KfW Development Bank

Ex-post evaluation
Solar World Cup 2014, Brazil

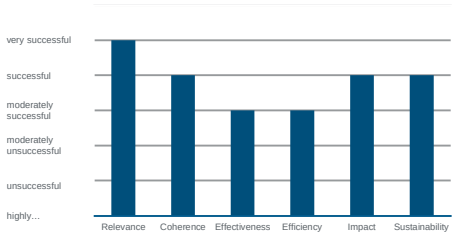
Title	Solar World Cup 2014 Minas Gerais (CEMIG)		
Sector and CRS code	Solar energy for centralised grids; CRS code: 23230		
Project number	2009 66 911		
Commissioned by	German Federal Ministry for Economic Cooperation and Development (BMZ)		
Recipient/Executing agency	CEMIG (Companhia Energética de Minas Gerais S.A.)		
Project volume / financing instrument	EUR 10 million / interest rate reduction		
Project duration	12/2012 (loan agreement) – 10/2018 (final inspection)		
Year of report	2024	**Year of random sample**	2020

Objectives and project outline

At outcome level, the goal was to install and operate a photovoltaic system on the roof of a venue for the 2014 World Cup, generating publicity. This was intended to contribute to the prevalence and expansion of photovoltaics as well as climate change mitigation (target at impact level).

As part of the project, a 1.42MW$_p$ (1.32MWAC) photovoltaic rooftop system was installed at the Mineirão stadium, one of the venues for the 2014 FIFA World Cup. The planned facility at the neighbouring Mineirinho sports complex was not implemented due to a lack of economic efficiency. The planned energy efficiency measures were also not implemented by the project, but as part of the preparatory renovation of the stadium in preparation for the World Cup.

Overall rating:
successful



Key findings

The following aspects were decisive for the successful overall result:

- In line with the Brazilian priorities, the project addressed a central bottleneck with a suitable design, integrated into the country strategy and the priority area of energy, and complemented Brazil's own efforts and the commitment of further DC instruments.
- The project picked up on the dawning spirit of optimism at the time in terms of photovoltaics and was ahead of the curve in the Brazilian context. The intention was to select the 2014 World Cup as a vehicle for the marketing of photovoltaics and to install a PV system at a venue for the 2014 World Cup, as well as the selection of the location for the Mineirão stadium, which received awards for the concept.
- The project's approach has proven its worth and made a significant contribution to the development of the Brazilian photovoltaic sector. It is noteworthy that the photovoltaic system was the world's largest PV rooftop system on a stadium at the time. As part of the 2014 World Cup and the 2016 Olympic Games, the PV system at Mineirão received a good deal of attention in the media and in the specialist world. It is still considered a reference project today.
- Despite the high specific costs of photovoltaics at the time and the negative profitability of the plant, efficiency is considered to be moderately successful from an overall economic perspective due to its broad-based impetus.
- The executing agency's expertise and professionalism suggest sustainable operations.

Conclusions

– PV (rooftop) system planning requires an analysis of the necessity of shade management and regular cleaning, including appropriate cleaning facilities. This can reduce obstructions to power generation.

– Projects that address technological developments and trends in markets with great untapped potential have a very broad impact potential. The visibility or public impact of the location can be a decisive factor in this respect.

– Comparatively high specific costs and insufficient profitability are inevitable and acceptable when increasing the prevalence of technologies, given the intended long-term macroeconomic impacts.

Ex-post evaluation – Rating according to OECD-DAC criteria

Overview of sub-ratings:

Relevance	1
Coherence	2
Effectiveness	3
Efficiency	3
Impact	2
Sustainability	2
Overall rating:	**2**

Overall context

The natural potential of solar energy in Brazil is enormous due to the country's geographical location. The average daily solar radiation levels are between 5 and 6 kWh/m² in most of Brazil and reach maximum values of 6.5 kWh/m² in the north-east and inland. Solar radiation is therefore approximately twice as high as in Germany, which has values between 2.4 and 3.4 kWh/m². The described solar potential in Brazil was practically untapped at the time the project was initiated (2009). There were primarily small off-grid plants for the electrification of off-grid regions. At the time of the appraisal (2010/2011), only approx. 0.17 MWp from around 30 small plants were connected to the grid, which corresponded to less than 0.01% of the installed capacity in Germany at the time.

The specific costs of photovoltaics (PV) were high at the time compared to other (renewable) sources of energy. The power generation companies had almost no experience with this technology, and the regulatory framework was still in its infancy.

Project summary

A 1.42 MWp (1.32 MW_{AC}) a photovoltaic rooftop system was installed at the Mineirão stadium, built to be a venue for the 2014 FIFA World Cup. This was done as part of the project with the executing agency Companhia Energética de Minas Gerais (CEMIG) in order to contribute to the expansion of the electricity supply from (non-conventional) renewable sources of energy (outcome level) and thereby save CO_2 emissions for environmental protection and climate change mitigation (impact level). Neither the neighbouring Mineirinho sports complex nor the alternatives examined were equipped with another photovoltaic rooftop system, contrary to the original design. The planned energy efficiency measures were also omitted, as they were implemented independently of the project as part of the preparatory renovation of the stadium for the World Cup. As a result, around 60% of the available budget funds expired (see *Efficiency – Allocation efficiency*).

Total costs

In EUR million	Investment (planned)	Investment (actual)
Investment costs (total)	**14.25**	**4.28**
Counterpart contribution	4.25	0.54
Debt financing	10.00	3.74
of which BMZ budget funds	*10.00*	*3.74*

Figure 11 : Map/satellite image of the project country incl. project location

Quellen: GADM/ Flanders Marine Institute (2023). Maritime Boundaries Geodatabase, Version 12. Eigene Darstellung.

Rating according to OECD-DAC criteria

Relevance

1. Alignment with policies and priorities

The project's objectives were in line with the Millennium Development Goals (MDG) at the time (especially Development Goal no. 7 "Ensure environmental sustainability"), Sustainable Development Goal (SDG) 13 ("Climate action"), the current Agenda 2030 (see *Contributions to Agenda 2030*) and the Paris Agreement (2015). Furthermore, the project's objective at that time and today is in line with the German Federal Government's objective of safeguarding the global climate and the environment and with the Federal Ministry for Economic Cooperation and Development's (BMZ) current focus on "Renewable Energy and Energy Efficiency" as agreed in the German-Brazilian Energy Partnership (Field of Action 1 "Climate action and adjustment to climate change" and 2 "Renewable energies and energy efficiency"), as well as the current core area strategy "Responsibility for our planet – climate and energy".[1] The latter envisages meeting the increasing energy demand with a climate-neutral energy supply and contributing to complete net decarbonisation of the energy sector by 2050.

