KfW Development Bank

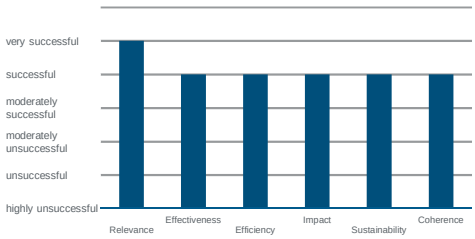
Ex post evaluation
Programme Energy Efficiency and Renewable Energy Phase III, North Macedonia

Title	Programme Energy Efficiency and Renewable Energy Phase III		
Sector and CRS code	23240		
Project number	2012 66 188 / 2009 66 390 (pooled)		
Commissioned by	BMZ		
Recipient/Project-executing agency	Elektrani na Severna Makedonija / Power Generation Plants of North Macedonia (ESM)		
Project volume/ financing instrument	*EUR 47.9 million*		
Project duration	*2013-2017*		
Year of report	2021	**Year of random sample**	2021

Objectives and project outline

The target at outcome level was (i) to increase the use of renewable energy resources, (ii) to diversify supply sources and (iii) to prevent climate-damaging carbon emissions. At impact level, the target was to contribute to global climate change mitigation. To achieve the desired targets, the first wind farm in North Macedonia was to be built with an installed capacity of 36.8 MW as part of the project. The wind farm was built as planned.

Overall rating:
Successful



Key findings

The project achieved a high level of development effectiveness, both at outcome and impact level. The project has been rated “successful” for the following reasons:

– The project is in line with the partner country’s political priorities. The demonstration effect of the measure plays a particular role here.

– Particularly during the project’s preparatory phase, coordination between different donors and institutions functioned very well, which also facilitated efficient project implementation.

– The target achievement is assessed as very successful at outcome level and successful at impact level based on the indicators. At impact level, the project also had a demonstration effect.

– Long-term operation of the wind farm is viewed as plausible. The guaranteed feed-in tariff for 20 years contributes to this. If energy prices develop in line with current trends, the continued sustainability of the measure is probable, even without a guaranteed feed-in tariff.

Conclusions

– Due to the necessary studies and wind measurements, etc., wind farm projects require comparatively long preparation times. This project was implemented very efficiently as studies and measurements already available were used consistently.

– The introduction of a new technology can justify higher specific production costs when compared to a technology already in use.

– Consistent bat and bird monitoring including systematic mortality monitoring should be implemented. In this context, the recommended measures to reduce the risk of collisions should be considered.

1 = very successful, 2 = successful, 3 = moderately successful, 4 = moderately unsuccessful, 5 = unsuccessful, 6 = highly unsuccessful

Rating according to OECD-DAC criteria

Overall rating: 2

Ratings:

Relevance	1
Coherence	2
Effectiveness	2
Efficiency	2
Impact	2
Sustainability	2

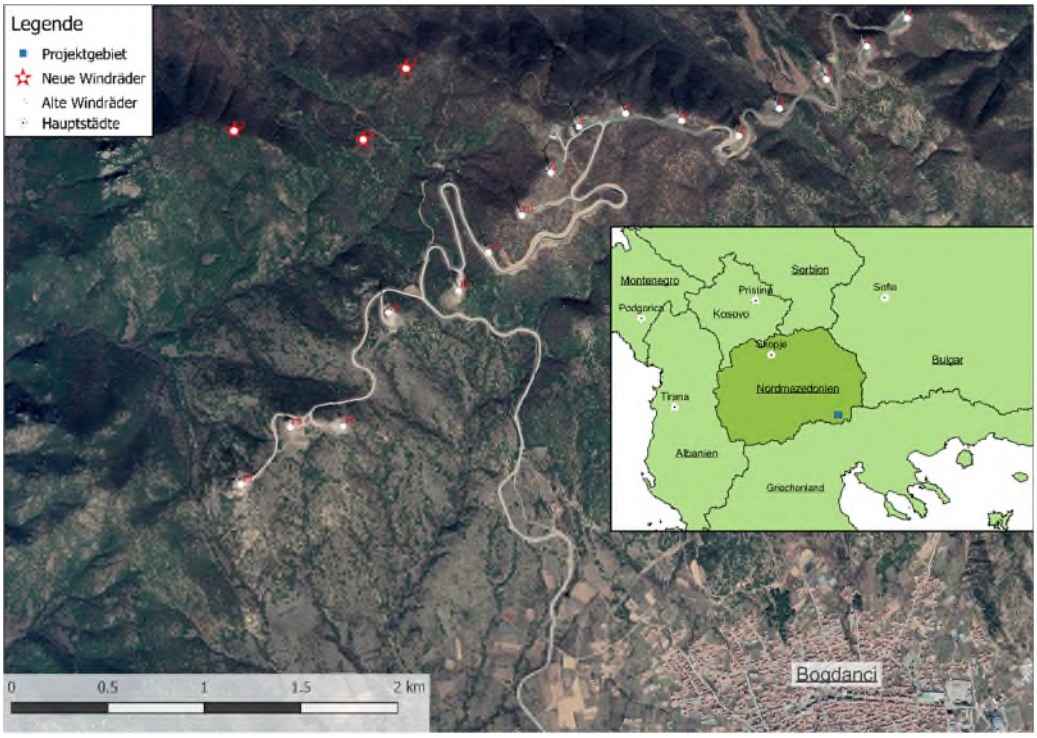
General conditions and classification of the project

