

Ex post evaluation – Egypt

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Sector: Power Generation /Renewable Energy (CRS: 23030)
Project: Zafarana IV Wind Farm – BMZ-No. 2003 66 674*)
Project Executing Agency: New and Renewable Energy Agency (NREA)

Ex post evaluation report: 2016

		Project A (Planned)	Project A (Actual)
Investment costs (total)	EUR million	104.8	117.8
Counterpart contribution	EUR million	29.9	39.4
Funding**)	EUR million	74.9	77.7

*) Random sample 2016

**) EUR 2.78 million have been financed using the funds of the project "Zafarana Wind Farm III"



Description: Construction of the Zafarana IV wind park with a total capacity of 80 MW and consulting services for the planning and implementing of the project. The wind farm was implemented by NREA (New and Renewable Energy Agency) and was operated by a private operator for the first five years.

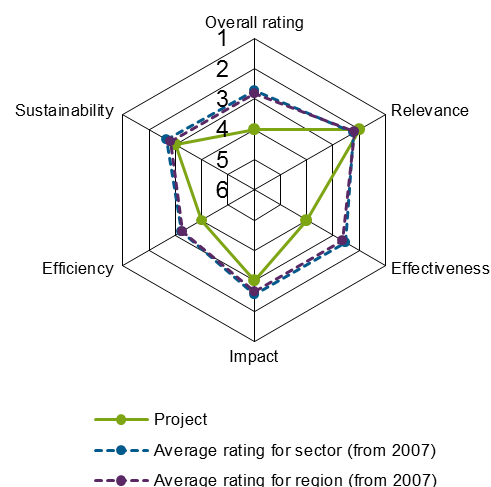
Objectives: The overall development objective ("impact") was to contribute to global climate protection. The project objective ("outcome") was to contribute to the economically efficient supply of electrical energy generated on an ecologically sound basis and to feed the electrical energy generated into the national grid.

Target group: The target group of the project was the totality of electricity consumers in the Egyptian grid as well as indirectly all global beneficiaries of climate change mitigation.

Overall rating: 4

Rationale: The project led to the diversification of the Egyptian electricity generation and helped to cover the continuously growing electricity demand in Egypt using a climate-friendly generation technology. However, initial wind forecasts have proven way too optimistic. Besides, the power plant's operation and maintenance remain constrained due to chronic budgetary restrictions. Tariffs have been raised, but not to the desired extent, putting NREA's financial sustainability at risk.

Highlights: Egypt has some of the best wind resources in the world on the Red Sea coast and along the Gulf of Suez. The Zafarana wind farm projects were the first large-scale projects making use of this potential. The current total installed capacity of wind energy is 750 MW of which the Zafarana wind park IV accounts for more than 10 %. In addition, the project allowed for the economic use of desert areas in the hinterland to the Red Sea coast, which can hardly be exploited for alternative uses - without harmful side-effects in social or ecological terms.



Rating according to DAC criteria

Overall rating: 4

Relevance

At the time of project appraisal, the Egyptian power sector was characterised by high annual increases in energy demand with an average growth rate of around 7 % p.a. and the electricity reserves amounted to only 8 % of the peak load - which is very low in the light of a steady annual demand increase. Egypt is endowed with a significant potential for wind energy. Thus, the development of Zafarana IV wind farm was a good approach to make best use of the natural resource advantage whilst tackling the growing energy demand. The intervention logic assumed at project appraisal that using the excellent wind conditions prevailing at the Red Sea to generate electricity would contribute to climate protection remains valid.

Electricity demand in Egypt continues to grow annually by approximately 6-7 %. The energy sector underwent reform in 2014, and - among other things - the Egyptian government targeted an increase of renewable energy. In 2015 the updated Renewable Energy (RE) strategy was published which aims at 20 % of energy to be sourced from RE in 2022, including approximately 3250 MW from wind energy. The current total installed wind energy capacity is 750 MW of which the Zafarana wind park IV accounts for more than 10 %. All of this confirms that the project's relevance remains valid until today. Nevertheless, looking at the challenges of the power sector in Egypt, further energy efficiency efforts, including demand side management measures, should be envisaged in order to limit excess electricity consumption.

From the beginning, this project was aligned with the objectives of the German-Egyptian cooperation and remains in line with the current program objective "to support the Egyptian Government in achieving their objectives for a sustainable power supply in the fields of renewable energy and energy efficiency". In addition, it fosters the Egyptian Government's Conference of Parties 16 (COP 16) commitment which clearly puts the focus on increasing renewable energy as an alternative to thermal energy. This contributes to achieving the Sustainable Development Goal 7 (SDG 7) that aims at ensuring access to affordable, reliable, sustainable and modern energy for all.

The project area of Zafarana consists of a total number of eight wind parks financed by Denmark, Spain, Germany and Japan. Yet, it must be noted that - whilst the coordination among the donors was mostly organized by the Project Executing Agency, the New and Renewable Energy Agency (NREA) - issues like the wind regime, wake effect and buffer zoning among the different parks were not well studied and anticipated at the planning stage of the wind farms.

