfolio, but also in Mexico as a whole. The provision of favourable financing mitigated the existing financing barriers, which were caused by regulatory uncertainty, among other things.

Lessons learned mainly include the following aspects:

- 1) The project-executing agency Bancomext received support in this previously unknown business sector through targeted technical and personnel support in the areas of environmental and social compatibility as well as credit-related analysis and structuring of corresponding financing projects, which contributed significantly to the success of the project.
- 2) The close cooperation with the TC project "Solar Energy Program Mexico (DKTI Solar)", which supported important political, scientific and economic actors in the development and implementation of strategies to increase the share of solar energy, paved the way for the success of the FC measure and is a prime example of the positive interaction of technical and financial cooperation as pillars of German DC.
- 3) Despite the enormous expansion of the generation capacities of grid-connected PV power plants in Mexico between 2015 and 2022, the change of government brought the construction of new power plants to a halt. It has been shown that changes in policy framework conditions that cannot be significantly influenced either in the context of project design or in the implementation phase can seriously jeopardise the long-term success of the project.

## Evaluation approach and methods

### Methodology of the ex post evaluation

The ex post evaluation follows the methodology of a rapid appraisal, which is a data-supported qualitative contribution analysis and constitutes an expert judgement. This approach ascribes impacts to the project through plausibility considerations which are based on a careful analysis of documents, data, facts and impressions. This also includes – when possible – the use of digital data sources and the use of modern technologies (e.g. satellite data, online surveys, geocoding). The reasons for any contradicting information are investigated and attempts are made to clarify such issues and base the evaluation on statements that can be confirmed by several sources of information wherever possible (triangulation).

#### Documents:

KfW's internal project documentation, project-executing agency documentation, information from the German Federal Ministry for Economic Cooperation and Development (BMZ) and GIZ.

#### Data sources and analysis tools:

Databases from relevant donors as well as national and international institutions

#### Interview partners:

Project-executing agency, target group, GIZ, project developer, local solar industry association

The analysis of impacts is based on assumed causal relationships, documented in the results matrix developed during the project appraisal and, if necessary, updated during the ex post evaluation. The evaluation report sets out arguments as to why the influencing factors in question were identified for the experienced effects and why the project under investigation was likely to make the contribution that it did (contribution analysis). The context of the development measure and its influence on results is taken into account. The conclusions are reported in relation to the availability and quality of the data. An evaluation concept is the frame of reference for the evaluation.

On average, the methods offer a balanced cost-benefit ratio for project evaluations that maintains a balance between the knowledge gained and the evaluation costs, and allows an assessment of the effectiveness of FC projects across all project evaluations. The individual ex post evaluation therefore does not meet the requirements of a scientific assessment in line with a clear causal analysis.

#### The following aspects limit the evaluation:

Documents on the Federal Ministry for Economic Cooperation and Development (BMZ) and partner strategy were only available to a limited extent at the time of project design and appraisal.

### Methods used to evaluate project success

A six-point scale is used to evaluate the project according to 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 from a weighting of all six individual criteria as appropriate to the project in question. Rating levels 1-3 of the overall rating denote a "successful" project while rating levels 4-6 denote an "unsuccessful" project. It should be noted that a project can generally be considered developmentally



“successful” only if the achievement of the project objective (“effectiveness”), the impact on the overall objective (“impact”) and the sustainability are rated at least “moderately successful” (level 3).

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**List of annexes:**

Target system and indicators annex

Risk analysis annex

Project measures and results annex

Recommendations for operation annex

Evaluation questions in line with OECD DAC criteria/ex post evaluation matrix annex

## Target system and indicators annex

Project objective at outcome level		Rating of appropriateness (former and current view)			
<p>During project appraisal: Reduction of carbon emissions through efficient, ecologically and socially responsible generation of electrical energy and contribution to the introduction of a technology for global climate action to the market that has not yet been established in Mexico.</p>		<p>Energy production from renewable sources is carbon-emission-free, but does not reduce existing issues. The goal of reducing carbon emissions therefore appears then as it does today – in particular with constantly increasing energy demand – implausible. Arguments can be put forward for avoiding additional carbon emissions by avoiding the expansion of fossil energy production.</p> <p>The goal of contributing to the market introduction of a previously unestablished technology for global climate action in Mexico seems plausible then as well as today.</p>			
<p>During EPE (target modified): Avoidance of additional carbon emissions through efficient, ecologically and socially responsible generation of electrical energy and contribution to the introduction of a technology for global climate action to the market that has not yet been established in Mexico.</p>					
Indicator	Rating of appropriateness (for example, regarding impact level, accuracy of fit, target level, smart criteria)	PA target level	PA status (2015)	Status at final inspection (2021)	Status at EPE (2023)
Indicator 1 (PA) Installed power generation capacity of grid-connected solar PV power plants promoted under the programme, after completion	Indicator and target level generally appear appropriate in terms of content.	120MW	0MW	666MW peak	Total: 692.2MW peak 563MWac  Based on KfW's share: 153.3MW peak 124.87MWac
Indicator 2 (PA) Electricity production of grid-connected solar PV power plants promoted under the programme, measured one year after completion	Indicator and target level generally appear appropriate in terms of content.	240,000MWh/year	0MW/year	1,441,919MWh/year	Total: 1,518,035MWh/year  Based on KfW's share: 336,700MWh/year
Indicator 3 (PA) Reduction of annual carbon emissions through the grid-	The reduction in carbon emissions appears implausible, in particular with regard to constantly increasing energy	130,000tCO <sub>2</sub> e/year	0tCO <sub>2</sub> e/year	761,333tCO <sub>2</sub> e/year	Total: 713,125tCO <sub>2</sub> e/year ar