The “Bogdanci Wind Farm” project under evaluation is embedded in the FC “Programme for Energy Efficiency and Renewable Energies”, phases II and III. The other components originally planned under the FC programme are: (1) the rehabilitation of six hydropower plants, (2) expansion of the hydropower plant in Spilje and (3) construction of a district heating system in Bitola. The construction of the first Bogdanci wind farm was financed in two phases. Phase III of the FC programme (BMZ-No. 2012 66 188), which was chosen in the random sample, comprised the financing for the hydropower plant in Spilje as well as securing full financing for the “Construction of the first Bogdanci Wind Farm” component already under way in phase II of the above-mentioned FC programme. The Spilje hydropower plant component was not implemented and will thus not be taken into account within the scope of this evaluation. The first financing phase (BMZ-No. 2009 66 390) for the wind farm will be included in this evaluation in order to evaluate the entire wind farm (project), independent of the two financing phases.

Brief description of the project

The first wind farm near the city of Bogdanci was built with a total of capacity of 36.8 MW. It comprised installing 16 wind turbines, each with an output of 2.3 MW. In addition, the power transmission cable was laid between the turbines, a 20/110kV substation and a 110kV transmission cable that is around 11.5 km long were installed and the existing Valandovo substation was expanded. Smaller building measures such as the construction of access roads, etc. were also carried out within the scope of the project. The target group of the project was the consumers connected to the electricity grid in North Macedonia. The connection rate in North Macedonia is 100 %, which means that all residents of North Macedonia benefit equally from the project.

Satellite image of the project area



Source: own data using Google Maps and https://www.openstreetmap.de/karte.html

Breakdown of total costs

Phase 3 secured the financing for the Bogdanci wind farm. As financing was originally planned for another phase (phase 2), only the actual costs are listed in the total costs, and not the planned costs.

		Inv. Total (Actual)	Inv. Phase 2 (Planned)	Inv. Phase 2 (Actual)	Inv. Phase 3 (Planned)	Inv. Phase 3 (Actual)
Investment costs (total) million	**EUR**	**55.61**	**55.50**	**32.90**	**22.60**	**22.71**
Counterpart contribution million	EUR	7.71[1]	22.60	0.00	7.60	7.71[1]
Debt financing million	EUR	47.90	32.90	32.90	15.00	15.00
Of which BMZ funds million	*EUR*	*47.90*	*32.90*	*32.90*	*15.00*	*15.00*

Relevance

Alignment with policies and priorities

The Bogdanci wind farm project was and continues to be in harmony with the policies and priorities of the partner country, as well as with the “Sustainable Energy for Development” sector concept of the German Federal Ministry for Economic Cooperation and Development (BMZ). Energy projects that aim to prevent carbon emissions are given clear priority here due to the global impacts of climate change. The North Macedonian government also attested the energy sector a critical role with regard to the emission of greenhouse gases in the Second National Environmental Action Plan

[1] The counterpart contribution and thus also the total costs deviate slightly from the figures in the final inspection and in the consultant’s final report. This amount matches the information provided by the project-executing agency at the time of the evaluation.

(NEAP) from 2006. According to the NEAP, 70 % of domestic greenhouse gas emissions can be attributed to the energy sector. At the same time, the energy sector has the greatest greenhouse gas reduction potential. In addition to the use of biogas, increasing the use of renewable sources of energy was also identified as a measure to reduce greenhouse gas emissions. Wind energy was also designated as a potential renewable source of energy for the future in addition to energy production from hydropower, solar, geothermal and biomass sources (NEAP, 2006). In the Strategy for Energy Development in the Republic of Macedonia until 2030, increasing the energy efficiency and use of renewable energies (RE) were identified as important adjustments for the energy sector itself, and specific targets for the use of RE were defined. According to these targets, the share of RE in the energy mix should be at least 20.1 % and up to a maximum of 31.5 % for energy production in 2020. During planning, wind and hydropower made up 19 % and 75 % of the total energy production from RE respectively, giving them paramount importance. In February 2007, the ERC regulatory commission finally implemented regulations for RE feed-in tariffs to provide stronger incentives for the use of RE sources in electricity generation. Initially, these only pertained to electricity production from small hydropower plants. Since May 2007, wind farms can also be registered as "preferential producers", thus giving them access to these feed-in tariffs. According to statements from the regulatory authority, the feed-in tariff was orientated towards the feed-in tariffs valid in Germany at the time.