Relevance rating: 2

Effectiveness

In terms of outcome, the project's objective as defined at the appraisal was to contribute to an economically more efficient supply of electrical energy generated on an ecologically sound basis and to feed the electrical energy generated into the national grid.

The project's objectives were to be measured by the following indicators:

Project objective-indicators	Targets at appraisal status	Actual status 2016
1) From the 2nd complete operating year on, an annual average supply of electrical energy into the national grid	320 GWh	This indicator has not been achieved. The actual average energy production of the last 3 years is only 197 GWh, i.e. 38.5 % below expectations.

2) From the 2nd operating year, annual avoidance of CO ₂ emissions	180,000 t	Accordingly only about 110,000 tons CO ₂ emissions per year are being saved.
3) CO ₂ avoidance cost	10 USD/t CO ₂	12.5 USD/t CO ₂
4) NEW: Technical availability of the windfarm	> 95 %	83.3 %

Since the beginning of operations in August 2008 until now, the average annual production of 320 GWh envisaged in the appraisal report has never been achieved. The technical availability of the wind turbines during the last 12 months was 83.3 % - as reported by NREA. This is far below the expected availability of above 95 %. Even though the evaluation mission was not able to get clear information about the weight of each of the contributing factors, the main reasons for the low performance can be explained as follows:

- 1) The target definition for energy production was based on economic objectives and general wind maps, but not on a long term due diligence derived from site measurements and wind data (nowadays state-of-the-art). It appears to have been derived from a limited set of phase I time series data, which turned out as too optimistic. It can be assumed that a production target of 260 GWh that was suggested in one of the follow-up studies in 2005 would have been more realistic.
- 2) The actually measured wind speed of 7 m/s is lower than the 9.1 m/s taken as basis during the project appraisal in 2013 - which was also assumed by NREA, the World Bank, the Global Environmental Fund (GEF) and the Danish Development Cooperation.
- 3) The construction of peripheral infrastructure close to the wind generators as well as of touristic buildings on the seashore tends to contribute to increased technical losses of the wind farm.
- 4) The procurement procedures for spare parts take too long. In addition, the slow supply of the pending spare parts by the contractors has resulted in the suspension of operation for some wind turbines.
- 5) NREA has budget constraints for operation and maintenance (O&M), and this directly influences the availability of the wind farm. The sustainable operation of the plant can only be ensured when the project owner allocates sufficient resources to O&M.
- 6) The aero-generators' quality and efficiency is lower than expected, as the equipment has presented problems and failures since the beginning of operations - as reported by the consultant to NREA in 2011.

On a pilot basis, this wind project's first five years of operation were outsourced to the private sector. After that initial period, NREA took over operations. NREA has a total number of 1,200 employees, of which only 200 people, including 55 engineers, are working at the Zafarana site itself (545 MW). The total staff at Zafarana is divided into two shifts of 100 people working 10 days per shift, being responsible for O&M activities of all 8 wind park projects.

At the time of appraisal, one of the project objectives was to provide the economically efficient supply of energy to the national grid. Under prevailing tariff mechanisms for renewable energy, it is difficult for NREA to cover its cost of production (dynamic generation cost of 72 EUR/MWh vs. tariff of 29 EUR/MWh in 2016). Since this was known at project appraisal, "economic efficiency" can only be understood in terms of low/ acceptable cost of CO₂ avoidance. The final value for the CO₂ avoidance cost is considered acceptable.

Effectiveness rating: 4

Efficiency

The total investment costs for the 80 MW wind park project were originally estimated at EUR 104.8 million, of which EUR 79.7 million (76 %) were to be financed from financial cooperation (FC) funds. In comparison to the appraisal report's estimates from the year 2003, total costs increased by 12 % to EUR 117.8 million. This is primarily due to the fact that the low voltage cables, high voltage cables and the transformer station were considerably more expensive than calculated. NREA has increased its own contribution, and remaining funds from Zafarana III were used to cover the additional costs. Compared with other wind farms and by today's standards, the investment amount is acceptable.

Zafarana IV was approved as a Clean Development Mechanism (CDM) project. The original target of avoided CO₂ emissions was estimated at 180,000t per year during project appraisal; in fact, 171,500t/a were registered in the CDM Project Design Document (PDD). Back then, a 95 % gas and 5 % heavy oil generation mix had been assumed as thermal alternative. However, the number of oil power plants decreased. This results in a lower actual CO₂ reference amount than expected. The reduced generation figures caused CO₂ emission reductions to decline further. Those were recorded at 110,000 tons by the end of 2015 - hence lower CDM revenues.

An implementation period of 45 months was planned at the time of appraisal. The windfarm was actually completed with a delay of only one month. The five year operation contract ended in 2013, however, only in November 2015 an agreement was reached between the supplier and NREA concerning the acceptance of the aero generators. Still, after more than 8 years of operation, two turbines (out of 94 altogether) have not been accepted by NREA because of noise problems on the gear box.

