

Comparison of Pre-Construction Energy Yield Assessments and Operating Wind Farm's Energy Yields

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Abstract

A comparison of real operational production data with the pre-construction energy yield assessments has been performed for farms in Germany based on reference energy yields of neighboring wind farms and international projects based on on-site wind measurements.

Different analysis' have been performed, such as the development of deviations between the pre-construction energy yield and the real data over the years and the dependency on hub height.

Possible reasons for deviations are discussed with the aim of lowering these deviations for future assessments.

Objectives

Based on the work performed 2008 and 2012 [1,2], a deeper analysis on basis of a moderate amount of datasets and new wind farms has been performed considering today's turbine types and hub heights.

The main focus of the presented work is on the following key questions:

- Are the calculation results (P50) within the "expectations", are they over- or underestimating the sites?
- Do the applied uncertainties correspond to reality?
- Are there any dependencies derivable from this data analysis (e.g. hub height, terrain or meteorological complexity)?

Methods

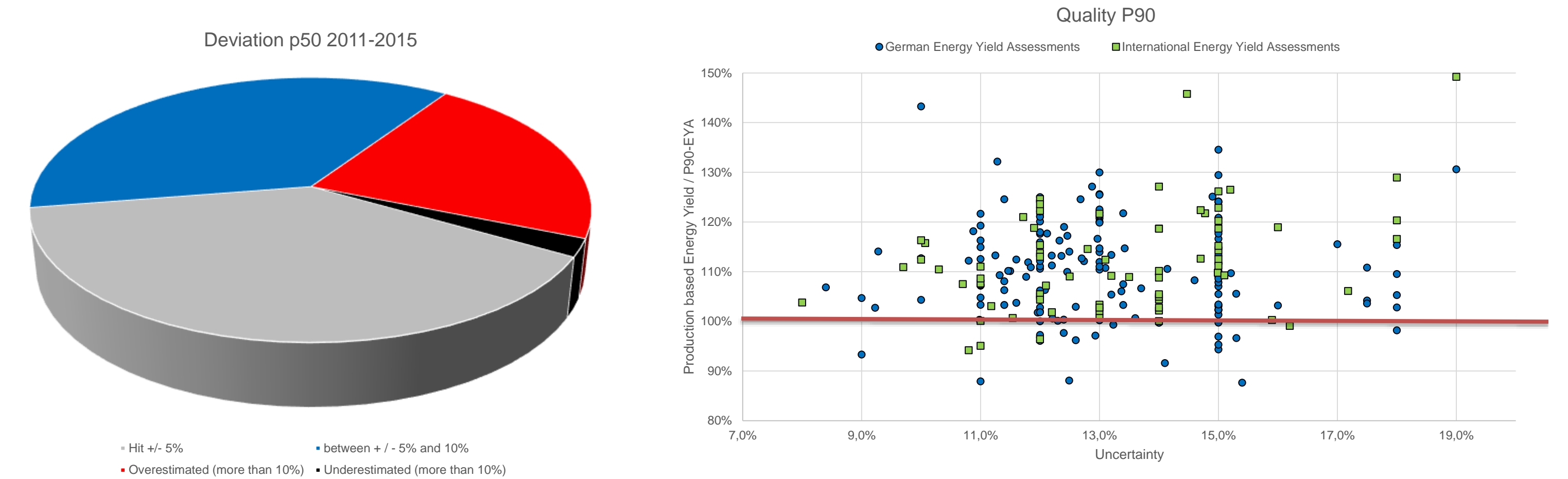
DEWI pre-construction energy yield assessments from 2001-2015 were used for the comparison with real production data, which were taken from the „Betreiberdatenbank“ (only Germany) or provided by the wind farm operator.

This work is based on the following:

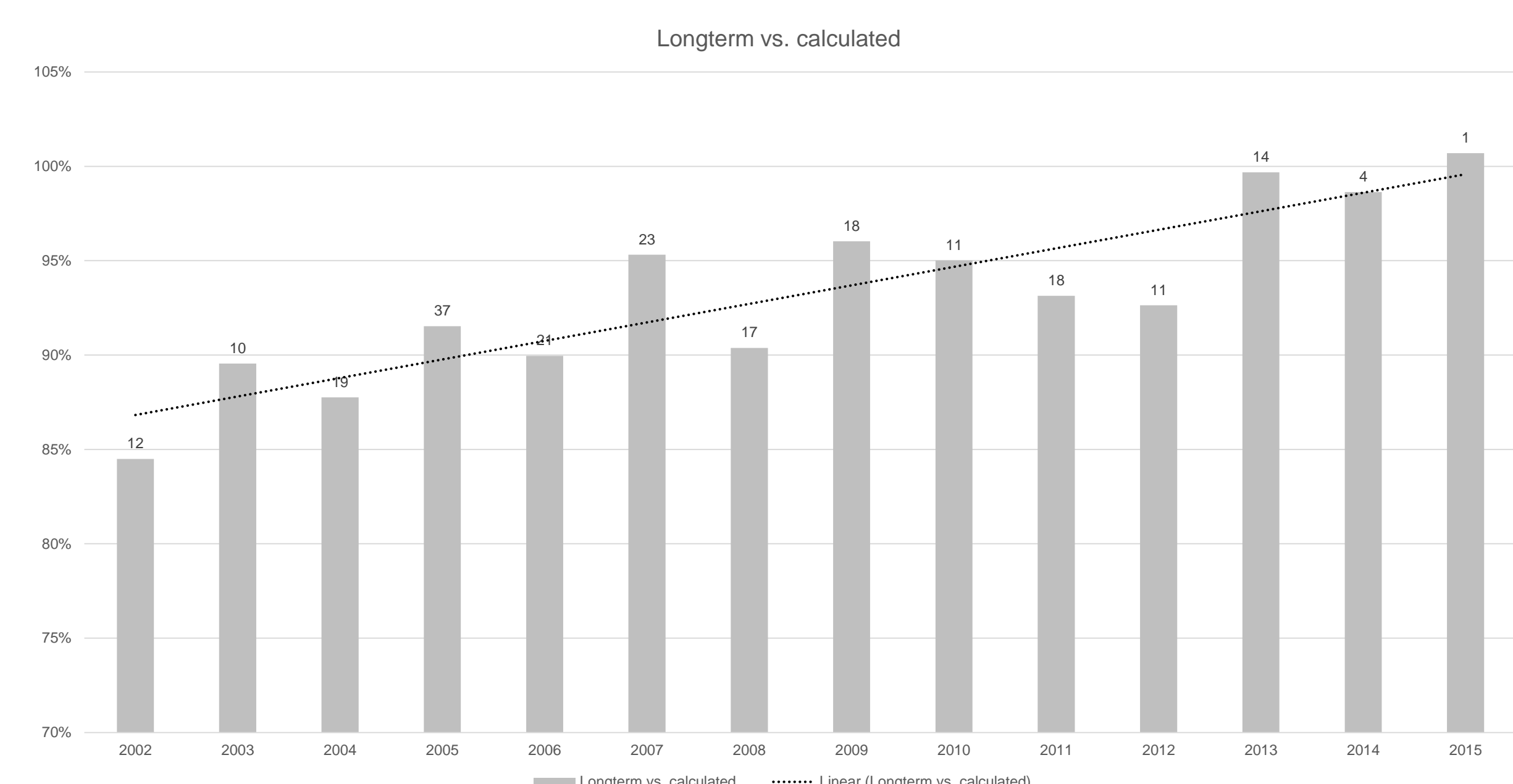
- 120 energy yield assessments from Germany, France and Taiwan performed by DEWI have been analyzed
- Monthly energy yield and availability figures founded the basis of the analysis
- German and international projects have been analyzed individually;
- Available operational data have been corrected to 100% availability;
- German projects have been long-term corrected based on the BDB-Index, a production based long-term source [3], for which the 100% level was modified using DEWI in-house procedures;
- International projects have been long-term corrected based on data from met stations or reanalysis data as MERRA data sets;
- Obvious monthly outliers have been removed;
- P50, P75 and P90 energy yields have been compared,
- a deviation of +/- 5% for the P50 has been classified as correspondence of "real" to "predicted" energy yield,
- For the P75 and P90 75% and 90% of the regarded projects need to be above or equal to the predicted energy yield.
- Average deviations depending on hub height have been determined for following hub height ranges: [50;80[, [80;100], [100;120], >120