The objective was also in line with the Brazilian government's sector strategy, in which the expansion of generation capacities from (non-conventional) renewable energy sources played a significant role (see *Relevance – Alignment with needs and capacities of persons concerned*). At the time the project was initiated (2009), the Brazilian photovoltaic sector and thus also the legal requirements and framework conditions were still in the early stages. An interministerial working party was convened at the end of 2008 to develop a policy on the use of grid-connected photovoltaics

[1] The BMZ strategy paper "BMZ Concepts 145 – Sector Concept for Sustainable Energy for Development" (01/2007) and BMZ core thematic strategy "Responsibility for our planet – climate and energy" from June 2021.

in Brazil. The recommendations of this working party aimed to exploit the possibilities of grid-connected PV energy generation as a complement to existing sources of energy and to introduce an incentive system in the medium term.

Even from today's perspective, there is consistency with the national sector/expansion plans and the Brazilian reduction commitments to achieve the Nationally Determined Contributions (NDC). As part of its Nationally Determined Contributions to reducing greenhouse gas emissions, the country has set a reduction target of 50 % by 2030 and aims to achieve carbon neutrality by 2050.

2. Alignment with needs and capacities of persons concerned

In response to the repeated drastic energy shortages with severe rationing plans, at the time of the project appraisal (PA) in 2010/2011 the Brazilian state pursued the goal of increasing generation capacities to meet rising demand and to avoid renewed energy crises. According to the programme proposal, the demand forecast at the time assumed an annual increase in electricity consumption of 5.2 % in the period of 2011–2019. The demand forecast resulted in the need for a significant expansion of power plant capacity. The Brazilian Ministry of Mining and Energy's (MME) ten-year expansion plan (Plano Decenal de Expansão de Energia) 2010–2019 envisaged expansion by up to 63 additional GW of power plant output by 2019. The Brazilian plans placed particular focus on large-scale hydropower plants. However, alternative (non-conventional) sources of energy such as wind power, biomass projects and small hydropower plants were also important. There were no concrete expansion plans for photovoltaics at the time.

The core problem of renewed energy shortages in Brazil's electricity supply was correctly identified. Consequently, the project addressed the further expansion of power plant capacities based on (non-conventional) renewable energies. It was thus able to contribute to solving the core problem. This was appropriate at the time and now. Making use of the enormous potential of solar was forward-looking. In hindsight, this is highlighted by the fact that the potential for hydropower (most important source of electricity generation at around 60 %) has since been exhausted and that hydropower generation has since fallen as a result of a prolonged drought. As a result, fossil-based electricity generation increased significantly. The renewed, severe water crisis in 2021 underlined the necessary diversification of Brazil's electricity generation capacities in the context of the aforementioned dependence on hydropower.

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.

3. Suitability of project concept

The project concept envisaged CEMIG as the executing agency. CEMIG is a publicly traded energy holding company with the state of Minas Gerais as the majority owner and was the second largest energy supply company in Brazil at the time of the PA. CEMIG was already a pioneer in the field of photovoltaics in Brazil at the time of the PA. In 2009, for the tenth time in a row, CEMIG Holding was awarded the Dow Jones Prize for Sustainability for economic, environmental and social sustainability in corporate policy. The project design therefore relied heavily on cooperation with a central and progressive player in the Brazilian energy market.

The following simulated impact logic was used as the basis for the project for the PA: Financing (input) and installation of publicly prominent photovoltaic systems (output) → Proof of the economic potential of grid-connected photovoltaics → Spill-over effects → Distribution of photovoltaics → Expansion of renewable energies → Sustainable electricity supply and reduction of the risk of renewed supply shortages (outcome) → Avoidance of CO_2 emissions → Environmental protection and climate change mitigation (impact).

The underlying theory of change and its impact relationships were generally plausible at the time of the appraisal and the ex-post evaluation (EPE). The assumption that the installation of a PV rooftop system on the stadium for the 2014 World Cup could contribute directly (through its own electricity generation) and indirectly as an innovative pilot project with a spill-over effect for the prevalence of photovoltaics and thus to efficient and environmentally compatible electricity generation is also considered plausible from today's perspective. However, the "proof of the economic potential of grid-connected photovoltaics" was unrealistic (see below). Furthermore, the intended energy efficiency measures (around 21 % of the total investment costs or 30 % of FC financing) are not addressed or represented in the theory of change. Conceptually, the energy efficiency measures were subject to great uncertainties. The energy efficiency measures are not very well integrated into the overall concept. In principle, the cooperation with GIZ in the energy efficiency measures is very welcome. However, the design was not yet very specific at the time of the PA. In

view of the fact that two out of a total of three outputs (the above-mentioned energy efficiency measures and the below-mentioned commercialisation strategy / power purchase agreements) were to be implemented with the support of GIZ, this is indeed an example of DC from a single source. At the same time, however, the project was dependent on several actors, without a concrete/formalised agreement with GIZ or a binding and fully developed design beyond a memorandum of understanding. Retrospectively, it would have made sense to focus exclusively on implementing the PV rooftop systems.

It was not possible to clarify conclusively as part of the EPE whether it was already obvious at the PA that the energy efficiency measures were being implemented as part of the stadium conversion, as this began in 2010. It is also surprising that the executing agency CEMIG was prepared to raise funds from a development loan for this. The implementation of energy efficiency measures as part of the project only seems comprehensible against the background that energy suppliers in Brazil must invest 0.5 % of their net turnover in energy efficiency measures for end consumers at the time of the appraisal and the state of Minas Gerais was and is both the majority owner of CEMIG and the owner of the stadium.