Long-term cost coverage in the Egyptian power sector is currently estimated to be around 66 %, thus not meeting KfW's sector standards of at least 80 %. So far, this low percentage has been part of the Egyptian Government's sector strategy, which has subsidised energy through a number of channels (including prices for crude petroleum, natural gas, liquefied natural gas/ LNG, gasoline, diesel fuel, fuel oil and electricity). As of 2013/2014, total combined energy subsidies accounted for nearly 9 % of the GDP. In July 2014, the Government of Egypt introduced an energy reform which aims at phasing out energy subsidies and at encouraging private participation in the sector. This reform is expected to reduce the financial burden for the state; at the same time, it is to address the challenge of a continuously increasing demand. As one reform element, a new tariff scheme for power generation projects has been introduced (determined Feed-in tariff/ FiT for different technologies up to 50 MW; cost covering power purchase agreements for power plants above 50 MW). These reforms could improve allocation efficiency - provided a strong commitment by the Government. Although private sector expressed strong interest in "Build-Own-Operate"/ BOO and FiT mechanisms, investments have not materialized yet and it remains to be seen whether cost coverage can be achieved.

The current total installed capacity is 35 GW, with a peak load around 29 GW. With electricity demand increasing by 6 % p.a., the energy sector is facing a great challenge. Technical transmission and distribution losses are quite good at around 12 %. Overall, the sector's production efficiency (transmission and distribution losses <20 %, availability of thermal power plants >85 %) is rather good. However, there is still potential for further improvement, especially with regard to energy efficiency in industry and buildings.

Efficiency rating: 4

Impact

The intended impact as defined at appraisal was to contribute to global climate protection. No indicator was defined, presuming that achieving the project objectives themselves would contribute to the overall impact. Since final generation is rather lower than originally assessed, the wind farm's impact is also less than expected. Nevertheless, a substantial contribution to the climate protection is made.

The 80 MW Zafarana IV wind park project was put into operation in 2008, and it has contributed to the envisaged energy mix in the national grid, albeit at reduced levels. The development of large wind farms concentrated in the Zafarana area - with a total capacity of up to 545 MW - has greatly increased public awareness on the feasibility of large-scale wind farms. It also contributes to technology transfer and allows for the economic use of desert areas with high wind energy potential, which can hardly be exploited

for alternative uses. Zafarana IV, in particular, provided some important lessons in terms to be learnt of its O&M contract with a private EPC contractor.

Impact rating: 3

Sustainability

The project was developed by NREA. Together with the contractor and the support by the implementation consultant Lahmeyer, NREA completed the project to achieve its main objective of providing clean based energy supply to the national grid. The sustainability of the project now mainly depends on the proper and timely execution of O&M activities.

Zafarana IV was the first project in Egypt that involved private sector participation in the O&M of wind turbines. The 5-year-operation contract was a good initiative in order to bring about private sector participation in that respect. This practice helped NREA collect and enhance experience from international operators. However, as mentioned above (see "Efficiency"), some technical defects occurred with the turbines, which resulted in extended discussions between NREA and the supplier over outstanding items, spare parts etc. Until now, the Final Acceptance Certificate has not been issued for two of the wind turbines.

For NREA, it is important to have sufficient financial and human resources for the O&M activities in order to maintain its envisaged output and outcome in the long run and to ensure technical sustainability. In general, NREA is willing and capable of maintaining the infrastructure, but constraints in budget allocations for O&M as well as for manpower and equipment are still a great challenge. Furthermore, NREA's organisational structure is characterised by centralised decision-making and low responsibility on site regarding staff and finances. In 2015, the O&M budget available for the production of 197 GWh amounted to nearly 0.3 ct€/ kWh. This is a fairly low value compared with international standards. Tariffs have been increased, but not to the desired extent. The current tariff received by NREA is 0.268 EGP/kWh, which does not even cover the agency's low-level expenses. Until today, NREA's continuous deficits, which are covered by the Government, have a strong impact on NREA's daily business and the available O&M resources. Updated feed-in tariffs with an annual increase of 20 % shall be applied for new projects or could be negotiated when entering into new O&M contracts (based on the 2015 electricity law). This should help enhance the agency's financial situation. However, it will not solve NREA's problem of accumulated financial losses. Increasing electricity prices on the end user's side shall reduce the budgetary deficit for utilities and government: The Ministry of Renewable Energy and Electricity is implementing an increasing tariff scheme with the aim to eliminate subsidies on electricity prices by 2019. Since 2014 electricity prices have already doubled on average (reduced increase for low consumption groups).

Furthermore, NREA encounters difficulties with the replacement of spare parts due to the lengthy internal procurement procedures it has to apply - being a state institution. This creates the risk that turbines stop working in cases where spare parts cannot be delivered on time. Such situations have repeatedly lowered the energy output not only of Zafarana IV, but of all other wind parks.

In terms of social and environmental sustainability, the project is located in the uninhabited Red Sea coast hinterland, and no resettlement was or will be required. The project site does not lie within the main bird migration route. Thus, the environmental risk assessment at the time of appraisal remains valid, and no conflicts are expected.

Sustainability rating: 3

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

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

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

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

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

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

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

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

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

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