Focus on needs and capacities of the participants and affected groups

At the time of the project appraisal (PA), the fundamental problem identified in the North Macedonian energy sector was the growing demand for energy despite already insufficient capacities and the associated dependence on imports. Inadequate investments in the existing infrastructure, the high share of carbon-intensive thermal power production methods and the unexploited potential of RE also contributed to the heavy pollution caused by electricity production in North Macedonia. And at the time of the appraisal, it was not possible to regulate the base and peak load of the power grid due to the lack of readily adjustable generation capacity, which led to the operation of thermal power plants in inefficient medium-load mode. From today's perspective, the main problem was appropriately identified and the measure is suitable for addressing the key issue determined, with the exception of the problem of quickly adjustable generation capacity. Wind power is not a suitable technology for addressing this issue as energy can only be produced when weather conditions permit. However, a combination of wind and hydropower is possible as the wind energy production leads to improved management of service reservoirs and thus, indirectly, to improved adjustability of the generation capacity. This means that the core problem was correctly identified at the time of the project appraisal. However, the project itself only addressed parts of the core problem. The problems of inadequate investments in the existing infrastructure and the high share of thermal energy generation were not or only indirectly addressed. The RE capacities installed under the project were created as a supplement and thus increased the domestic energy supply, but did not lead to a reduction in energy production at thermal plants. The target group was the entire population of North Macedonia connected to the power grid (100 %).

Appropriateness of the design

The measure's design was technically and financially appropriate and generally suitable for solving the core problem, particularly with regard to the unexploited potential of RE. As a standalone project with an installed capacity of 36.8 MW, the project itself was only able to make a small contribution towards solving the core problem. The key potential of the measure is in its introduction of a new technology and the associated demonstration effect, in particular.

The concept behind the measure is sufficiently precise and plausible. The assumed causal relationships are reasonable and plausible: "Construction of the first wind farm in North Macedonia → improved exploitation of renewable energy resources → increased use of renewable energy resources → provision of additional generation capacity → increased share of RE in the energy mix → prevention of climate-damaging carbon emissions".

With regard to a holistic sustainable development approach, the measure predominantly focuses on ecological dimensions of sustainability by reducing carbon emissions. However, the economic and social dimensions are factored in with the selection of an efficient technology as well as the

selection of the target group (entire population of North Macedonia) as well as the provision of additional generation capacity, which benefits all consumers.

Reaction to changes / ability to adjust

The measure itself, meaning the outputs created, was not adjusted over the course of the implementation. However, the financing structure was adjusted to ensure the smooth completion of the wind farm. In 2013 a second loan agreement amounting to EUR 15 million was concluded and the North Macedonian counterpart contribution was reduced accordingly.

Summary of the rating

With the construction of North Macedonia's first wind farm and the associated exploitation of previously untapped RE resources, the project goes hand in hand with the political priorities of the partner country. The demonstration effect of the measure plays a particular role here as it provides the opportunity to take into account the partner country's priorities beyond the individual project and organise the energy sector in ways that take advantage of new RE technologies. The concept of the measure and the underlying causal relationships are plausible and appropriate. We rate the relevance of the project as very successful overall.

Relevance rating: 1

Coherence

Internal coherence (division of tasks and synergies within German development cooperation):

The project was implemented within the scope of action, so questions regarding internal coherence are not relevant.

Common technical (IEC) standards and international environmental and social standards were taken into account during the measure's implementation.

External coherence (complementarity and coordination with actors external to German DC):

The partner's own efforts received significant support from the financing of the first wind farm in North Macedonia. The project-executing agency ESM (formerly ELEM) began its involvement in the wind energy sector in 2005 with what is known as a wind power forecast. In the process, the state-owned energy producer received support from entities that included USAID, among others. In 2006, ESM installed four wind measuring stations in different parts of North Macedonia. Since the end of 2008, ESM has received support in the form of a grant from the EU-Western Balkan Investment Framework (WBIF) amounting to EUR 400,000 for creating the feasibility study, which included a comprehensive environmental and social impact study. The North Macedonian government applied for the grant. The extensive feasibility study was concluded in 2011. According to the WBIF homepage, the development and subsequent construction of the wind farm (using funds from KfW Development Bank) is one of the success stories of the regional blending facility, which primarily supports the EU expansion process and development in the countries of Albania, Bosnia and Herzegovina, Kosovo, Montenegro, Serbia and North Macedonia.

Coordination between the donors and institutions involved in the preparation and implementation of the project was remarkably good according to statements from WBIF representatives and the EU delegation in Skopje. In general, however, coordination among donors in the North Macedonian energy sector is not particularly strong.

