EnergieKontor

since 1990

# ROTOR BLADE EXTENSION

# (RBE)

www.rotorbladeextension.com

# Content

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# The Company

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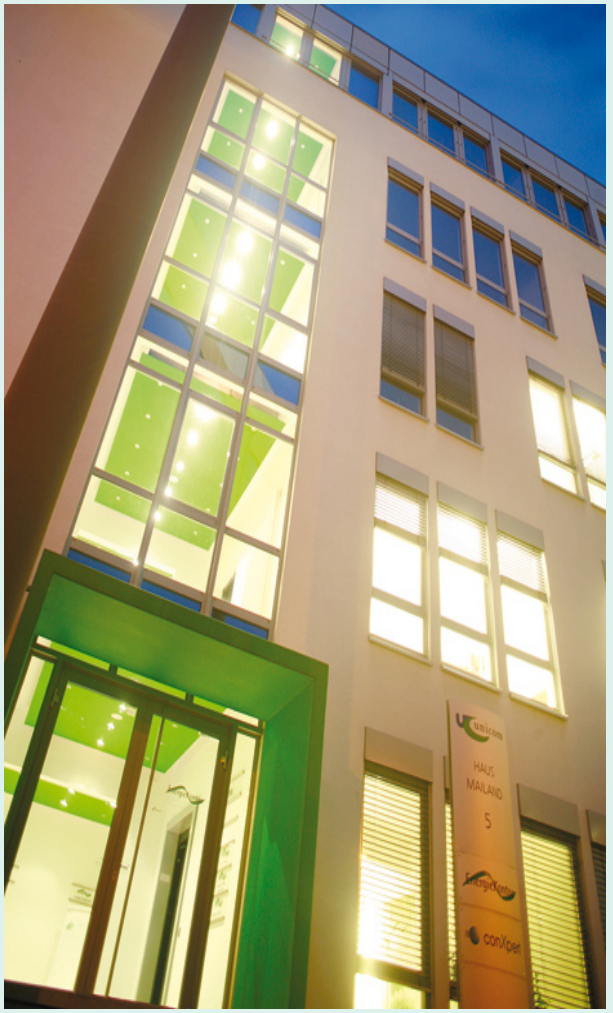
- Founded in 1990
- Number of Employees – 194
- Headquarters Bremen (DE)
- Subsidiaries: Bremerhaven, Hagen, Aachen, Bernau, Potsdam, Augsburg - Germany;

  Leeds, Glasgow, Edinburg - United Kingdom

  Lisbon – Portugal

  Austin/Texas, Rapid City/South Dakota – USA

  Toulouse, Rouen - France
- Public since May 2000
- Business Areas:
  - Planning and Sales Onshore Wind and Solar Farms
  - Wind Farm Operation
  - Optimisation of wind turbines



# The Concept

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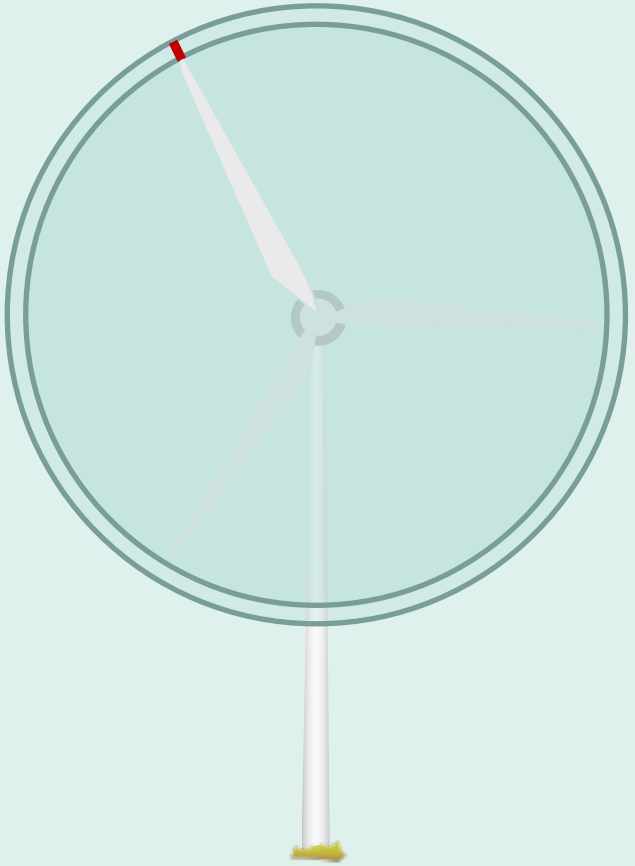
- Blade Tip Extensions
- Extends the length of your wind turbine blades
- Installed in days, with limited downtime
- Low effect on WTG lifecycle and components
- Instant Power increase at relative wind speeds
- Multi-agency collaboration led by Energiekontor



