
Performance and reliability benchmarking using the cross-company initiative WInD-Pool

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Motivation

Challenges of an Operator

Strengths and Weaknesses?
Benchmarking

How to improve?
Best Practices

Maintenance optimization?
Reliability characteristics



WInD-Pool

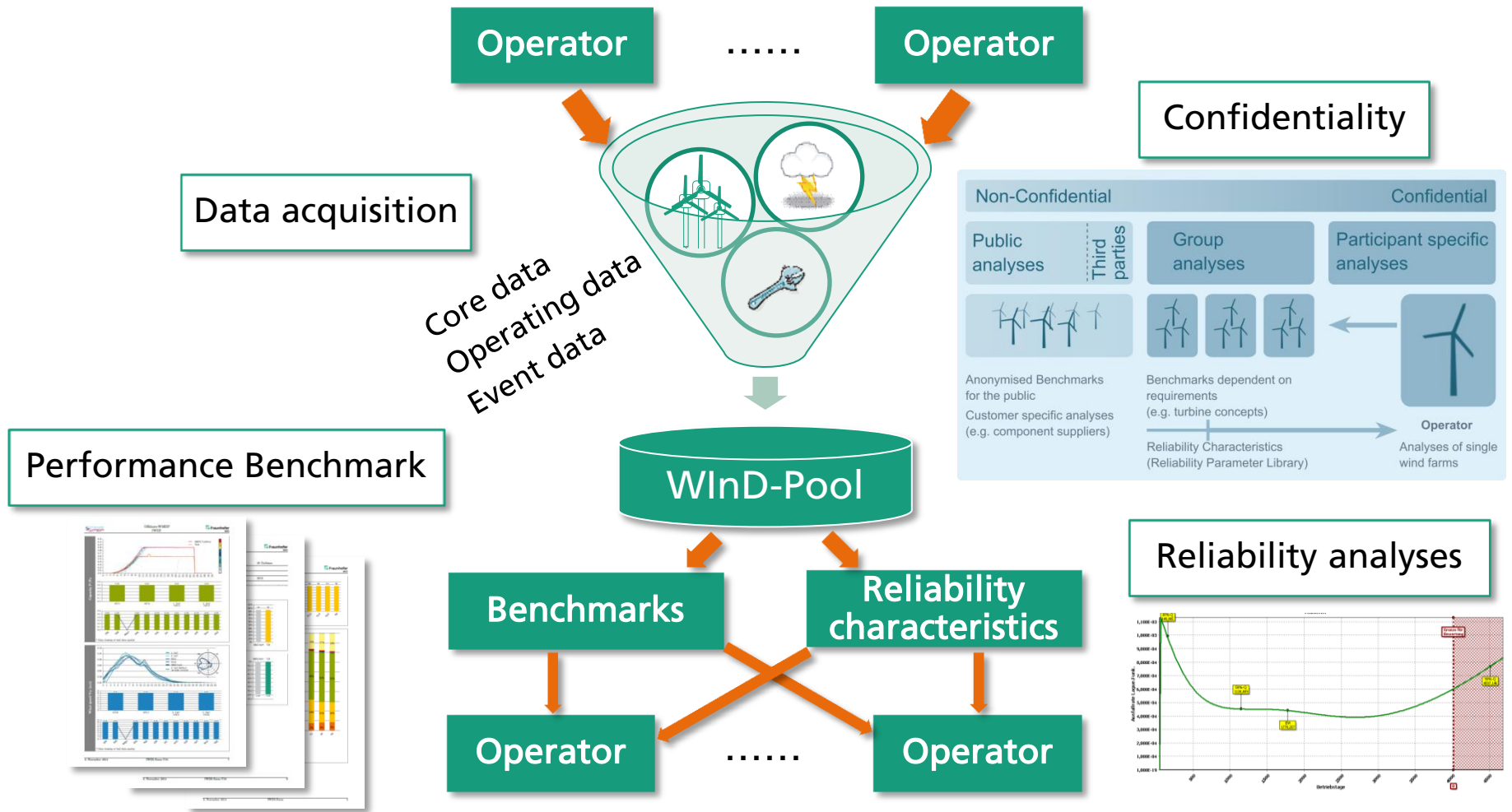
Wind Energy Information Data-Pool

- Cross company initiative of leading operators and Fraunhofer IWES
- Converts operational experience into knowledge
- Performance Benchmarks
- Reliability Characteristics
- Funded by the Federal Ministry for Economic Affairs and Energy (BMWi)



WInD-Pool

Working Principle



Exemplary Results

Underlying Data

Available Data

Offshore

- Operating Data of 298 WT (2009 – 2015)
- Event Data of 55 WT (2 675 months)

Onshore

- Operating Data of 200 WT (2004 – 2014)
- Event Data of 574 WT (42 800 months)