The target system was certainly conceptually comprehensible and verifiable. However, target formulations, indicators and value allocation were only partially appropriate and were adapted accordingly as part of the EPE (see *Appendix 1)*:

- Similar to the theory of change, the energy efficiency measures are insufficiently mapped in the original target system at the time of the PA. The target formulation at the outcome level at the time of the PA did not refer to the energy efficiency measures despite having an indicator that is appropriate in principle (LEED certification).[2] Nevertheless, the energy efficiency measures are not included in the target formulation ex-post, as they were ultimately not implemented (see *Relevance – Reaction to changes/adaptability)*.
- Irrespective of the above efficiency measures, the target formulation at outcome level was modified as follows as part of the EPE: “The installation of a publicly prominent photovoltaic system as part of the 2014 World Cup contributes to the prevalence and expansion of grid-connected photovoltaics in Brazil.” The adjustment was made because, from the perspective of the EPE, the original target formulation (proof of the economic potential of grid-connected photovoltaics) and the corresponding indicator (100 % covering of the costs) are considered unrealistic or too ambitious (see *Allocation efficiency*). On the one hand because, as stated in the programme proposal, the specific costs were still very high at the time, and on the other hand, because the commercialisation strategy still had to be developed. This was based on the assumption that a higher sales price (above market level) could be achieved with a solar label that was yet to be developed on the open market (Ambiente de Contratação Livre – ACL). At the same time, however, the programme proposal recognised that full coverage with solar power is unrealistic even for environmentally conscious electricity customers due to the high generation costs (around three times as high as small hydropower at the time of the PA). Especially as long-term purchase agreements in the ACL, as assumed by the programme proposal, do not seem appropriate for the context due to the low generation volume of the PV rooftop system on the stadium and its high volatility. Furthermore, it was obvious that the executing agency CEMIG, as one of the largest energy supply companies in Brazil, had the corresponding competence with regard to the strategic marketing of electricity from renewable energies. This is also underlined in retrospect by the fact that CEMIG is the largest provider in the ACL at the time of the EPE with a market share of 15 %.
- At impact level, the target formulation was not changed, but the indicator “installed capacity (MW_p) of grid-connected PV systems in Brazil up to 2015” was omitted, as the period between planned completion in 2012 (actual 2013) as well as the major event of the 2014 World Cup, which was decisive for marketing the PV system and the spill-over effects, and the intended increase in installed capacity by 2015 were unrealistically estimated with regard to the medium-term market development stated in the programme proposal.

Irrespective of the criticisms regarding the theory of change and target system presented above, which do not question the results logic as such, the project had great potential for broad-based effects due to its public impact. The intention to choose the 2014 World Cup as a vehicle for the marketing of photovoltaics and to install a PV system at a venue for the 2014 World Cup was outstanding from a conceptual point of view. In terms of publicity, the Mineirão stadium, which was the second largest stadium in Brazil at the time, well-known throughout the country and the venue of the 2014 World Cup, was an excellent choice for raising awareness of photovoltaics in the media, business, politics and society and promoting the prevalence and increased use of this technology. The project participants

[2] Leadership in Energy and Environmental Design (LEED) is a green building classification system developed by the U.S. Green Building Council. New buildings and renovations can be classified into four quality levels: Certified (40–49 points), Silver (50–59 points), Gold (60–79 points) and Platinum (80 points and more).

picked up on the pioneering spirit of photovoltaics around the world at the time and were ahead of their time in the Brazilian context.

The design was based on a holistic approach to sustainable development. The project was primarily aimed at ecological and economic sustainability, as at the time of the PA it was an ecologically and macroeconomically cost-efficient alternative (see *Allocation efficiency*) to meet the increasing demand from thermal power plants. Ultimately, the project impacts the social dimension of sustainability through an efficient, reliable electricity supply secured over the long term.

The project was conceptually suitable for contributing to achieving the DC programme objective. The plan was to support Brazil in implementing a climate-neutral, sustainable energy policy and decentralised energy supply. Specifically, the project was able to contribute to the following objectives on a design level: “The financed plants have measurable success of stable output and CO_2 reductions” and “investments in innovative solutions are increasing”.

From today's perspective (and as it was perceived at the time), the measure's design, including its technical, organisational and financial structure, is considered suitable overall for helping to solve the described core problems and to achieve the DC programme objective. The capacities of the partner government and project-executing agency were realistically estimated and adequately taken into account in the design.

4. Reaction to changes/adaptability

With regard to the technical changes, the project demonstrated a great ability to adapt to the local conditions of the stadium.

Originally, two photovoltaic rooftop systems were planned. One was to be built on the front and main roof of the Mineirão stadium (~300 and 510 kW_p) and a second on the neighbouring Mineirinho sports complex (~560 kW_p). Of the planned outputs, only the PV system on the main roof of the Mineirão stadium was implemented in a modified technical design. Instead of thin-film modules, improved roof statics as part of the stadium conversion meant that more effective polycrystalline modules with an output of 1.420kW_p could be installed on the main roof. The laminated crystalline modules were not installed on the canopy for static reasons. An overview of the design changes in the planning of the PV systems can be found in the *Design changes* appendix.

The PV system at the Mineirinho sports complex was omitted because, according to the final inspection, the responsible institutions did not see any reference to the World Cup and, according to CEMIG, there was also a fundamental renovation in question. This was already subject to uncertainty at the time of the PA, as stated in the programme proposal. Public buildings were considered as alternatives. Ultimately, none of the alternatives examined were economically viable. Unlike the main measure for the PV rooftop system at the Mineirão stadium (see *Efficiency – Allocation efficiency*), the profitability of the second PV rooftop system was decisive for the executing agency CEMIG.

Investments in energy efficiency measures were also omitted, as these were implemented independently of the project as part of the preparatory renovation of the stadium for the World Cup. The extent to which the omission of the energy efficiency measures was foreseeable could not be clarified conclusively as part of the EPE.

Rating summary

The project addressed a central bottleneck and was conceptually suitable for contributing to solving the core problem. It was integrated into the policies and priorities of both the Brazilian and the German governments, and adequately took into account the capacities and potential of the Brazilian partners. The project’s intention of promoting the use of the practically untapped solar potential in the context of the 2014 World Cup by publicly promoting a PV system on the stadium roof of the Mineirão venue was outstanding from a conceptual point of view. The relevance is rated as very successful against this background.

Relevance: 1

Coherence

5. Internal coherence

The project is embedded in the country strategy for bilateral cooperation (cooperation for sustainable development – ZnE), which has been in place since 2008. Renewable Energy and Energy Efficiency are defined as a priority area with the aim of supporting the Brazilian government in implementing a climate-friendly and sustainable energy policy. In line with this, the project fully integrated into the current commitment of German DC with Brazil in the priority area of energy during the PA (2010/2011). Commitment in the priority area of Renewable Energy and Energy Efficiency included expanding the range of long-term financing opportunities, introducing innovative technologies and supporting partners in creating, improving and implementing a conducive environment for Renewable Energy and Energy Efficiency. With regard to its commitment to photovoltaics, the project was directly linked to the International Climate Initiative (IKI) project "Solar Pilot Project Brazil" implemented by FC.