**Power Curve:**

$$P = \rho \cdot \frac{v^3}{2} \cdot C_p \cdot A_{rotor}$$

P: power

ρ: air density

V: wind speed

Cp: power coefficient

Arotor : swept area of the turbine

# The Concept

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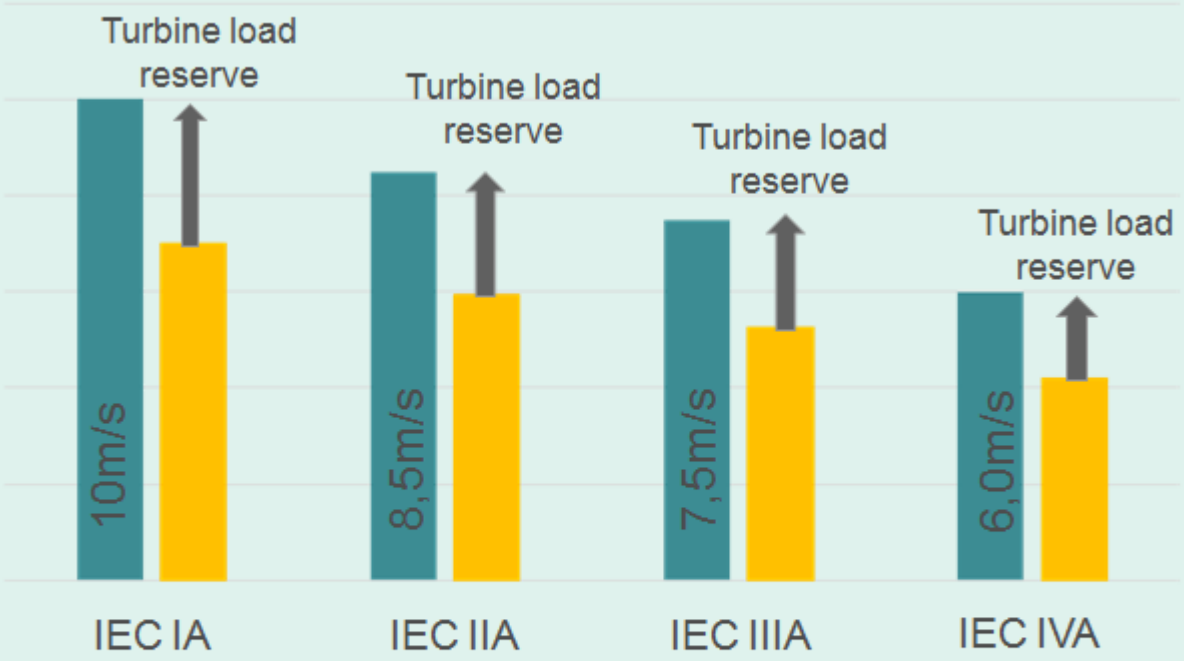
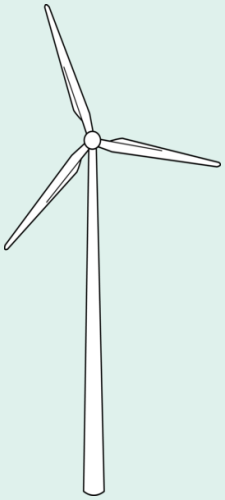



If the IEC class of the turbine is higher than the site IEC class, the wind turbine presents a load reserve which may be explored. This load reserve can be transformed in actual load of the turbine by installing the RBE product.