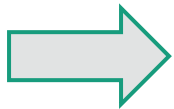
Analyzed Data

Offshore

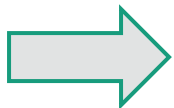
- Operating Data of 158 WT
- Years 2011 - 2014
- Good data 95 %

Onshore

- Operating Data of 200 WT
- Years 2013 – 2014
- Good data 95.2%



Presented results are highly aggregated and solely based on operating data (SCADA)



Presented analyses were carried out specifically for this publication and do not represent the extent of “normal” reporting

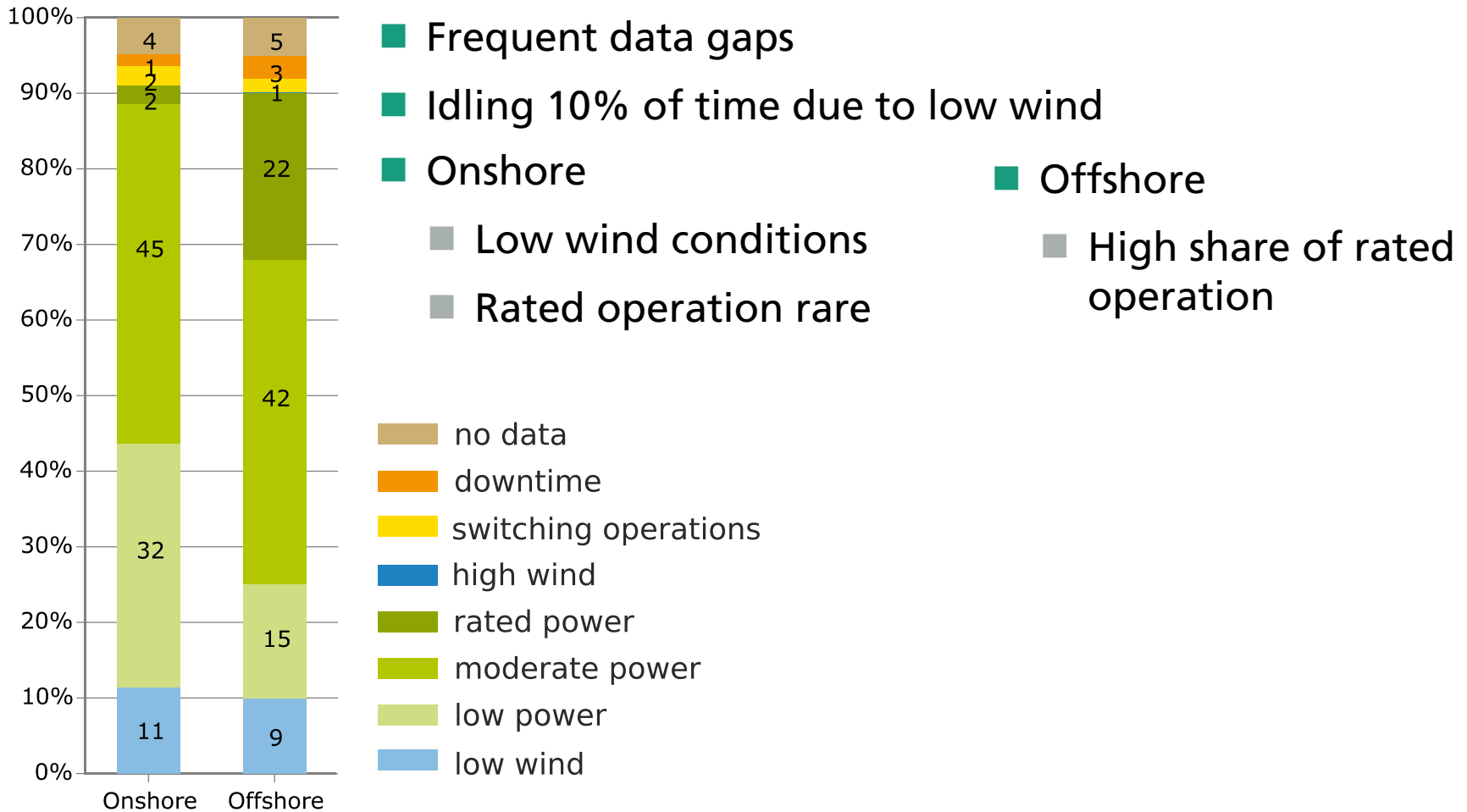
Exemplary Results

Key Performance Indicators

- Wind conditions at hub height (nacelle anemometers)
 - Onshore: 5.6 m/s, 187 W/m²
 - Offshore: 7.9 m/s, 566 W/m²
- Capacity Factor
 - Onshore: 18.4%, 1610 hours of full load
 - Offshore: 39%, 3422 hours of full load
- Time based and production based availability (data gaps considered as downtime)
 - Onshore: 94.1% and 92%
 - Offshore: 92.2% and 88,1%