<p>connected solar PV power plants promoted under the programme, measured one year after completion</p>	<p>demand, as it can be presumed that no existing power plants were shut down. In this respect, the indicator can alternatively be formulated as follows: <i>Avoidance of annual carbon emissions through the grid-connected solar PV power plants promoted under the programme, measured one year after completion</i></p> <p>The target level is derived from the target level of generation capacity and therefore generally seems appropriate.</p>				<p>Based on KfW's share: 158,171tCO<sub>2</sub>e/year</p>
<p>Indicator 4 (PA) Mobilisation of private financing (equity from project developers) for investments in grid-connected solar PV power plants</p>	<p>The indicator appears appropriate in terms of content, as the project developers' own contributions demonstrate their fundamental willingness to invest in the new technology and thus ultimately also suggest a corresponding improvement in the general framework conditions. However, the mobilisation of private debt capital for investments in grid-connected solar PV power plants should also be measured (do private banks provide debt capital for these types of projects so that development banks can withdraw in the future?) In this respect, the indicator can alternatively be formulated as follows: <i>Mobilisation of private financing (equity from project developers and debt capital from commercial banks) for investments in grid-connected solar PV power plants.</i></p> <p>The target level cannot be meaningfully defined in advance, as it depends largely on the size of the investments to be financed and the debt capital provided by private and public banks. A percentage figure (proportion of the total financing) therefore seems more suitable.</p>	<p>EUR 60 million</p>	<p>EUR 0</p>	<p>EUR 156.4 million</p>	<p>EUR 179 million<sup>1</sup></p>
<p>Indicator 5 (PA) Mobilisation of public Mexican financing (Bancomext) for investments in grid-connected solar PV power plants</p>	<p>The indicator falls too short as it limits itself to Bancomext. During the course of the project, it became apparent that other public Mexican banks were able to provide debt capital for the three solar PV power plants financed by the module. The Nafin financing share is also funded by KfW.</p>	<p>EUR 160 million</p>	<p>EUR 0</p>	<p>Open</p>	<p>EUR 290 million</p>

<sup>1</sup> EUR/USD: 1.0866 on 30 June 2023

	<p>In this respect, the indicator can alternatively be formulated as follows: <i>Provision of financing for investments in grid-connected solar PV power plants by public banks.</i></p> <p>The target level cannot be meaningfully defined in advance, as it largely depends on the size of the plants to be financed, co-financing by private banks and the equity share of the project developers. A percentage figure (proportion of the total financing) therefore seems more suitable.</p>				
<p>Indicator 6 (PA) The electricity produced is fed into the grid and remunerated.</p>	<p>The indicator appears appropriate in terms of content, but disregards how reliably the feed-in took place as a purely qualitative indicator.</p>	Yes	No	Yes	Yes
<p>NEW: Indicator 7 Total mobilised investment and KfW's share</p>	<p>The indicator measures the extent to which KfW's investment could be leveraged by further funds.</p>				1:6.69

<b>Project objective at impact level</b>		<b>Rating of appropriateness (former and current view)</b>			
<p>During project appraisal: The sustainability of the energy system in Mexico has increased.</p>		<p>The objective at impact level seems appropriate then as well as today.</p>			
<p>During EPE (if target modified): N/A</p>					
<b>Indicator</b>	<b>Rating of appropriateness</b> (for example, regarding impact level, accuracy of fit, target level, smart criteria)	<b>Target level</b> PA / EPE (new)	<b>PA status</b> (2015)	<b>Status at final inspection</b> (2021)	<b>Status at EPE</b> (2023)
<p>Indicator 1 (PA) Increase in annual primary energy generation from renewable energy sources</p>	<p>The indicator generally appears appropriate to measure the contribution of the financed solar PV power plants to the increase in annual primary energy generation from renewable energy sources. However, as a unit, the recommendation is to use GWh per year.</p>	>0GWh/a	0GWh/a	N/A	<p>Total: 1,518GWh/year</p> <p>Based on KfW's share: 336.7GWh/year</p>