# Technical Base Concept

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**Current Products:**

- RBE Bonus 1.0MW

| | |
|---|---|
| RBE length | 1m |
| Modified diameter | 56m |
| Rotor area increase | 7,6% |
| Add. Weight/blade | 30kg |

- RBE Bonus 1.3MW

| | |
|---|---|
| RBE length | 1,5m |
| Modified diameter | 65m |
| Rotor area increase | 8,6% |
| Add. Weight/blade | 45Kg |

**Installation:**

On a hanging blade – 6 days/turbine

# Rotor Blade Extension - Present

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## Debstedt WF - Germany:

- 11x AN Bonus 1.0MW
- In Operation since 1999
- **1 RBE installed in 2009**

Production Measurements:

- Original: December/2005 until October/2009
- Modified: November/2009 until current date
- **Annual Energy Production (AEP) increase of 7% (*)**

(*) results provided by Operations Department at Energiekontor

## Penedo Ruivo WF - Portugal:

- 10 x AN Bonus 1.3MW
- In Operation since 2005
- **2 RBE installed in April/2014**

Production Measurements:

- Original: 2005 until March/2014
- Modified: April/2014 until current date
- **Annual Energy Production (AEP) increase of 5-8% (**)**

(**) results provided by INEGI – Institute of Mechanical Engineering and Industrial Management, Portugal

# Rotor Blade Extension - RBE portfolio

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**Penedo Ruivo WF - Portugal:**

- Installation of 10 RBE in AN Bonus 1.3 MW turbines – 2016 till 2019

**Seixinhos WF - Portugal:**

- Installation of 8 new RBE in AN Bonus 1.3 MW turbines – 2016 till 2019

**Montemuro WF - Portugal:**

- Installation of 8 new RBE in AN Bonus 1.3 MW turbines – 2017 till 2019

# Rotor Blade Extension – In progress

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**Senvion MM82 – RE40 Blades:**

- Installation of specially designed RBE for the MM82 with RE40 blades
- 2 UK wind farms owned and operated by Energiekontor
- Project is at advanced stage of engineering design
- Planned installation dates – 2 WTGs in May 2021, followed by 19 more WTGs in 2022
- Estimated AEP increase at these wind farms is approximately 9%
- Exciting times at Energiekontor

**GE 1.5sl - LM37.7 Blades:**

Currently working on the early stage development of new RBEs for this type to achieve up to 9% of AEP increase.

# The Concept – Economic approach

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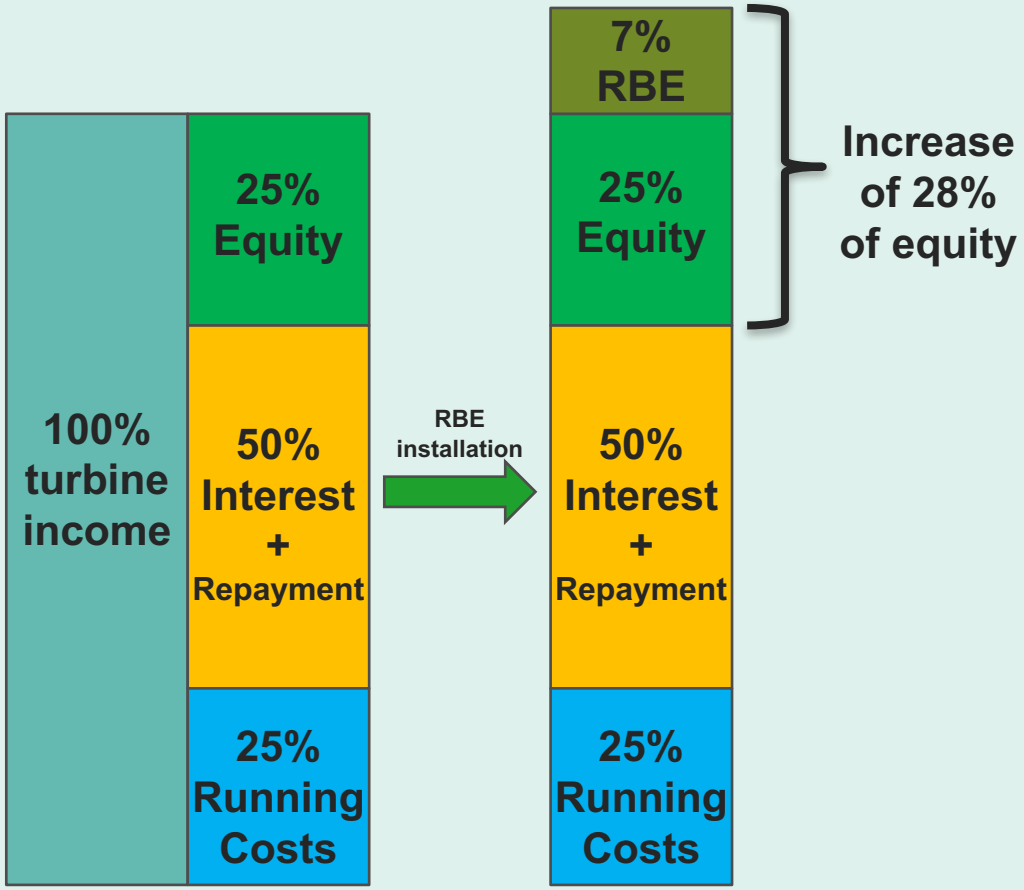
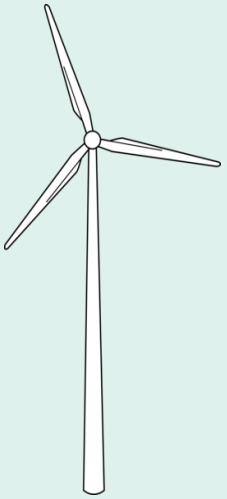
## Example for AN BONUS 1.0MW