Results

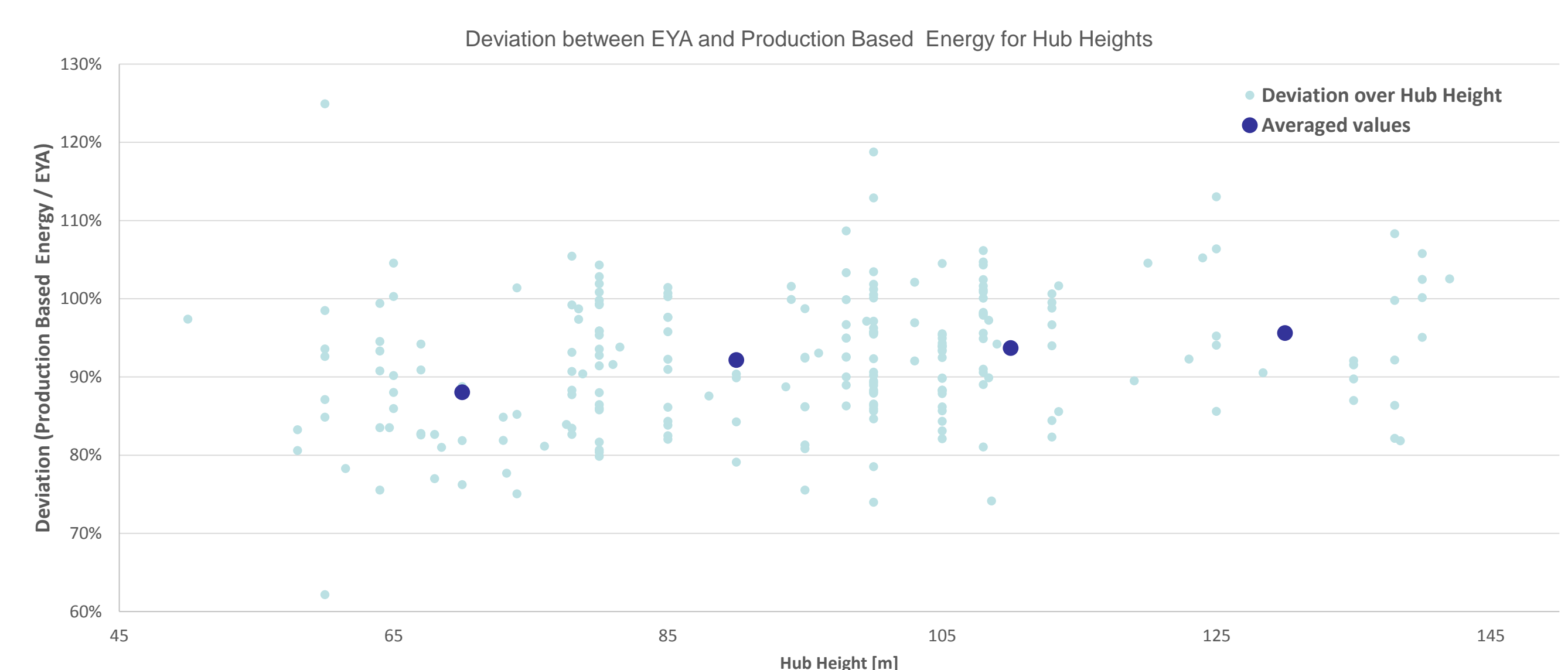
For all EYA evaluated for the years 2011-2015, 39% are within the expectations. Another 37% is between 5% and 10% of deviation, 22% significantly overestimates the energy yields determined on basis of real production data.



Distributions for P90 energy yields show that uncertainties are chosen reasonably. For 89% of the evaluated projects the P90 energy yield of the pre-construction energy yield assessment was reached with the energy calculated on basis of the production data.



The development over the years shows a continuous improvement of the prediction quality.



The deviations decrease with increasing hub height.

Conclusions

Energy Yield Assessments got more reliable over the years, about 40% meet the real P50 within some confidence range. Uncertainties are generally fitting, so do 89% of the projects reach at least the proposed P90 energy yield.

Investigating the dependency of the deviation on hub height, we found a steadily decreasing gap between pre-construction energy assessment and the energy yield calculated on basis of the production data with increasing hub heights (up to 142m).

References

1. Spengemann, P.; Borget, V: Validation of the predicted energy yield of wind farms based on real energy production data; DEWEK 2008
2. Schorer, Levée: Review of the Real Energy Production Data of Operating Wind Farms in Comparison to Former Predicted Energy Yields; Dewi Magazin 42
3. Regionaler monatlicher Windindex der Betreiber-Datenbasis (BDB Index, auch als IWET-Index oder als Häuser-Keiler-Index bezeichnet), Vertrieb seit 01/2005: enveco GmbH, Grevener Strasse 61 c, 48149 Münster.