The project was launched in 2009 during a specialist trip organised by GIZ. As part of this trip, the participating representatives of CEMIG, the government of the state of Minas Gerais, Instituto IDEAL,[3] GIZ and KfW decided to implement a photovoltaic system on the roof of the "Mineirão" stadium and to look for options for this. The fundamental idea of a solar world championship, i.e. to use the 2014 World Cup as an advertising medium for photovoltaics, originated at Instituto IDEAL.

The implementation concept also provided for a close link between TC and FC. The energy efficiency measures as well as the commercialisation strategy/power purchase agreements listed below should be implemented with the support of GIZ (see *Relevance – Suitability of project concept*). Both components were ultimately not implemented. The energy efficiency measures were implemented during the stadium conversion and the commercialisation strategy (including a solar label), and regulatory changes for the benefit of photovoltaics made those measures superfluous. According to GIZ, additional commercialisation strategies were therefore no longer necessary. Irrespective of this, there was a constant exchange and close cooperation between TC and FC.

The project is consistent with the MDGs at the time as well as with the current 2030 Agenda and the Paris Agreement (see *Relevance – Alignment with Policies and Priorities / Agenda 2030)*.

6. External coherence

The project addressed the Brazilian government's expansion plans. According to the programme proposal, the project also addressed the Brazilian government's idea of a "Green World Cup".

With the planned executing agency CEMIG as Brazil's second largest energy supply company and a central player in the expansion of renewable energies (see *Suitability of project concept*), the project also aimed to support its own efforts (see *Contribution to overarching (intended) development policy changes*) and use existing national structures.

Direct coordination between the donor institutions in the sense of internally coordinating the design of their contributions has not been and is not desired by Brazil to this day. Rather, the partners on the Brazilian side insist on formulating support requirements for the individual donors and shape these bilaterally. At the activity level, on the other hand, there is close communication between donors, which is not called into question by Brazilians either.

Rating summary:

The project was integrated into the country strategy and the energy focus, complemented the commitment of the DC instruments and was characterised by close cooperation between TC and FC. The project also complemented and supported Brazil's own efforts and used existing national structures. Coherence is therefore considered successful.

Coherence: 2

[3] The Brazilian Instituto IDEAL (https://institutoideal.org) was founded in 2007 as a private non-profit institute with the aim of promoting renewable energies in Latin America.

Effectiveness

7. Achievement of (intended) goals

At outcome level, the objective underlying the EPE was to install and operate a publicly prominent photovoltaic system on the roof of a football World Cup 2014 venue.

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

Table: Target achievement outcome

Indicator	Status at PA	Target value at PA/EPE	Actual value at EPE
(1) Installed capacity of the PV rooftop systems (kWp)	0	>1,200 (PA/EPE) (Mineirão ~810) (Minerinho ~560)	1,420 **Achieved**
(2) Annual electricity generation from PV rooftop systems (MWh/year)	0	1,900 (PA/EPE)	1,274 (Ø 2020–22) or 1,505 (Ø 2015–22) **Not achieved**
(3) Availability (%)	0	>95 (EPE)	93.7 (Ø 11/2020–10/2023) 97.8 (Ø 01/2023–10/2023) **Partially achieved**

8. Contribution to goal achievement

Contrary to the original design, only the PV rooftop system was implemented at the Mineirão stadium. The focus was rightly on the time-critical implementation of the PV rooftop system at the 2014 World Cup Mineirão Stadium (implementation first started at the end of 2012). With the installation and operation of the PV rooftop system on Mineirão, the intended main output of a publicly prominent PV rooftop system at a World Cup venue was achieved, the intent of which to contribute to the prevalence and expansion of photovoltaics (impact). The Mineirão stadium was the first venue for the 2014 World Cup with a photovoltaic rooftop system and, at the time of construction, the largest photovoltaic system in the world built on the roof of a stadium. Alternative publicly prominent locations considered for the second photovoltaic rooftop system ultimately failed due to a lack of minimum profitability. The energy efficiency measures were also omitted (see *Relevance – Reaction to changes/adaptability*).

With regard to the achievement of the indicator target values, the results are mixed:

Although the PV rooftop system at the Mineirinho sports complex was omitted and only the PV rooftop system on the Mineirão was implemented, the Indicator 1 target value (installed capacity) was nevertheless achieved. This is due to the fact that it was possible to install higher-performance polycrystalline modules on Mineirão instead of thin-film modules (see *Relevance – Reaction to changes/adaptability*).

Nevertheless, with only one PV rooftop system on the Mineirão, the annual electricity generation of the two PV rooftop systems (Indicator 2) is below the target value of the programme appraisal, which was estimated based on two PV rooftop systems. With regard to generation, however, it should be noted that the target achievement of Indicator (2) also lags behind the simulation of the EPC contractor for the PV rooftop system on Mineirão, which came to an annual generation of close to 1,800 MWh/year for Mineirão as a result of the installation of more powerful modules. The fact that, despite the target achievement of the installed capacity, the generation is below the estimated generation of the PA and the simulation is not attributable to the expected technical degradation, but suggests optimisation potential for system operation (see *Sustainability – Durability of effects over time*). This is also due to the shade that falls on Mineirão due to the architecture, which was not taken into account in the EPC contractor's simulation. Due to the elliptical shape of the stadium and the respectively different orientation to the sun and shade, the system has 88 different individual PV systems with different orientations, in contrast to conventional systems, which usually have only one orientation. Active shade management could have resulted in higher generation.

The potential for increasing the production of the Mineirão PV rooftop system lies in regularly cleaning the modules. Since no facility for transporting water to the stadium roof was planned as part of the project, water must be

transported to the stadium roof by means of mobile temporary pumps and tankers, which is costly. According to observations, the PV rooftop system was not cleaned regularly, which is likely related to this. According to published studies involving CEMIG employees, this reduces production by approx. 16.5 % during the dry season and by approx. 8 % during the rainy season.[4]

The fact that the photovoltaic rooftop system is producing less than its actual technical capabilities is also reflected in the fact that the target values of Indicators 2 (annual electricity generation) and 3 (availability) are not achieved. The average availability for the period 11/2020 to 10/2023 does not correspond to the international standard for comparable photovoltaic systems. When calculating availability, excluding the months that the Mineirão rooftop PV system was shut down due to major events (such as the repeated interruption of the electricity supply to the distribution grid due to voltage fluctuations), the availability is around 95 % – which is considered acceptable for this plant. In 2023 up to the EPE (January to October), availability was 97.8 %. CEMIG aims for 95 % availability for the Mineirão PV rooftop system, in accordance with its internal guidelines. Overall, availability is therefore considered to be partially achieved.