An increase of 7% of the total obtained power from the turbine actually reflects in a gain of almost 30% on the income of the company for each turbine.



# Technical Base Concept

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## Loads, Structure

- Cut-Off-Wind speed adapted to limit maximum loads
- Edgewise and flap wise bending remains within tolerances

## Sound

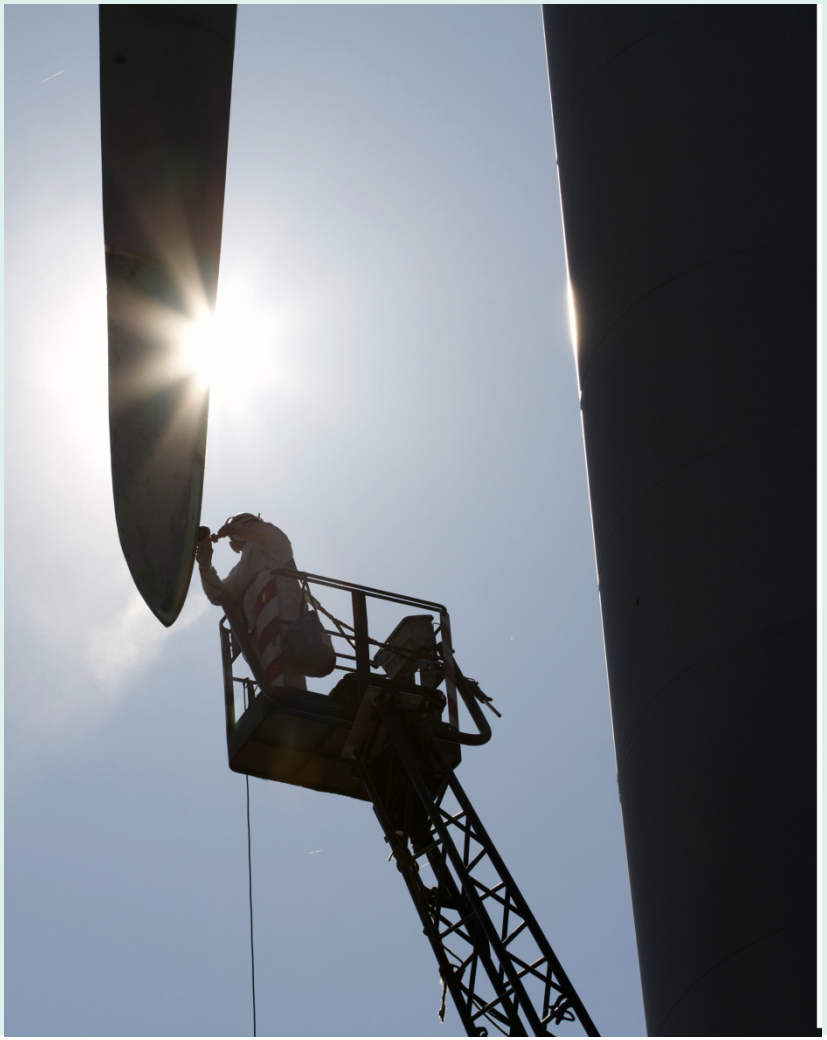
- Sound level has no significant increase

