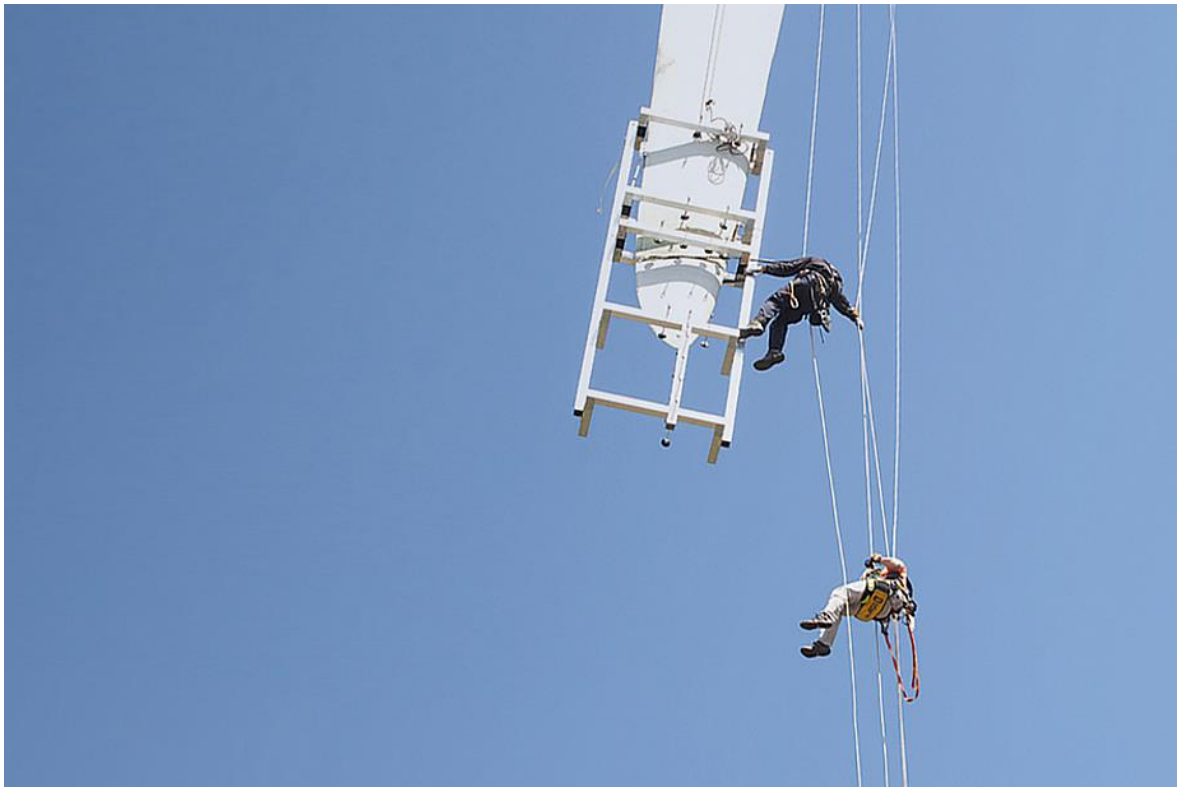

Report Wind Farm Optimisation 2016-2020

- **Findings after 5 years of systematic optimisation of the Own Farm Segment**
- **Average 2% p. a. additional yield through technical innovations**
- **Over 20% lower power generation costs through commercial optimisations**

Bremen, 13 July 2021

I. Background

Since 2016, we have been a development and testing partner for prototype development and field tests in 13 projects for manufacturer-independent technical retrofits of wind turbines to increase yield. In our own parks, we have achieved an average of 2% additional yield p. a. through an individually designed optimal mix of measures. In addition, we were able to reduce the electricity production costs by more than 20% compared to the expenses of previous years through commercial optimisations.