<p>Indicator 2 (PA) Increase in annual savings in energy consumption</p>	<p>The indicator is not appropriate for the project, as energy savings are not the objective of the project.</p>	<p>&gt;0PJ/a or GWh/a</p>	<p>0PJ/a or GWh/a</p>	<p>N/A</p>	<p>Not relevant for module</p>
<p>Indicator 3 (PA) Increase in annual avoided greenhouse gas emissions</p>	<p>The indicator is appropriate as it reflects the main objective of the module (reduction of carbon emissions).</p>	<p>&gt;0tCO<sub>2</sub>e/a&gt;0</p>	<p>0tCO<sub>2</sub>e/a</p>	<p>N/A</p>	<p>Total: 713,125tCO<sub>2</sub>e/ye ar  Based on KfW's share: 158,171tCO<sub>2</sub>e/ye ar</p>

## Risk analysis annex

Identification of the risks that have occurred (ex ante, identified during the course of the project and ex post)

Risk	Relevant OECD-DAC criterion
Delays due to initially unclear operationalisation of the reform and opening of the electricity market (during the course of the project)	Efficiency
<p>Mexican government's declining commitment with regard to reducing carbon emissions – including through the promotion of renewable energy sources (ex-ante)</p> <p>Forced transfer of built infrastructure to state property (during the course of the project)</p>	Sustainability

## Project measures and their results annex

The project measures included the award of a low-interest FC development loan to the project-executing agency Bancomext for passing on discounted loan conditions to private investors or project developers of the four solar PV power plants.

An SBF-financed programme was used to train Bancomext employees in the areas of environmental and social impact assessment and management.

The following power plants were financed with the FC funds:

Last name	Location	Capacity	Start-up of operation date
La Orejana	La Orejana, State of Sonora, Mexico	162.8MW <sub>peak</sub>	March 2019
Santa Maria	Cuauhtémoc, State of Chihuahua, Mexico	181.4MW <sub>peak</sub>	March 2019
Solem 1	Aguascalientes in the State of Aguascalientes, Mexico	180MW <sub>peak</sub>	September 2018
Solem 2	Aguascalientes in the State of Aguascalientes, Mexico	168MW <sub>peak</sub>	January 2019



## Recommendations for operation annex

No recommendations were made.

## Evaluation questions in line with OECD-DAC criteria/ex post evaluation matrix annex

### Relevance

Evaluation question	Specification of the question for the present project	Data source (or rationale if the question is not relevant/applicable)	Rating	Weighting ( - / o / + )	Reason for weighting
<b>Evaluation dimension: Policy and priority focus</b>			2	o	
Are the objectives of the programme aligned with the (global, regional and country-specific) policies and priorities, in particular those of the (development policy) partners involved and affected and the Federal Ministry for Economic Cooperation and Development (BMZ)?	<p>Were the objectives of the programme in line with the Mexican government's objectives at the time of the appraisal and are they still in line with the Mexican government's objectives today?</p> <p>Did the objectives of the programme correspond to the objectives of the German Federal Ministry for Economic Cooperation and Development (BMZ) sector concept "Sustainable Energy for Development" at the time of the appraisal and do they also correspond to the Federal Ministry for Economic Cooperation and Development (BMZ) objectives in the energy sector?</p>	<p>Mexican energy legislation</p> <p>German Federal Ministry for Economic Cooperation and Development (BMZ) sector concept: "Sustainable Energy for Development"</p> <p>Federal Ministry for Economic Cooperation and Development (BMZ) country strategy</p> <p>Programme proposal</p>			
Do the objectives of the programme take into account the relevant political and institutional framework conditions (e.g. legislation, administrative capacity, actual power structures (including those related to ethnicity, gender, etc.))?	<p>What regulatory and institutional hurdles were there for solar PV power plants?</p> <p>What is the situation today (is there a feed-in guarantee and remuneration)?</p>	<p>Programme proposal</p> <p>Interviews with project developers and other expert agencies</p>			
<b>Evaluation dimension: Focus on needs and capacities of participants and stakeholders</b>			2	o	
Are the programme objectives focused on the developmental needs and	Was the promotion of solar PV projects a suitable approach to achieving the DC	Interview with project developers			