In view of the widespread public impact of the PV rooftop system on Mineirão, the achievement of the technical operating data in the indicators and the actual electricity generation fade into the background and the positive effects prevail.

9. Quality of implementation

The quality of the management and implementation by all project participants was goal-oriented and characterised by a very high level of personal commitment to ensure completion before the 2014 World Cup. Given the time pressure, it is understandable that the focus was initially on Mineirão and not on the alternative locations of the second PV rooftop system.

10. Unintended effects (positive or negative)

Negative unintended effects on humans and the environment were not identified in the construction or the operating phases. The PV rooftop system installed on an existing building is a measure with minimal impact. This is also reflected in the fact that an environmental licence is no longer required for operation. The necessary (simplified) environmental licences for construction and operation were properly obtained.

Rating summary

The PV rooftop system on Mineirão fully meets the targets set for public impact. Management and implementation were also characterised by a very high level of commitment. Therefore, overall effectiveness is considered to be moderately successful despite mixed indicator target achievement.

Effectiveness: 3

Efficiency

11. Production efficiency

At the PA (2011), the total costs of the project were estimated at EUR 14.25 million. The final total costs of the project were EUR 4.28 million. The significant difference is mainly due to the implementation of only one PV rooftop system on Mineirão and to the omission of energy efficiency measures (see Relevance – *Reaction to changes/adaptability*) as well as to the grid measures already implemented before the start of the project to connect the stadium. This had already been carried out by CEMIG in order to provide the electrical energy required for the stadium's conversion. The costs for consulting services were also significantly lower. The consulting costs are deemed reasonable.

The costs[5] for the Mineirão (front and main roof) and Mineirinho PV rooftop systems were estimated at a total of EUR 5.65 million at the time. The final costs[5] for the implementation of the PV rooftop system at Mineirão amounted to

[4] Field I-V Curve Measurements Methodology at String Level to Monitor Failures and the Degradation Process: A Case Study of a 1.42 MWp PV Power Plant, December 2020" and "Analysis of the soiling effect on the performance of photovoltaic modules on a soccer stadium in Minas Gerais" (2018).

[5] Including inverters, cabling including internal grid connection, protection and management, transport, insurance, design, building site equipment, installation, commissioning, extended warranty, consulting costs and training.

EUR 4.22 million.[6] This means that the final costs for the photovoltaic component are significantly lower than the costs estimated at the time of the PA.

The final costs result in specific costs of EUR 2.973 million/MW. This figure is within the range of the international average at the time (2012). The specific costs are considered reasonable in view of the challenging local conditions for the PV system on Mineirão, the system's size, the additional sealing work and difficulties during installation, in particular taking into account that the work was tendered internationally.

The PV rooftop system was completed as intended before the 2014 World Cup. This was to be put into operation as early as 2013 at the Confederation Soccer Cup. Although the measures were largely completed and inaugurated before the Confederation Soccer Cup, the plant could only be commissioned later, but in good time before the 2014 World Cup, as there were problems with the grid connection (transformer problems) that required a custom-made transformer.

12. Allocation efficiency

The energy produced is sold on the free market (ACL). Due to the monthly fluctuations in production, the generated electricity is not sold contractually to a specific customer, but is allocated on a monthly basis to supply contracts with customers who buy state-subsidised energy from renewable energies.

The average annual sales price for the period 2015–2023 was BRL 277.88/MWh. This corresponds to approximately EUR 60/MWh at an average multi-year exchange rate. According to approximate calculations as part of the EPE, the updated dynamic production costs (LCOE) based on the most important data provided by CEMIG are around EUR 317/MWh. These significantly exceed the average annual sales price.

According to CEMIG's calculations, the real internal rate of return (IRR) is slightly negative. Since the CEMIG financial model may not be shared externally, a simplified calculation was carried out as part of the EPE. According to those calculations, the IRR would be more negative than that calculated by CEMIG. Factors that contributed to the negative IRR were the high specific costs of photovoltaics at the time (not competitive with other renewable sources of energy such as wind), the sharp downturn in electricity production and the sharp devaluation of the BRL against the EUR (repayment in EUR). In view of the size and capacity of CEMIG, it can nevertheless be assumed that there will be sufficient provision of funds for operation, maintenance and replacement procurement.

It was not possible to assume profitability for the proliferation of a technology that was almost completely unused in Brazil at the time, while the specific costs of photovoltaics were still high back then. In addition, with regard to profitability, it should be emphasised that for CEMIG, the PV rooftop system on Mineirão was not the priority, but rather the innovative nature of the project, the gathering of expertise and experience with the technology of large-scale PV systems, the commercialisation of PV energy and marketing as an innovative energy supply company and pioneer in the field of PV systems.

In contrast to the individual economic perspective at the level of CEMIG, the project is nevertheless considered efficient from a macroeconomic perspective, as it has contributed to making (large-scale) photovoltaic technology and its great potential known as a flagship project in Brazilian PV electricity generation and contributed to the broad impact (see *Contribution to overarching (intended) developmental changes*). The plausible broad-based impact led to far greater impacts than the direct measurable and quantifiable impacts of the project at effectiveness and impact level.

Ultimately, only EUR 3.74 million out of a total of EUR 10 million was used as part of the project, as the energy efficiency measures and a second PV rooftop system were omitted (see *Relevance – Reaction to changes/adaptability*). The FC development loan was reduced accordingly by EUR 6.26 million at the request of CEMIG. In view of the impacts that go beyond the project, the non-exhaustion of the available funds and potentially lost impacts as a result are not important.

Rating summary

Insufficient or negative profitability is acceptable and unavoidable in the case of the distribution and establishment of technologies in view of the intended long-term macroeconomic effects. Therefore, efficiency is considered to be

[6] The difference to the above-mentioned final costs of EUR 4.28 million arises from a minor measure (procurement of six electric cars).

moderately successful overall, despite the negative internal rate of return due to the good production efficiency and the macroeconomic effects of the flagship project.