The project was implemented together with the state-owned energy producer that generates 95 % of the power produced domestically. The project thus used the partner's existing structures to carry out the activities. Project monitoring focused primarily on operational data. Beyond that, no joint systems are used.

Summary of the rating:

Although coordination among donors in the energy sector is not particularly strong, coordination between the various donors and institutions involved in preparing and implementing the project worked well. Thus, we rate the coherence of the measure as successful.

Coherence rating: 2

Effectiveness

Achievement of (intended) targets:

The goal at outcome level adjusted within the scope of the EPE was:

(i) increased use of RE resources;

(ii) diversification of supply sources and

(iii) prevention of climate-impacting carbon emissions.

Within the scope of the PA, different objectives were defined at outcome level to some extent for financing phase 1 (BMZ-No. 2009 66 390) and 2 (BMZ-No. 2012 66 188). The original target at outcome level for the first financing phase was to

(i) contribute to the diversification of the supply sources and

(ii) increase the share of RE used for power production;

For the second financing phase, the original target at outcome level was to

(i) increase the share of RE in North Macedonia's electricity supply,

(ii) prevent climate-impacting carbon emissions and

(iii) diversify sources of energy.

Within the scope of the EPE, the targets defined for the different financing phases during the PA were merged. The target (ii) for the first financing phase and the target (i) from the second financing phase were integrated and slightly reworded to be "increased use of RE". This formulation includes both energy production and electricity supply. Using the phrase "increasing the share […]" was deliberately avoided as the share of RE in energy production / electricity supply can also be influenced by external factors, in addition to the project.

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

Indicator	Status during PA	Target according to PA/EPE	Actual value at EPE
(1) Additional power generation fed into the grid	0	At least 90 GWh/a (PV)	Achieved: Ø 107.27 GWh/a[2]
(2) Time availability per year	0	97 % (EPE)	Achieved: Ø 98.25 %[5]
(3) Preventing climate-impacting carbon emissions	0	At least 80,000 t CO_2-eq/a	Achieved: Ø 80,934 t CO_2/a[5]

[2] The average values refer to the years 2015–2020, as these are the only years with data available for the entire calendar year. Production first began in April 2014. For 2021, data were only available through the end of July at the time of the evaluation.

With regard to indicator 1: in 2014, the generation only began in April. At the time of the evaluation, data were only available through the end of July for 2021. During the years from 2015–2020, an average of 109.46 GWh of electrical energy was produced per year. According to information from the project-executing agency, 98 % was fed into the grid.

With regard to indicator 2: the values for both the average time availability and the time availability for each year since the plants were put into operation were significantly above the target of 97 %. Over the years, the time availability decreased from 99.24 % in 2015 to 97.56 % in 2020. As the service contractor is under contractual obligation to ensure time availability of at least 97 %, we do not assume that the time availability will fall below 97 % in future. However, this level could be increased again through careful and close monitoring of the service contractor.

With regard to indicator 3: at the time of the PA, the emissions factor, which is used to calculate the amount of carbon emissions saved, was 0.89 t CO_2/MWh. This factor decreased, and was 0.74 t CO_2/MWh for North Macedonia in 2021. Despite the reduction of nearly 17 %, the indicator was still achieved due to the wind farm's very good production figures.

No indicator was defined for target (ii) diversification of supply sources. To date, the Bogdanci wind farm is the only wind farm in North Macedonia and has made a definitive contribution to diversifying supply sources because it introduced a new technology. Several further wind farm projects are currently in the pipeline. These plans include expanding the existing wind farm in Bogdanci by around 14 MW to up to a maximum of 50 MW. A German investor is also planning to build a 400 MW wind farm in the northeast region of the country, thus increasing the project's contribution to diversifying supply sources even more.

Contribution to achieving targets:

The measure's outputs were rendered as planned during the PA; no adjustments with regard to the rendered outputs were made over the course of project implementation.

The use of the created outputs is rated good. The wind farm operates around 6,800 hours per year and, depending on the amount of wind, has a 78 % utilisation rate on average. In addition, the 33.64 % capacity factor of the wind farm, meaning the ratio of energy generated to installed power, can be rated as good. The average use in Germany is a capacity factor of approximately 17 %.

The project's target group consists of all consumers connected to the power grid. The connection rate in North Macedonia is 100 %. Accordingly, the entire population of North Macedonia benefits from the project to the same degree. As a result, the measure contributed to achieving the targets at the level of the intended beneficiaries.

One critical factor facilitating the achievement of the intended targets was the wind farm's very good performance, which, for example, led to the reaching of the annual carbon savings targets despite the emission factor decreasing by around 17 %. One further important factor is the good site selection with an average wind speed of 7.23 m/s since the start-up of operation.