<p>capacities of the target group? Was the core problem identified correctly?</p>	<p>programme objective compared to other RE power plants?</p> <p>Were there alternative sources of financing for solar PV power plants at the time of the appraisal?</p> <p>Would solar PV projects have been marketable even without subsidised financing?</p>	<p>Interview with project-executing agency</p> <p>Interview with ASOLMEX and GIZ</p>			
<p>Were the needs and capacities of particularly disadvantaged or vulnerable parts of the target group taken into account (possible differentiation according to age, income, gender, ethnicity, etc.)? How was the target group selected?</p>	<p>Not relevant</p>	<p>Non-target group project without recognisable vulnerable target group</p>			
<p>Would the programme (from an ex post perspective) have had other significant gender impact potentials if the concept had been designed differently? (FC-E-specific question)</p>	<p>What options did the programme offer to take into account gender impact potentials? (e.g. preferred consideration of female workers in the building and operation of the plants)</p>	<p>Interview with project developers</p> <p>Interview with Bancomext</p>			
<p>Evaluation dimension: Appropriateness of design</p>			<p>2</p>	<p>0</p>	
<p>Was the design of the programme appropriate and realistic (technically, organisationally and financially) and in principle suitable for contributing to solving the core problem?</p>	<p>Was the product (low-interest loan) suitable to support the introduction of solar PV power plants to the market (was it able to reduce existing hurdles)?</p>	<p>Interview with project developers</p> <p>Interview with Bancomext</p>			
<p>Is the programme design sufficiently precise and plausible (transparency and verifiability of the target system and the underlying impact assumptions)?</p>	<p>Has the design of the programme adequately taken into account the existing obstacles to the establishment of solar PV power plants?</p> <p>Are the selected indicators suitable for measuring the developmental success of the programme?</p>	<p>Interview with project developers</p> <p>Interview with Bancomext</p> <p>Interview with ASOLMEX</p> <p>Interview with GIZ</p>			

<p>Please describe the theory of change, incl. complementary measures, if necessary in the form of a graphical representation. Is this plausible? As well as specifying the original and, if necessary, adjusted target system, taking into account the impact levels (outcome and impact). The (adjusted) target system can also be displayed graphically. (FC-E-specific question)</p>	<p>Representation of the project's results logic. If applicable, make adjustments to the original results logic</p>	<p>Module proposal</p>			
<p>To what extent is the design of the programme based on a holistic approach to sustainable development (interplay of the social, environmental and economic dimensions of sustainability)?</p>	<p>Are there other renewable energy sources with producing costs that are lower than those of solar PV power plants and therefore have higher social (in terms of economic profitability) and economic sustainability?</p>	<p>Internet research Interview with project developers Interview with Bancomext Interview with ASOLMEX</p>			
<p>For projects within the scope of DC programmes: is the programme, based on its design, suitable for achieving the objectives of the DC programme? To what extent is the impact level of the FC module meaningfully linked to the DC programme (e.g. outcome impact or output outcome)? (FC-E-specific question)</p>	<p>Does the module objective make a meaningful contribution to achieving the DC programme objective?  Compared to other renewable energy plants, was the promotion of solar PV projects the most effective approach to achieving the DC programme objective?</p>	<p>Interview with GIZ Interview with project developers Interview with Bancomext Internet research Interview with ASOLMEX</p>			
<p>Evaluation dimension: Response to changes/adaptability</p>			<p>2</p>	<p>0</p>	
<p>Has the programme been adapted in the course of its implementation due to changed framework conditions (risks and potential)?</p>	<p>Were there any adjustments to the programme during the course of the project?</p>	<p>Reporting to the Federal Ministry for Economic Cooperation and Development (BMZ)  Internal follow-up reports  Project completion report PCR</p>			

## Coherence

Evaluation question	Specification of the question for the present project	Data source (or rationale if the question is not relevant/applicable)	Rating	Weighting (- / 0 / +)	Reason for weighting
<b>Evaluation dimension: Internal coherence (division of tasks and synergies within German development cooperation):</b>			1	0	
To what extent is the programme designed in a complementary and collaborative manner within the German development cooperation (e.g. integration into DC programme, country/sector strategy)?	<p>Was there a DC programme objective that the module contributed to achieving?</p> <p>Is the objective of the project compatible with the sector strategy applicable at the time (and today)?</p>	<p>Reporting to the Federal Ministry for Economic Cooperation and Development (BMZ)</p> <p>Interview with GIZ</p> <p>Federal Ministry for Economic Cooperation and Development (BMZ) sector and country concepts</p>			
Do the instruments of the German development cooperation dovetail in a conceptually meaningful way, and are synergies put to use?	Which other German DC projects, if any, accompanied the module and contributed to achieving the objectives?	<p>Reporting to the Federal Ministry for Economic Cooperation and Development (BMZ)</p> <p>Interview with GIZ</p>			
Is the programme consistent with international norms and standards to which the German development cooperation is committed (e.g. human rights, Paris Climate Agreement, etc.)?	<p>Were international norms and standards on human rights (child labour) and occupational safety observed?</p> <p>Was a complaints office set up?</p> <p>Who owned the land where the plants were built?</p> <p>Was compensation an issue?</p> <p>Were international technical standards and norms taken into account when building the plant?</p>	<p>Interview with project developers</p> <p>Interview with Bancomext</p>			
<b>Evaluation dimension: External coherence (complementarity)</b>					