Efficiency: 3

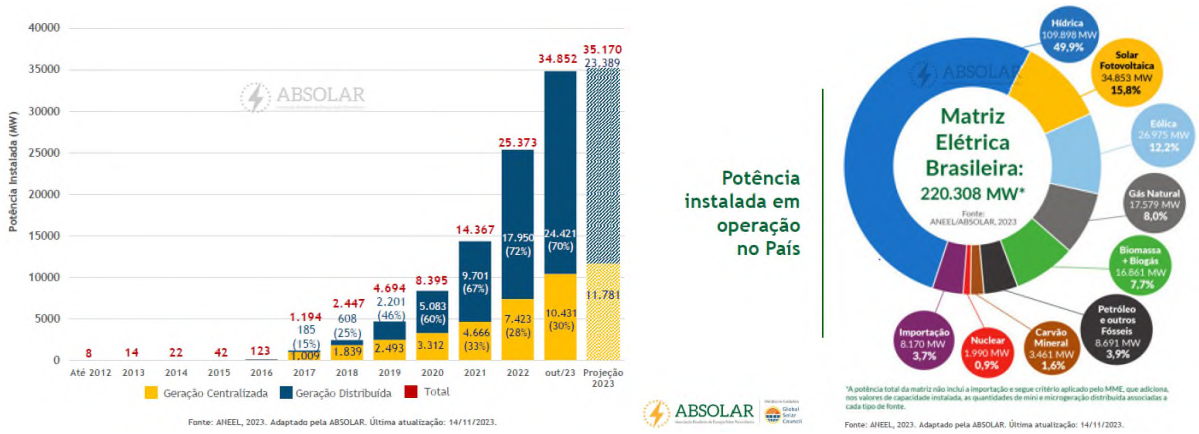
Impact

13. Overarching (intended) developmental changes

At impact level, the objective underlying the EPE was to contribute to the distribution and expansion of photovoltaics as well as climate protection.

After the period leading up to 2013 in which Brazil's solar potential was virtually unexploited, the photovoltaic sector has developed tremendously since then. Brazil ranked sixth worldwide in the annual increase in installed output at 9.9GW in 2022 and tenth in terms of total installed PV capacity. In 2023, photovoltaics accounted for close to 16 % (~35GW) of Brazil's generation capacity (Figure 2). The state of Minas Gerais (site of the project) is one of the leading Brazilian states in terms of installed PV capacities. The Brazilian Association for Photovoltaics and Solar Energy (ABSOLAR) estimates that the photovoltaic sector has created more than one million jobs altogether since 2012.

Figure 2: Development of PV and installed power plant capacities (2022) in Brazil



Source: ABSOLAR presentation based on data from the regulatory authority ANNEL

The extensively adapted regulatory framework conditions in favour of promoting photovoltaics also contributed to this. The law on decentralised electricity supply from photovoltaics (Lei 14.300/2022), which entered into force in 2023, creates greater legal certainty for existing and new systems and regulates the contribution to grid costs for new systems. This enactment has intensified the PV boom, as many investors want to take advantage of the currently very favourable feed-in conditions. The law thus also ensures the long-term expansion of PV. This is also reflected in the ten-year plan for the development of the energy sector (Plano Decenal de Expansão de Energia, PDE) 2022–2031, which assumes an expansion of decentralised PV of 37GW (from 9GW, 31 December 2021).

Both the investment costs and operating costs of photovoltaic systems have fallen sharply and were therefore also within international ranges.[7]

Photovoltaic energy is thus in direct competition with wind power as the cheapest generation source in Brazil. A comparative analysis by the Brazilian energy research company shows that while wind power projects have a lower average investment value in BRL/kW than photovoltaic projects, the latter have lower average operating and maintenance costs compared to wind power plants. Therefore, (in the Brazilian context), competitiveness between the two sources of energy depends on other costs and expenses, marketing strategies and capital structure and costs.[8]

[7] Brazilian energy research company – EPE: Caderno de Preços de Geração (year of publication 2021)

[8] Brazilian energy research company – EPE: Caderno de Preços de Geração (year of publication 2021)

The achievement of the direct target at impact level is shown in the Impact target achievement table. Beyond these directly measurable effects of the PV rooftop system, the section *Contribution to overarching (intended) developmental changes* assesses the achievement of the target in quantitative terms.

Impact target achievement table:

Indicator	Status at PA	Target value at EPE	Actual value at EPE
Carbon emissions prevented (t/year)	0	629 [1) and 2)]	642 [3)] **Achieved**

[1)] Calculation of the CO_2 coefficient based on IGES (combined margin 2007–2009: 0.279t CO2/MWh)

[2)] Estimated generation of UFV Mineirão and UFV Mineirinho (~1,900MWh)

[3)] Calculation based on gross production (2015–2022) and the corresponding CO_2 coefficients of IGES (combined margin 2015–2022: 0.428t CO_2/MWh)

14. Contribution to overarching (intended) developmental changes

The project contributes to the prevention of CO_2 emissions and thus to the overarching development policy objective of environmental protection and climate change mitigation by expanding electricity generation capacities from photovoltaics: Although the second PV rooftop system has not been implemented and the electricity generation is below the target value (see *Effectiveness – Contribution to goal achievement)*, the target value with regard to the avoidance of CO_2 emissions (t/year) has been achieved. This is due to the fact that the CO_2 coefficient (grid emission factor) has increased compared to the value at the PA (see below). However, the target value would not have been achieved by the Mineirão PV rooftop system alone without the increase in the CO_2 coefficient. With a second PV rooftop system, the avoided CO_2 emissions would have been higher than the above-mentioned actual value at EPE.

However, the overarching (intended) developmental changes go beyond these direct and quantifiable CO_2 savings. They result from the intended impetus for the prevalence of use and the induced expansion of photovoltaics. However, these can only be assessed descriptively.

As outlined in the previous section on *overarching (intended) developmental changes*, the Brazilian photovoltaic sector has developed tremendously. According to the programme proposal, the generation capacity from photovoltaics was only 0.17MW_p at the time of the PA. The evaluated project “Solar World Cup 2014” in conjunction with the FC-financed project “Solar Pilot Project Brazil” alone generated 2.42MW_p.

As part of the 2014 World Cup, the 2016 Olympic Games and beyond, the PV system at Mineirão received a lot of attention in the media as well as from experts, including at conferences and in the literature (including in studies involving CEMIG employees). In addition, the PV rooftop system at the Mineirão stadium was the subject of several doctoral theses and master’s studies. The PV system is still regarded as a reference project and has been or is being visited by universities and professionals interested in photovoltaics. It is noteworthy that the PV system was the first PV rooftop system on a Brazilian World Cup stadium[9] at the time and the world’s largest stadium PV rooftop system.