Quality of implementation

The quality of the measure's implementation by the project-executing agency and the consultant is evaluated as good with regard to target achievement. In terms of management quality regarding the target achievement, potential for improvement was discovered on the part of the project-executing agency during the evaluation. The project-executing agency completely outsourced the operation and maintenance of the wind farm to the wind turbine manufacturer within the scope of an O&M contract. The information on the time availability of the wind farm indicates very high availability of 99.19 % in the first year of operation. Over the years, availability declined to 97.57 % in 2020. This still equates to a satisfactory time availability of the wind farm. As the time availability target is stipulated at a minimum of 97 % in the O&M contract, it cannot be assumed that the availability will decrease below 97 % as long as the O&M contract remains valid. However, if the project-executing agency were to be more closely managed and monitored and preventative maintenance were to be performed, it may be possible to return the time availability to the initially higher levels achieved during the first year of operation. The good technical availability also indicates good construction

quality of the farm. The participation of the project-executing agency in the measure is assessed as good due to a high level of involvement throughout the entire term of the project.

Unintended impacts (positive or negative)

The measure did not demonstrate unintended positive impacts in the short or medium term. The measure was implemented in three lots. A North Macedonian subcontractor was commissioned to implement lots one and two. A North-Macedonian-Italian consortium was commissioned for lot three. In this respect, it can be assumed that the measure made notable employment impacts in the local construction sector during the construction phase. However, there have not been any long-term impacts on employment due to the fact, in particular, that operation and maintenance were outsourced to an international service contractor.

There is a potential risk though it is not possible to estimate unintended negative impacts with certainty. Due to the wind farm's location, there is a potential risk that bats and birds may collide with the wind turbines. It was not possible to determine with any certainty how high this risk may be within the scope of the EPE. Although post-construction monitoring was conducted, it only monitored the flight activity of bats and birds, it did not comprise systematic mortality monitoring. Bats' flight activity is very different during various times of the year, which thus changes the risk of collisions. Flight activity – and thus the risk of collisions – is highest from mid-July until the end of October.

In 2018, a total of 11 bat carcasses were found on four days, and another one was discovered on 9 July 2019. These discoveries were coincidental and not the result of a systematic search. Taking into account the previously mentioned information about flight activity and according to experts, there is a risk that the number of bats killed by collisions is significantly higher. Based on a detailed analysis of flight activity, it is recommended that mitigation measures be taken for bats, but not for birds.

The recommended measures to reduce the risk of collisions between bats and turbines had not been implemented at the time of the EPE. Neither the service contractor nor the project-executing agency found bat carcasses at the wind farm site at any point. No carcasses were discovered during the on-site inspection on 4 November 2021 either – however, it should be noted that there is often very little flight activity during the month of November as that is when bats begin to hibernate. Essentially, a systematic search with trained personnel is the only way to provide information about the actual situation.

Summary of the rating:

The achievement of the intended targets at outcome level is rated as very successful based on the defined indicators. The quality of implementation is also rated as very successful. With regard to the unintended negative impacts, it is ultimately impossible to assess how high the number of bird and bat deaths from collisions or other influences caused by the wind farm actually is, as no systematic mortality monitoring was conducted within the scope of post-construction monitoring. However, after discussions with the project-executing agency and the operating company, the evaluation mission is under the impression that there is not an excessive number of collisions. Nevertheless, the fact that the recommended mitigation measures to protect bats were not implemented influences the effectiveness of the measure, resulting in the measure being rated successful overall but not very successful.

Effectiveness rating: 2

Efficiency

Production efficiency

The total investment costs including consulting costs amounted to EUR 55.61 million. The counterpart contribution was EUR 7.71 million and the KfW loan was EUR 47.9 million. EUR 53.2 million of

the total costs were for investments, and EUR 2.50 million were for consulting costs. The consulting costs thus amount to 5 % of the total investment costs overall. According to the original planning, the aim was to keep consulting costs at EUR 1.54 million, which is significantly lower than the actual consulting costs. The consulting costs rose by 62 % when compared to the plan, which is significant in its own right. The cost increase is primarily due to very optimistic planning at the time of the PA. However, in relation to the overall investment costs, a consulting cost percentage of 5 % can be considered appropriate.

The total investment costs (CAPEX) for the wind farm in relation to installed capacity are EUR 1,512/kW. Generally speaking, the total costs per kW of installed capacity vary greatly depending on the country. This has to do with several factors, including different meteorological and local conditions. These costs at that time can be deemed appropriate by international comparison. According to internal estimates, the dynamic production costs are 6.63 EURct per kWh, which is significantly lower than the feed-in tariffs and very similar to the estimated value of 6.17–7.17 EURct per kWh contained in the feasibility study (see page 161; study from June 2011). Electricity production of 114 GWh/a at 50 MW was defined in the feasibility study, which results in calculated generation of 100.8 GWh/a when determined using the actual installed capacity of 36.8 MW. The average actual production is 109.46 GWh, which is 10 % higher than the planned value. All of the information mentioned above indicates that the wind farm's real operation is economically efficient.