<p>and coordination with actors external to German DC):</p>					<p>Mexico's climate strategy targets in general and Bancomext's business plan in particular. Co-financing via public development banks.</p>
<p>To what extent does the programme complement and support the partner's own efforts (subsidiarity principle)?</p>	<p>Would the project-executing agency have been able to implement the programme without the support of the FC module?</p> <p>Was there a counterpart contribution from the project-executing agency, and what measures were financed from this?</p>	<p>Interview with Bancomext</p>			
<p>Is the design of the programme and its implementation coordinated with the activities of other donors?</p>	<p>What activities do the most important donors in Mexico carry out in the area of solar PV?</p> <p>Was there consultation/coordination with other donors?</p>	<p>Reporting to the Federal Ministry for Economic Cooperation and Development (BMZ)</p> <p>Interview with ASOLMEX</p>			
<p>Was the programme designed to use the existing systems and structures (of partners/other donors/international organisations) for the implementation of its activities and to what extent are these used?</p>	<p>Not relevant</p>				
<p>Are common systems (of partners/other donors/international organisations) used for monitoring/evaluation, learning and accountability?</p>	<p>Not relevant</p>				

## Effectiveness

Evaluation question	Specification of the question for the present project	Data source (or rationale if the question is not relevant/applicable)	Rating	Weighting ( - / 0 / + )	Reason for weighting
<b>Evaluation dimension: Achievement of (intended) targets</b>			1	0	
<p>Were the (if necessary, adjusted) objectives of the programme (incl. capacity development measures) achieved? Table of indicators: Comparison of actual/target</p>	<p>Has the project contributed to the reduction of carbon emissions and the introduction of a technology for global climate action to the market that has not yet been established in Mexico through the efficient, ecologically and socially responsible generation of electrical energy?</p> <p>Were the target values of the indicators mentioned in the appraisal report achieved?</p> <p>How has the demand for electricity and the share of solar PV in the electricity mix developed in Mexico?</p> <p>How much electricity have the financed power plants generated in recent years?</p> <p>Was it always possible to feed the generated electricity into the grid?</p> <p>How have the generation capacity and average producing costs for solar PV developed in Mexico?</p>	<p>Interview with project developers</p> <p>Interview with Bancomext</p> <p>Interview with GIZ</p> <p>Internet research</p> <p>Interview with ASOLMEX</p>			
<b>Evaluation dimension: Contribution to achieving objectives:</b>			1	0	
<p>To what extent were the outputs of the programme delivered as planned (or</p>	<p>Was the loan to Bancomext disbursed according to plan?</p>	<p>Interview with project developers</p>			

adapted to new developments)? ( <i>Learning/help question</i> )	Were the financed solar PV power plants built as planned and were they connected to the grid as planned?	Interview with Bancomext
Are the outputs provided and the capacities created used?	Are the solar PV power plants able to produce electricity and feed it into the grid?	Interview with project developers Interview with ASOLMEX
To what extent is equal access to the outputs provided and the capacities created guaranteed (e.g. non-discriminatory, physically accessible, financially affordable, qualitatively, socially and culturally acceptable)?	Not relevant	
To what extent did the programme contribute to achieving the objectives?	What contribution does the programme make to reducing carbon emissions and to introducing solar PV power plants to the market?	Interview with project developers Interview with Bancomext
To what extent did the programme contribute to achieving the objectives at the level of the intended beneficiaries?	What contribution does the programme make to the project developers of solar PV projects in order to continue implementing further power plants in the future?	Interview with project developers
Did the programme contribute to the achievement of objectives at the level of the particularly disadvantaged or vulnerable groups involved and affected (potential differentiation according to age, income, gender, ethnicity, etc.)?	Not relevant	Non-target group project without recognisable vulnerable target group
Were there measures that specifically addressed gender impact potential (e.g. through the involvement of women in project committees, water committees, use of social workers for women, etc.)? (FC-E-specific question)	Were women specifically supported as part of the project (e.g. female employees of Bancomext, the project developers or the construction companies)?	Interview with project developers Interview with Bancomext