Interviews with pioneers and long-standing experts in the Brazilian energy sector confirmed that the public impact of the project provided important impetus for the development of the Brazilian photovoltaic sector. In addition to the aforementioned now considerable share of photovoltaics in Brazil’s generation capacities, which is speaks for itself, it was also confirmed that photovoltaics and the corresponding expertise have been established and that marketing for them is now irrelevant.

An impressive development in photovoltaic generation capacities can also be observed at CEMIG. At the time of the EPE, the share of PV in the total generation capacity (~5,300GW) was only 1 % (~56MW_p), but CEMIG plans to install a total of 1,800MW_p[10] of PV capacity by 2027. An additional 170MW_p was planned to be commissioned by the end of 2023. Furthermore, CEMIG has obtained approval for further large-scale PV systems. These are floating PV systems with a total capacity of around 270MW_p and are planned to be implemented by 2025 or 2026. As a result, the project had direct impacts on CEMIG in addition to the sectoral impact.

[9] In Recife, a 1MW system was installed next to the World Cup stadium and a rooftop PV system with a capacity of ~0.4MW was installed at the Maracanã World Cup stadium in Rio de Janeiro.

[10] CEMIG GT and CEMIG SIM.

The effects intended by CEMIG through the collection of expertise and experience with the technology of large-scale photovoltaic systems, the commercialisation of photovoltaic energy and marketing as an innovative energy supply company have occurred.

The plausible demonstration effects of the project thus contribute both directly through the PV rooftop system on Mineirão and through the impetus for expanding further PV capacities to avoid CO_2 emissions and thus to the DC programme, which aims, among other things, to reduce greenhouse gas emissions in energy generation.

In the context of the water crisis (2021), which led to increased use of thermal power plants in addition to capacity bottlenecks in energy generation, Brazil's CO_2 coefficient rose. Looking ahead, even after overcoming the water crisis (2021), it is still essential to diversify Brazil's energy supply in order to avoid future crises that would lead to a renewed (temporary) increase in fossil electricity generation, given the fact that electricity generation or expansion from large hydropower plants can no longer be planned reliably. Together with wind power, photovoltaics make an important contribution to this.

15. Contribution to overarching (unintended) developmental changes

No unintended developmental changes were identified within the scope of the EPE.

Rating summary

The Brazilian photovoltaic sector has developed impressively since the PA – both in terms of installed capacity and in terms of regulatory changes for the benefit of photovoltaics – and is in direct competition with wind power as the cheapest generation source. In addition to the CO_2 emissions (t/year) directly avoided as a result of the PV rooftop installation on the Mineirão stadium, the project played a significant role in contributing to the development of the Brazilian photovoltaic sector in general and to the expansion of the executing agency's photovoltaic capacities. Overall, the project's impact is rated as successful.

Impact: 2

Sustainability

16. Capacities of persons concerned

The project-executing agency CEMIG has a sound financial, personnel and organisational position. The training level and professionality of the employees is high. CEMIG's self-conception and image are characterised by motivation and ownership. This is also reflected in the above-mentioned independent development and implementation of further large-scale PV plants *(see Contribution to overarching (intended) developmental changes*).

Given the extensive experience CEMIG has gained, it has built up good resilience to respond adequately to technical problems. Despite strongly fluctuating electricity sales prices, sufficient financial resilience can also be assumed in view of CEMIG's size.

17. Contribution to support for sustainable capacities

CEMIG's personnel responsible for operation and maintenance received two weeks of training from the EPC contractor as well as ongoing on-the-job training.

Prior to implementing the project, CEMIG had little experience in the area of photovoltaics. The project deepened the expertise and experience with regard to photovoltaics, particularly with regard to the technical requirements.

The project has contributed to the diversification of CEMIG's generation capacities and contributed to the further expansion of photovoltaics to ensure energy security for electricity consumers. This is particularly important with regard to climate change (see *Contribution to overarching (intended) developmental changes*).

18. Durability of effects over time

The quality of the PV rooftop system and other technical equipment is high. The amount of damage from commissioning to date is considered normal and unremarkable.

Any disruptions of operation are rectified by CEMIG, even if the availability factor is slightly below the average of comparable PV systems. However, there are restrictions on access to the Mineirão (at events or on weekends), so that repairs can sometimes not be carried out immediately – which affects the availability of the system accordingly.

Operation and maintenance were carried out by the EPC contractor for the first two years on the basis of a service contract; since then these duties have been taken over by CEMIG employees. Both operation and maintenance by CEMIG comply with the highest standards (Best International Engineering Practice) and are carried out with an appropriate personnel structure.

Since commissioning, there have been problems with the SCADA system and the availability of data. CEMIG is continuing work on a solution, but this is complicated by specially required access codes for settings and is affected by the interim acquisition of the EPC contractor responsible at the time of the project.

There is room for improvement in terms of operation and maintenance. This can also be used as a learning experience for other PV systems or system planning. This includes e.g. periodic performance analyses (every two years), increasing the availability of the PV system to at least 95-97 % through regular semi-annual calculation of the plant's performance ratio (PR) and corresponding operational measures, regular cleaning of the modules twice a year (see *Effectiveness – Contribution to goal achievement)*, analysis of the degradation of the PV modules and the pooling and validation of all information (financial, technical, operational and maintenance). The implementation of regular degradation analyses and their consideration in the module warranty for a period of at least ten years is an effective measure with regard to future PV systems.

Overall, the professionalism and pronounced ownership on the part of CEMIG as well as the operating data and constant monitoring of the system indicate sustainable operation and the achievement of the technical service life (25 years).

Rating summary

The executing agency's sound economic, personnel and organisational position and its growing expertise and professionalism suggest sustainable operation and sustainable effects from the Mineirão PV rooftop system. Sustainability is therefore rated as successful.

Sustainability: 2

Overall rating

The project's approach picked up on the spirit of optimism associated with a globally active attitude towards photovoltaics and was ahead of its time in the Brazilian context. The intention to choose the 2014 World Cup as a vehicle for the marketing of photovoltaics and to install a PV system at a venue for the 2014 World Cup was excellent in terms of design. In terms of publicity, the Mineirão stadium, which was the second largest stadium in Brazil at the time, well-known throughout the country, was an excellent location for raising awareness of photovoltaics in the media, business, politics and society and promoting the prevalence and increased use of this technology. These aspects were decisive for the very successful assessment of the OECD-DAC criterion of relevance. The project's approach has proven its worth, as its broad-scale effectiveness plausibly contributed significantly to the development of the Brazilian photovoltaic sector, which is expressed in the successful evaluation of the OECD-DAC criterion of impact. The successful coherence and assumed sustainability also fit into this picture. The former is characterised by its integration into the country strategy and the focus on energy, as well as by the complementarity of DC instruments and Brazil's own efforts.