According to the consultant's report, the preparatory work (e.g. developing the design, competitive bidding, contract negotiations, conclusion of contract) was intended to run from May 2011 until January 2012. There were slight delays due to a longer competitive bidding process and longer contract negotiations for lot one. The implementation phase was scheduled to last from December 2012 to September 2013. There were also slight delays here. The plan was to start operating the wind farm (without taking over certificates) at the end of August 2013. The original plan created during the PA was somewhat more conservative here and aimed to start up operation at the end of March 2014. However, the wind farm actually began operating in April 2014, which, when compared to the implementation consultant's planning, was a delay of seven months. However, delays of this length are normal for infrastructure projects of this type. So the time efficiency for preparation and implementation is rated good.

Allocation efficiency

Compared to the dynamic production costs for the wind farm amounting to 6.63 EURct per kWh, the dynamic production costs of the hydropower plant operated by ESM amount to 2.71 EURct per kWh, which indicates that the costs per kWh of electricity produced from wind energy are 244 % higher than those per kWh of electricity produced from hydropower. In other words, the costs for one kWh of electricity from hydropower are less than half of the costs for one kWh of electricity from wind energy. However, it should be noted that one important target of the measure was diversifying the supply sources. This target could not have been achieved if, within the scope of the project, hydropower had been selected based on the lower specific production costs. It should also be noted that the project rolled out a technology that had not yet been introduced, and that the project thus had a demonstration effect (see Impact). The positive impacts this generated cannot be quantified, but must clearly be rated as positive. We thus consider that allocation efficiency is satisfied for this project.

Summary of the rating:

Coordination and management costs of 4 % are quite appropriate for this type of project, and given that an entirely new technology was introduced here, one with which the executing agency had no previous experience, these costs should be viewed as comparatively low. The time efficiency of the project is good. The production efficiency (costs per unit of installed capacity) is positive by international comparison. The specific production costs are even significantly lower than the specific costs calculated in the feasibility study. The only disadvantage for wind energy here becomes apparent when the specific production costs of wind energy and hydropower are compared. We nevertheless deem the allocation efficiency as achieved based on the project's objective (diversification of supply sources) and the fact that the project had a demonstration effect, thus generating future impacts

beyond those of the wind farm evaluated here. As a result, we rate the efficiency as successful overall.

Efficiency rating: 2

Impact

Impact (intended)

The target at impact level adjusted within the scope of the EPE was:

(i) to contribute to global climate change mitigation.

The desired target at impact level was more broadly defined during the project appraisal. The project originally aimed to:

(i) contribute to social and economic development in North Macedonia and

(ii) contribute to environmental protection and climate change mitigation.

From the perspective of the EPE, it is not plausible that an increased electricity supply from RE would automatically contribute to the country's social and economic development. As a result, this target was discarded. A contribution to environmental protection would only be plausible if the project replaced thermal energy production and the wind farm had led to the decommissioning of the thermal power plant, for example. This could potentially have influenced the air quality. However, as this project fed additional energy into the grid, it is not plausible that the project contributed to environmental protection. Target (ii) was adjusted accordingly.

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

Indicator	Status PA	Target according to PA	Actual value at EPE
(1) Prevention of climate-impacting carbon emissions	0	At least 80,000 t CO2-eq/a	Achieved: Ø 80,934 t CO_2/a (2015–2020)

With regard to indicator one: the project made a plausible contribution towards climate change mitigation by preventing climate-damaging carbon emissions. Development policy changes were identifiable in areas in which the measure aimed to contribute. However, it is impossible to estimate how large the contribution was to the total reduced carbon emissions in North Macedonia.

Contribution towards impact (intended)

The measure made a verifiable contribution to global climate change mitigation as it reduced carbon emissions by over 80,000 t. The savings generated are also within the target range. The measure thus achieved the intended impact. However, the effects of carbon reductions are generally not perceptible in the short to medium term. The measure's target group is the entire population of North Macedonia (outcome level) as well as the global population (impact level). The measure thus contributed to achieving the targets at the level of the intended beneficiaries.

The project introduced the use of wind as RE in North Macedonia for the first time. No further wind farms have been built as yet, but various wind farm projects are in the pipeline. There are plans to expand the wind farm in Bogdanci to max. 50 MW. Near the city of Bogoslev, North Macedonia's second wind farm with an installed capacity of 36 MW is scheduled to be built by 2023 (TUEV SUED reviews landmark 36-MW wind project in North Macedonia on behalf of Erste Group | TÜV SÜD Indonesia (tuvsud.com), published: 7 July 2021). ESM is also planning to build a further wind farm (Miravci) with around 50 MW of installed capacity in Gevgelija. In addition, a German investor is planning to

construct a 415 MW wind farm in the northeast region of North Macedonia as a strategic investment (Balkan Green Energy News, published: 13 October 2021). Even though the project was unable to demonstrate any broad impacts by the time of the EPE, we assume that the large number of planned wind projects will substantially increase the use of wind energy in North Macedonia in the medium to long term. It is therefore plausible that the measure will contribute to structural changes in the energy sector in the medium term.