<p>Which project-internal factors (technical, organisational or financial) were decisive for the achievement or non-achievement of the intended objectives of the programme? (<i>Learning/help question</i>)</p>	<p>What was the effect of the SBF-financed programme for capacity building of Bancomext's ESMS?</p>	<p>Interview with Bancomext</p>			
<p>Which external factors were decisive for the achievement or non-achievement of the intended objectives of the programme (also taking into account the risks anticipated beforehand)? (<i>Learning/help question</i>)</p>	<p>How have the regulatory and institutional framework conditions for solar PV power plants changed over time since the project appraisal?</p> <p>How has the willingness of other development or commercial banks to finance solar PV power plants developed?</p> <p>What role does the parallel TC program "DKTI Solar" play, in particular in terms of improving the framework conditions?</p>	<p>Interview with project developers</p> <p>Interview with Bancomext</p> <p>Interview with GIZ</p> <p>Internet research</p> <p>Interview with ASOLMEX</p>			
<p>Evaluation dimension: Quality of implementation</p>			2	o	
<p>How is the quality of the management and implementation of the programme to be evaluated with regard to the achievement of objectives?</p>	<p>What was the role of Bancomext in the project implementation?</p> <p>Was Bancomext able to implement the project with adequate quality?</p>	<p>Interview with Bancomext</p>			
<p>How is the quality of the management, implementation and participation in the programme by the partners/sponsors evaluated?</p>	<p>How did Bancomext coordinate with the project developers, in particular during the preparation and construction phase?</p>	<p>Interview with project developers</p> <p>Interview with Bancomext</p>			
<p>Were gender results and relevant risks in/through the project (gender-based violence, e.g. in the context of infrastructure or empowerment projects) regularly monitored or otherwise taken into account during implementation? Have corresponding measures (e.g. as part</p>	<p>Were gender-related risks (gender-based violence in particular) monitored or otherwise taken into account during implementation?</p>	<p>Interview with project developers</p> <p>Interview with Bancomext</p>			

of a CM) been implemented in a timely manner? (FC-E-specific question)					
Technical implementation quality during plant building	Were the agreed technical norms and standards also qualitatively implemented during plant construction?	Assessment of the plants as part of the evaluation trip			
Evaluation dimension: Unintended consequences (positive or negative)			2	+	Development of social infrastructure plans for the surrounding communities
Can unintended positive/negative direct impacts (social, economic, ecological and, where applicable, those affecting vulnerable groups) be seen (or are they foreseeable)?	<p>What unintended positive or negative effects did the project have?</p> <p>Negative effects may have arisen, for example, from the construction and operation of the power plants (ESIA risks)</p> <p>Are there any negative effects on local residents (e.g. water scarcity)?</p> <p>How is water managed with regard to cleaning the solar panels?</p> <p>What happens to defective panels (waste management)?</p>	<p>Interview with project developers</p> <p>Interview with Bancomext</p> <p>Visit to the power plant sites</p>			
What potential/risks arise from the positive/negative unintended effects and how should they be evaluated?	What were the impacts of unintended positive/negative direct effects?	<p>Interview with project developers</p> <p>Interview with Bancomext</p> <p>Visit to the power plant sites</p>			
How did the programme respond to the potential/risks of the positive/negative unintended effects?	<p>How were negative unintended effects in particular managed?</p> <p>Was the project-executing agency able to manage them (appropriate ESMS)?</p>	<p>Interview with project developers</p> <p>Interview with Bancomext</p> <p>Visit to the power plant sites</p>			

## Efficiency

Evaluation question	Specification of the question for the present project	Data source (or rationale if the question is not relevant/applicable)	Rating	Weighting ( - / o / + )	Reason for weighting
<b>Evaluation dimension: Production efficiency</b>			2	-	Forced transfer of built infrastructure to state property
How are the inputs (financial and material resources) of the programme distributed (e.g. by instruments, sectors, sub-measures, also taking into account the cost contributions of the partners/executing agency/other participants and affected parties, etc.)? (Learning and help question)	Not relevant	Only one input (low-interest loans)			
To what extent were the inputs of the programme used sparingly in relation to the outputs produced (products, capital goods and services) (if possible, in a comparison with data from other evaluations of a region, sector, etc.)? For example, comparison of specific costs.	<p>How high are the costs per MW of installed output for the three financed power plants, and how does this size compare regionally and with solar PV plants built in Mexico at a later time?</p> <p>Were the favourable terms passed on by Bancomext to the project developers?</p>	<p>Interview with project developers</p> <p>Interview with Bancomext</p> <p>Interview with GIZ</p> <p>Interview with ASOLMEX</p>			
If necessary, as a complementary perspective: To what extent could the outputs of the programme have been increased by an alternative use of inputs (if possible, in a comparison with data from other evaluations of a region, sector, etc.)?	Were there other development banks that could have acted as project-executing agencies?	<p>Interview with project developers</p> <p>Interview with Bancomext</p>			
Were the outputs produced on time and within the planned period?	<p>How long did the lending process to the project developers take, and how did the developers view the process?</p> <p>How long was the construction phase for the power plants?</p>	Interview with project developers			

Were the coordination and management costs reasonable (e.g. implementation consultant's cost component)? (FC-E-specific question)	Not relevant	No implementation consultant involved			
Was the implementation of the plants cost-effective?	Were the construction contracts awarded and implemented cost-effectively? Are the plants profitable despite relatively low feed-in remuneration?	Interview with project developers and operators			
<b>Evaluation dimension: Allocation efficiency</b>			2	0	
In what other ways and at what costs could the effects achieved (outcome/impact) have been attained? ( <i>Learning/help question</i> )	Were there alternatives to the selected project structure (e.g. direct financing of the power plants)?  Would the state-owned energy company also have come into question as a project-executing agency?	Interview with project developers  Interview with GIZ  Interview with ASOLMEX			
To what extent could the effects achieved have been attained in a more cost-effective manner, compared with an alternatively designed programme?	Not relevant				
If necessary, as a complementary perspective: To what extent could the positive effects have been increased with the resources available, compared to an alternatively designed programme?	Not relevant				