The very successful assessment of relevance and the successful assessments of coherence, impact and sustainability outweigh the moderately successful effectiveness due to the mixed indicator target achievement and the moderately successful efficiency due to the negative profitability and are decisive for the overall successful assessment of the project.

Contributions to Agenda 2030

The global community has agreed on the Sustainable Development Goals (SDGs) of Agenda 2030 (UN, 2015) and the implementation of the Paris Agreement (UNFCCC, 2015). SDG 13 on climate action includes measures to take urgent action to combat climate change and its impacts, and SDG 7 includes measures that ensure access to affordable, reliable, sustainable and modern energy for all. The aim of the Paris Agreement is to limit global warming to well below 2°C compared to the pre-industrial era and, if possible, below 1.5°C. By generating power from renewable energy and avoiding CO_2 emissions, the project contributes to SDG 13 (Take urgent action to combat climate change and its impacts) and SDG 7 (Ensure access to affordable, reliable, sustainable and modern energy for all), as the integration and distribution of renewable energy has a direct impact on access to affordable, reliable, sustainable and modern energy as well as on the general fight against climate change and its effects. Ultimately, the expansion of renewable energy sources as a cost-efficient alternative in the face of increasing energy requirements also contributes to environmentally sustainable economic growth (SDG 8). The “cooperation for sustainable development” with the global partner country Brazil, in which the project is integrated, also contributes to partnerships to achieve the goals (SDG 17). In particular, through complementarity of photovoltaics with hydropower, the project has contributed to the resilience of energy infrastructure (SDG 9) with regard to drought periods, which are more likely to occur in the future due to climate change.

Project specific strengths/weaknesses and general conclusions/lessons learned

The project had the following strengths and weaknesses in particular:

- The project's approach picked up on the global spirit of optimism with regard to photovoltaics and was ahead of its time in the Brazilian context.
- The intention to choose the 2014 World Cup as a vehicle for the marketing of photovoltaics and to install a PV system at a venue for the 2014 World Cup was excellent in terms of design.
- In terms of publicity, Mineirão Stadium, then Brazil's second largest stadium and well-known throughout the country, was an excellent location for raising awareness of photovoltaics in the media, business, politics and society and promoting the prevalence and increased use of this technology.
- In hindsight, it became apparent that electricity generation is significantly impaired by dirt on the modules. No facility for transporting water to the stadium roof was planned in the design. As a result, time-consuming water procurement leads to irregular cleaning of the modules.
- Due to the roof architecture/construction and the elliptical shape of the stadium, the PV rooftop system is heavily affected by shading throughout the entire day and thus generates less power. Active shade management was not planned in the design.
- The focus of the project was consistently on promoting the distribution of photovoltaics in the Brazilian market. In view of the technology, which was still virtually unused in 2011/22 and the high specificity of photovoltaics, it was not possible to assume that the system would be economically viable.

General conclusions and lessons learned:

- Projects that address technological developments and trends in markets with great untapped potential have a particularly broad-based impact potential. The visibility or public impact of the location can also be a decisive factor for this.
- Compared to other technologies, high specific costs and insufficient profitability in the distribution and establishment of technologies in early market phases are acceptable given the intended longer-term macroeconomic impacts.
- When designing PV (rooftop) systems, cleaning facilities must be taken into account depending on the context in order to avoid impairing power generation.
- Analysis of site-related shading and its impact on production has the potential to prevent or reduce yield losses.
- Carrying out regular degradation analyses and taking these into account in the module warranty for a period of at least ten years is an effective measure for optimised plant operation.

Evaluation approach and methodology

Ex-post evaluation methodology

Ex-post evaluations follow the approach of a rapid appraisal, i.e. a data-supported, qualitative contribution analysis resulting in an expert opinion. Effects are attributed to the project considering plausibilities, based on thorough analysis of documents, facts and impressions. This includes – if possible – the use of advanced technology (e.g. satellite imagery, online interviews, geocoding). 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:

Internal project documents; country/sector strategy, data from national regulatory authorities and other sectoral institutions, public studies and executing agency reports / questionnaire response

Data sources and tools for analysis:

Energy Research Company (EPE), national electricity regulatory authority (ANEEL), Brazilian association for photovoltaic and solar energy (ABSOLAR), partner monitoring data, IGES Grid Emission Factors, GPS data, satellite images

Interview partners:

Project-executing agency and long-standing stakeholder in the Brazilian photovoltaic sector.

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 project is taken into account concerning its influence on the results. The conclusions are put into perspective regarding the availability and accuracy of the available data. An evaluation concept is the frame of reference for the evaluation.

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

The following aspects limit the evaluation:

None.

Rating methodology

Projects are rated on a six-point scale for each of the OECD-DAC criteria. The scale is as follows:

Level 1 very successful: result that clearly exceeds expectations

Level 2 successful: fully in line with expectations and without any significant shortcomings

Level 3 moderately successful: project falls short of expectations but the positive results dominate

Level 4 moderately unsuccessful: significantly below expectations, with negative results dominating despite discernible positive results

Level 5 unsuccessful: despite some positive partial results, the negative results clearly dominate

Level 6 highly unsuccessful: the project has no impact or the situation has actually deteriorated

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

The annex to this report is available upon request (german only).

List of abbreviations:

ABSOLAR	Associação Brasileira de Energia Solar Fotovoltaica (Brazilian association for photovoltaics and solar energy)
FI	Final Inspection
BMZ	Federal Ministry for Economic Cooperation and Development
CEMIG	Companhia Energética de Minas Gerais
CO_2	Carbon dioxide
DAC	Development Assistance Committee
EUR	Euro
(F)IRR	(Financial) Internal Rate of Return
FC	Financial cooperation
FC E	FC evaluation
GIZ	Gesellschaft für Internationale Zusammenarbeit GmbH
GW	Gigawatts
kW_p	Kilowatt peak
MDG	Millennium Development Goals
MME	Ministério de Minas e Energia (Ministry of Mining and Energy)
MW	Megawatt
NDC	Nationally Determined Contribution
PA	Project appraisal
PV	Photovoltaic
SDG	Sustainable Development Goal
TC	Technical cooperation
WM	World Cup

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