From the perspective of the project-executing agency, a gas pipeline to Greece or Bulgaria would have been the realistic alternative had it not been possible to realise the wind farm. This would have further increased the North Macedonian energy sector's dependency on imports. Had it not been possible to develop wind power as an RE source, ESM, in its role as energy producer, would have been forced to rely on a transition of thermal power plants away from coal to gas, and more small hydropower plants, to the detriment of diversifying sources of energy.

Contribution to impact (unintended)

No unintended impacts were identified at impact level.

Summary of the rating:

The contribution to the overarching developmental impacts is rated as successful due to the annual carbon reduction. In addition, the project had a spill-over effect and there are currently several further wind projects in the pipeline, which will multiply the climate impacts. No unintended changes were evident or foreseeable. We therefore rate the impact of the project as successful overall.

Overarching developmental impact rating: 2

Sustainability

Capacity of participants and those affected

The operation and maintenance of the wind farm have been taken over by an external service provider within the scope of a maintenance contract (O&M contract). This also includes the maintenance of access routes to the wind farm, the power transmission cables between the turbines, etc. The O&M contract for the wind farm was concluded for a period of ten years and is valid until 19 September 2024. During the last two years of this period, ESM personnel will be trained with regard to operation and maintenance. However, according to its own statements, the project-executing agency would prefer to extend the contract or award a contract to a new external service provider for maintenance and operation of the 16 wind turbines. The intention is also for this partner to take over maintenance and operation for the three wind turbines that will be built within the scope of Bogdanci phase 2. A technical engineer supplied by the project-executing agency is currently responsible for the Bogdanci wind farm. However, this engineer is not stationed at the wind farm. Instead, he carries out his responsibilities from central dispatching at the head office in Skopje. If needed, the engineer responsible for the wind farm can rely on assistance from five further staff members, however, these persons are not responsible for the wind farm in a full-time capacity. The feed-in tariff (FIT) is 8.9 EURct/kWh and therefore substantially higher than the dynamic production costs of 6.63 EURct/kWh. It is expressly confirmed that ESM will receive the FIT for a term of 20 years (until 2034) for the 16 turbines in Bogdanci wind farm 1 once operation begins. After the FIT period ends, the electricity produced in Bogdanci would need to be sold at market prices. However, the FIT is also valid for the additional 13.2 MW expansion of the wind farm for 20 years after it is put into operation (construction is scheduled to begin in 2022). According to a statement from the Energy Regulation Commission (ERC), it is not possible to sell one portion of the electricity produced in Bogdanci under feed-in tariffs and to sell the other portion at market prices. As a result, it remains to be determined whether the electricity produced in Bogdanci will actually be sold at market prices after 2034.

With average production of 109 GWh per year as achieved between 2015 and 2020, ESM generates revenue from the wind farm amounting to EUR 9.7 million per year. This is significantly higher

than the operating costs, including the costs for the maintenance contract for 2020 amounting to EUR 1.36 million. The wind farm is therefore highly profitable. Due to the staffing and financial capacities described, we assume that the positive impacts of the measure will remain over time as well.

Contribution to supporting sustainable capacities

The financial situation of the executing agency ESM is weak (see Annex 8). The evaluation of the 2020 annual financial statements revealed the following picture: the company covers operating costs (positive EBITDA). EBIT was positive in 2018 and 2019, but it continued to decline. In 2020, the company was no longer able to cover its costs fully (negative EBIT). The cash flow of the company also decreased steadily between 2018 and 2020, and was negative in 2020. The debt-to-equity ratio is low at 18 %. Liquidity (second-degree liquidity) is good at 100 %. However, this has also seen a sharp decline of 219 % since 2018. Returns on equity and investment are very bad at -3 % and -2 %, respectively. There is no income statement per power plant. It is therefore impossible to make detailed statements about the wind farm. However, the very positive relationship between income and operating costs for the wind farm (see Efficiency) clearly plays a role in strengthening the general financial situation of ESM.