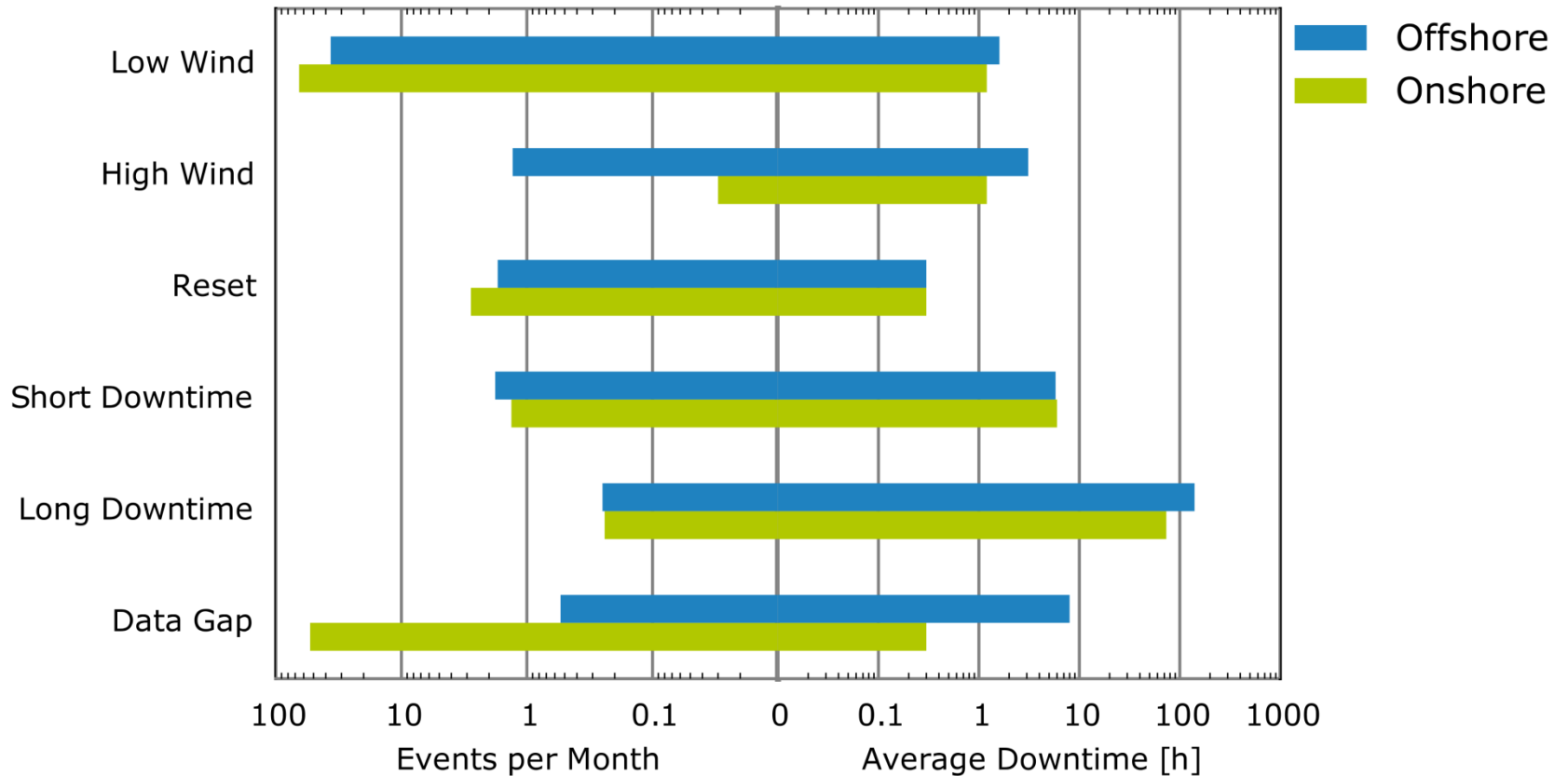
Exemplary Results

Operating States



Exemplary Results

Events: Frequency and Duration



Exemplary Results

Further Results at a Glance

- Increasing event rate at higher wind speed
 - Mainly resets and short downtime
- Long Downtimes account for ~70% of total downtime
 - Only about 6% of all events
- 18% (onshore) respectively 27% (offshore) of all technical events are wind farm wide events
 - Wind farm wide data gaps account for 22% (onshore) respectively 74% (offshore) of all data gaps

Conclusion and Outlook

A Benefit for the whole Industry

- WInD-Pool is an ongoing initiative of Operators and Fraunhofer IWES turning operational experience into knowledge
- WInD-Pool provides significant benefits for participating Operators
- Further Operators are welcome to join the initiative
- Detailed maintenance data are the next “BIG STEP”
- Application of standards is very important for comparability
- Fundamental questions can be answered as part of research work
- Results on onshore and offshore WT show significant differences



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