## Impact

Evaluation question	Specification of the question for the present project	Data source (or rationale if the question is not relevant/applicable)	Rating	Weighting ( - / o / + )	Reason for weighting
<b>Evaluation dimension: Overarching developmental changes (intended)</b>			2	o	
Is it possible to identify overarching developmental changes to which the programme should contribute? (Or if foreseeable, please be as specific as possible in terms of time.)	<p>Did the project contribute to the DC programme objective (the sustainability of the energy system in Mexico is increased)?</p> <p>Did the programme contribute to the breakthrough of photovoltaic technology in Mexico as a renewable energy source?</p>	<p>Interview with project developers</p> <p>Interview with GIZ</p> <p>Interview with Bancomext</p> <p>Internet research</p> <p>Interview with ASOLMEX</p>			
Is it possible to identify overarching developmental changes (social, economic, environmental and their interactions) at the level of the intended beneficiaries? (Or if foreseeable, please be as specific as possible in terms of time)	What effects did the project have with regard to the project developers and at sector level (introduction of a new technology to the market)?	<p>Interview with project developers</p> <p>Interview with GIZ</p> <p>Interview with Bancomext</p> <p>Interview with ASOLMEX</p>			
To what extent can overarching developmental changes be identified at the level of particularly disadvantaged or vulnerable parts of the target group to which the programme should contribute? (Or, if foreseeable, please be as specific as possible in terms of time)	Not relevant	Non-target group project without recognisable vulnerable target group			
<b>Evaluation dimension: Contribution to overarching developmental changes (intended)</b>					

<p>To what extent did the programme actually contribute to the identified or foreseeable overarching developmental changes (also taking into account the political stability) to which the programme should contribute?</p>	<p>What contribution does the project make to the DC programme objective? Particularly relevant here are the following indicators: -Increase in annual primary energy generation from renewable energy sources -Increase in annual avoided greenhouse gas emissions</p>	<p>Internet research  Interview with GIZ</p>
<p>To what extent did the programme achieve its intended (possibly adjusted) developmental objectives? In other words, are the project impacts sufficiently tangible not only at outcome level, but at impact level? (e.g. drinking water supply/health effects)</p>	<p>Has the project achieved its development policy objectives, i.e. has it -contributed to introducing a technology for global climate action to the market that has not yet been established in Mexico and -contributed to the sustainability of the energy system in Mexico?</p>	<p>Interview with project developers  Interview with GIZ  Interview with Bancomext  Interview with ASOLMEX</p>
<p>Did the programme contribute to achieving its (possibly adjusted) developmental objectives at the level of the intended beneficiaries?</p>	<p>Has the project led to the project developers implementing further solar PV projects?</p>	<p>Interview with ASOLMEX</p>
<p>Has the programme contributed to overarching developmental changes or changes in life situations at the level of particularly disadvantaged or vulnerable parts of the target group (potential differentiation according to age, income, gender, ethnicity, etc.) to which the programme was intended to contribute?</p>	<p>Not relevant</p>	<p>Non-target group project without recognisable vulnerable target group</p>
<p>Which project-internal factors (technical, organisational or financial) were decisive for the achievement or non-achievement of the intended developmental objectives of the programme? <i>(Learning/help question)</i></p>	<p>What were the decisive factors of the programme? -the basic provision of financing? -the subsidised conditions?</p>	<p>Interview with project developers  Interview with GIZ  Interview with Bancomext</p>
<p>Which external factors were decisive for the achievement or non-achievement of the intended developmental objectives</p>	<p>What regulatory or institutional changes have enabled or accelerated the implementation of the power plants?</p>	<p>Interview with project developers  Interview with GIZ</p>

of the programme? ( <i>Learning/help question</i> )		Interview with Bancomext Interview with ASOLMEX			
Does the project have a broad-based impact? <ul style="list-style-type: none"> <li>- To what extent has the programme led to structural or institutional changes (e.g. in organisations, systems and regulations)? (Structure formation)</li> <li>- Was the programme exemplary and/or broadly effective and is it reproducible? (Model character)</li> </ul>	How has the expansion of solar PV power plants in Mexico developed?  What financing options are now available for solar PV power plants (commercial banks)?  Were there any FC successor projects in this action area?	Internet research Interview with project developers Interview with GIZ Interview with Bancomext Interview with ASOLMEX Interview with KfW sector team			
How would the development have gone without the programme (developmental additionality)?	Would the power plants have been built even without the provision of subsidised loans by FC (were there alternative sources of financing)?	Interview with project developers			
<b>Evaluation dimension: Contribution to (unintended) overarching developmental changes</b>				N/A	
To what extent can unintended overarching developmental changes (also taking into account political stability) be identified (or, if foreseeable, please be as specific as possible in terms of time)?	In addition to the avoidance of carbon emissions and the market development of a new technology, were there any other overarching developmental impacts?  Has the expansion of the electricity grid kept pace with the expansion of decentralised renewable energy or have there been/are there instabilities?  How does the planned electricity and constitutional reform have a negative impact on power plants and the sector in general?	Interview with Bancomext Interview with GIZ			
Did the programme noticeably or foreseeably contribute to unintended	Were there unintended positive/negative direct developmental impacts?	Inspection of the plants			