Sustainability of the impacts over time

The context of the measure can be described as stable, particularly due to the binding feed-in tariffs set for 20 years. Moreover, ESM has a 35-year licence for the wind farm to produce energy, which authorises the project-executing agency to feed electricity produced in the wind farm into the grid for at least 35 years, regardless of a feed-in tariff. After the period of validity for the feed-in tariff expires, the electricity produced at the wind farm would be sold at current market prices (Hungarian Energy Exchange). The energy prices on the free market have recently increased steadily, particularly in the course of the energy shortage. In 2021, the market price was 100.16 EUR/MWh (Hungarian Energy Exchange) on average. Based on the assumption that energy prices will not decrease substantially, and due to the dynamic production costs, it is assumed that the impacts of the measure will remain even without the FIT. We therefore estimate that the positive impacts achieved by the measures are sustainable.

Recommendations for operation and other recommendations (from the final inspection)

Within the scope of the final inspection, the following recommendations were made for ongoing operation:

1. removal of corrosion damage on 14 of the 16 wind turbine towers (by the supplier);
2. installation of fly screens in the medium-voltage system and in the cable vault;
3. sealing of openings in the cable ducts to prevent intrusion of insects and rodents;
4. continuation of the measures already started for greenery and erosion protection;
5. implementation of reinforcement measures to prevent landslides from blocking access roads;
6. implementation of a bird and bat monitoring campaign with a monitoring study after the system is put into operation.

Recommendations 1–5 were implemented appropriately. Recommendation 6 was only partially implemented. After the wind farm was put into operation, a measure known as post-construction bird and bat monitoring was carried out. However, this only included monitoring the flight activity of birds and bats. To estimate the severity of collision risks and to define suitable mitigation measures, the evaluation mission recommends implementing mortality monitoring.

Summary of the rating:

ESM decided to outsource the operation and maintenance of the wind farm over the long term, as it has for the other power plants it owns. The current maintenance contract is valid until September

2024. During the last two years of the maintenance contract, ESM has the option of having its own staff trained by the current service provider. We therefore view the long-term operation of the wind farm as secure, even if there are changes to the business decisions made with regard to outsourcing operation and maintenance. Due to the guaranteed feed-in tariffs until at least 2034, which are significantly higher than the dynamic production costs, we also view the wind farm as profitable over the long term. Based on the estimation of the evaluation mission, the positive impacts at outcome and impact level can therefore be maintained over time. The recommendations for operation were largely implemented. In summary, we therefore assess the sustainability as successful.

Sustainability rating: 2

Overall rating: 2

With the exception of the relevance criterion, which was rated very successful, all of the project's sub-criteria were rated successful. The project is accordingly rated as successful.

Conclusions and learning experiences

The project had the following strengths and weaknesses in particular[3]:

- The very good preparation of the project at an early stage with wind measurements, the implementation of a comprehensive feasibility study and the successful cooperation with other institutions during the preparation phase. This facilitated an efficient and smooth implementation of the project.
- The project-executing agency's interest in the project is, and continues to remain, high. The associated high level of involvement and professionalism of the project-executing agency made implementation much easier.
- In addition to good production figures, the favourable framework conditions for promoting RE in North Macedonia (feed-in tariff of 8.9 EURct/kWh) in particular were pivotal for the success of the project.

Conclusions and learning experiences:

- Wind farm projects require a comparatively long preparation phase due to the large number, complexity and length of inception reports and necessary wind measurements. This project was implemented very efficiently since, in the preparation phase, there was consistent cooperation with other actors, and the studies and measurements already available were used.
- The introduction of a new technology combined with the demonstration effects can justify higher specific production costs compared to technology that is already in use.
- Consistent post-construction bat and bird monitoring, including systematic mortality monitoring, should be performed over the course of the expansion to the Bogdanci wind farm. In this context, recommended measures to reduce the risk of collisions should be determined.
- Even though maintenance and operation are covered by an external maintenance contract, the operator should implement close monitoring to ensure that certain technical figures that have a large influence on the economic efficiency of the system, for example time availability, remain as high as possible through preventative maintenance (also beyond contractually agreed minimum targets).

[3] Strengths and/or weaknesses identified within the scope of this evaluation do not represent sufficient prerequisites for future projects to ensure successful implementation. The heterogeneous and dynamic context needs to be analysed appropriately and taken into account when designing new projects.

Methodology of 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:

Internal project documents, secondary technical literature, strategy papers, context analyses, country analyses and sector analyses, media reports.

Data sources and analysis tools:

Partners' operation and monitoring data, digital databases, GPS data, satellite images, semi-structured interviews

Interview partners:

Project-executing agencies, regulatory authorities (ERC), geonatura Consulting Company, operation and maintenance consultant, EU, EBRD, WBIF

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:

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Methods used to evaluate project success

To evaluate the project according to OECD-DAC criteria, a six-step scale is used for all criteria except for the sustainability criterion. 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).

Publication details

Responsible:
FC Evaluation Department
Evaluation Department of KfW Development Bank
FZ-Evaluierung@kfw.de

KfW Group
Palmengartenstrasse 5–9
60325 Frankfurt am Main, Germany