As one of the leading project developers and operators for wind power, we have built 128 wind farms with 642 turbines to date and are responsible for the operational management of 1 GW of wind power capacity, of which more than300 MW are in our own portfolio. Since 2016, we have been systematically optimising the yields and profitability of our wind farms and have established a comprehensive and comparative testing system in the market. After evaluating the results of the last five years, we have now summarised our diverse experience with technical and commercial optimisations in this report Wind Farm Optimisation 2016-2020, as a contribution to the most effective use of wind power in general and in order to contribute to faster progress in the energy transition.

II. technical optimisation - innovations for more yield

Through technical optimisations in our wind farms we generate 2% more yield per year. That is 15.5 million kWh of additional wind power, which alone can supply 6,500 two-person households with energy and save 15,000 t of CO2 emissions.

In our own wind farms, we have technically optimised wind turbines of different types and years of construction and thus achieve an average of 2% additional yield per year. For individual measures and turbines, the yield has been increased by up to 8% p. a. We are a frequent partner for prototype developments and field tests, so that we can successfully deduce which technologies are successful and which are not.

From the broad portfolio of proven technical innovations, we select the optimal combination for each turbine type and location to achieve more yield. In this way, we tap into the hidden potential of wind farms.

The following types of technical optimisation are part of our portfolio of measures:

- Power curve optimisation
- Aerodynamic improvement
- Rotor blade extension
- Improving wind tracking
- Unbalance correction
- Load optimisation after Big Data analyses
- Optimisation of the control
- Electrotechnical optimisation

In the optimisation of other owners' wind farms, which we have been offering since June 2021, only those technologies are used to increase the yield of the turbines that have proven themselves in our own wind farms or whose use we consider promising based on our experience to date.

III. commercial optimisation - reducing electricity production costs

Through commercial optimisation, we have achieved a reduction in the electricity production costs of more than 20% in our wind farms. Since 2016, we have specifically analysed all the costs of the wind farms and reduced the costs of individual types of expenditure, in some cases significantly.

In our own park segment of 280 MW, we have been saving 3.1 million euros in costs annually since 2016 because we have optimised expenditure in our wind parks in such a way that the electricity production costs have fallen by more than 20%. The central reasons for this are our more than 30 years of experience and good networking in the market, which means that our expert teams are always familiar with the breadth and depth of all relevant economic optimisation options.

The significant improvement in cost efficiency is based primarily on three pillars:

a) Pooling synergies and volume effects,

(b) updated maintenance concepts and preventive maintenance; and

c) well negotiated framework agreements.

This allows us to manage wind farms very cost-efficiently.

We have made the following optimisations on the expenditure side at our wind farms:

- Savings through volume effects
- Savings through framework agreements in the project network
- International insurance pool over 500 MW
- Optimised maintenance and servicing concepts
- Systematic preventive maintenance
- Strategic purchasing of medium and large components
- Big data analyses and targeted benchmarking Power generation costs

IV. Review

The review of the measures for the technical and commercial optimisation of our wind farms since 2016 is consistently positive and has far exceeded our expectations. In addition to the direct economic effects of the measures, we also benefit from the data and insights gained, so that we can optimise a large number of relevant parameters for new projects right from the start. Furthermore, we are very well networked in the market and learn about new, innovative ideas for optimising wind farms at an early stage.

The financial effect of the technological and economic improvements made to our wind farms since 2016 can be summarised as follows:

- 1.4 million euros in additional revenue annually through technical optimisation measures
- Annual cost savings of 3.1 million euros through commercial optimisations

Over the years, a five-step approach to planning and implementing optimisation measures has proven its worth, which we have been using ever since and also apply to optimisation projects on behalf of other wind farm owners.

The process of both technical and commercial optimisation takes place in these five steps:

- Step 1: Pre-audit based on central key data
- Step 2: Detailed analysis
- Step 3: Project setup and implementation planning
- Step 4: Implementation of the optimisation measures
- Step 5: Project conclusion with disclosure of the achieved effect (additional income or cost reduction)

For enquiries about exchange and cooperation in the context of technical retrofitting to increase yields or commercial optimisation, please contact our team of experts at windparkexperten@energiekontor.com

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