(positive and/or negative) overarching developmental impacts?	What do they look like?	Interview with Bancomext Interview with project developers
Did the programme noticeably (or foreseeably) contribute to unintended (positive or negative) overarching developmental changes at the level of particularly disadvantaged or vulnerable groups (within or outside the target group) (do no harm, e.g. no strengthening of inequality (gender/ethnicity))?	Were there any negative overarching developmental changes in the programme's intervention area (e.g. with regard to environmental damage during construction and operation or with regard to residents near the power plants?)	Inspection of the plants Interview with Bancomext Interview with project developers

## Sustainability

Evaluation question	Specification of the question for the present project	Data source (or rationale if the question is not relevant/applicable)	Rating	Weighting (- / 0 / +)	Reason for weighting
<b>Evaluation dimension: Capacities of participants and stakeholders</b>			3	0	
Are the target group, executing agencies and partners institutionally, personally and financially able and willing (ownership) to maintain the positive effects of the programme over time (after the end of the promotion)?	<p>Are the power plants running smoothly?</p> <p>Is a continuous supply of power possible?</p> <p>Are the current feed-in tariffs cost-effective, and can the plants be operated economically? Are there long-term off-take agreements or does the power have to be sold via the spot market?</p> <p>How are the plants maintained?</p> <p>Are the systems properly maintained in accordance with the operating manual?</p>	<p>Inspection of the plants</p> <p>Interview with Bancomext</p> <p>Interview with project developers</p>			



	What happens to defective modules (waste management)?			
To what extent do the target group, executing agencies and partners demonstrate resilience to future risks that could jeopardise the impact of the programme?	What risks (e.g. regulatory) exist with regard to the continued operation of the power plants, and how do the owners plan to deal with them?	Interview with project developers Interview with ASOLMEX		
<b>Evaluation dimension: Contribution to supporting sustainable capacities:</b>			2	0
Did the programme contribute to the target group, executing agencies and partners being able and willing (ownership) to maintain the positive effects of the programme over time in terms of financial, personnel and institutional capacity, and, where necessary, to curb negative effects?	How is the financing of solar PV power plants now anchored at Bancomext and how has it developed?  Are sufficient financial resources available to operate the power plants (O&M)?	Inspection of the plants  Interview with Bancomext  Interview with project developers		
Did the programme contribute to strengthening the resilience of the target group, executing agencies and partners to risks that could jeopardise the effects of the programme?	Not relevant	Strengthening resilience was not part of the programme		
Did the programme contribute to strengthening the resilience of particularly disadvantaged groups to risks that could jeopardise the effects of the programme?	Not relevant	Non-target group project without recognisable vulnerable target group		
<b>Evaluation dimension: Durability of impacts over time</b>			3	–  Change of government in 2018 put renewable energy from private production at a disadvantage

<p>How stable is the context of the programme (e.g. social justice, economic performance, political stability, environmental balance)? (<i>Learning/help question</i>)</p>	<p>Are there risks that the (particularly regulatory) environment has changed negatively for the operators of the plants?</p> <p>Are there any security risks in the region of the power plants?</p>	<p>Interview with GIZ</p> <p>Interview with Bancomext</p> <p>Interview with project developers</p>
<p>To what extent is the durability of the positive effects of the programme influenced by the context? (<i>Learning/help question</i>)</p>	<p>How would the aforementioned risks affect the yield of the power plants?</p>	<p>Interview with project developers</p>
<p>To what extent are the positive and, where applicable, the negative effects of the programme likely to be long-lasting?</p>	<p>Which mitigation measures can lower the aforementioned risks?</p>	<p>Interview with project developers</p>
<p>How sustainable is the operation of the plants?</p>	<p>How are replaced defective components handled?</p> <p>Is there proper disposal of the resulting waste?</p> <p>Are the plants secure against burglary and vandalism?</p> <p>Is the operating staff properly accommodated in the plants and in a manner suitable for personnel?</p> <p>Is the debt service of the project developers to Bancomext and from Bancomext to KfW carried out according to plan?</p>	<p>Interview with project developers</p> <p>Interview with Bancomext</p>