## Fatigue Loads

- Approx. 25% less load cycle
- No influence on initially calculated WTG lifetime

**Certified by DEWI-OCC**

**Patented by Energiekontor**



# Machine and Blade Surveys

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## Technical Surveys of Prototype

- Performed after 3 years in operation
- Independent auditors
  (DEWI OCC in Germany)

- Surveys included
  – Rotor blades
  – Turbine components

- Tasks
  – Endoscopic inspection of gear box
  – Vibration analysis of complete drive train
  – Visual check of main bearing
  – General blade and machinery visual check

## Report Conclusions

"Normal and no unusual wear on all inspected components"

"Low additional maintenance"

# Tests performed

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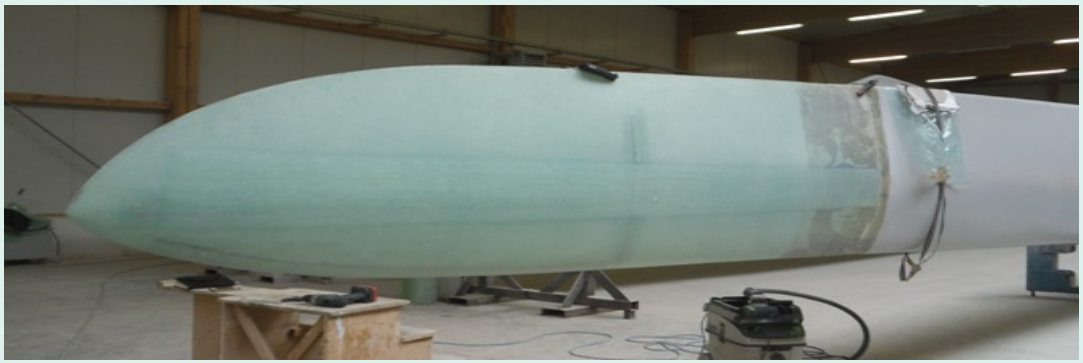
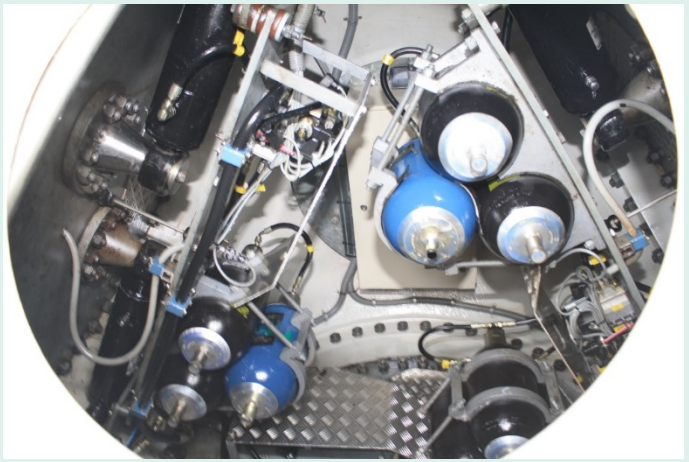
- Load measurements on blade's roots and main shaft, according IEC 61400-13.
- Gear box and main bearing analysis.
- Natural frequency of the blade measurement.
- Distance from the modified tip blade to the tower.



# Conclusion

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- Available now for 1.3 MW
- Safe operation due to reduced cut-out limit
- No additional noise impact
- Simplified installation process
- Significantly improved performance
- Close to no production losses due to short installation time
- Short return on investment period (3 years)
- No influence on WTG safety aspects
- Further RBE prototypes (other types of turbines) in development for 9% AEP increase – MM82/RE40 and GE1.5sl/LM37.7

# Partnership and collaborations

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## Design and Development

SPITZNER ENGINEERS
experts in development and design of composite parts

P. E. CONCEPTS
PROGRESSIVE ENGINEERING

windrad
simulation & engineering

## Installation

GR WIND
We keep you going

BLADEFENCE

Renewable Advice

## Manufacture

M+D FLUGZEUGBAU

## Testing and evaluation Campaigns

Fraunhofer IWES

inegi
driving science & innovation

## Certification

DEWI OCC
a UL company

## Quality process and consulting

energy
JUST IN TIME.

# THANK YOU!

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