

# Power Gearbox for Large Aero Engines

Martin Mohr  
Chief Development Engineer

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# Rolls-Royce

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# Our businesses

**Civil Aerospace**  
**Defence Aerospace**  
**Power Systems**  
**Marine**  
**Nuclear**



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# Civil Large Engines Design Strategy



Technology EIS Readiness	2020+	2025+
Bypass Ratio	11+	15+
Overall Pressure Ratio	60+	70+
Efficiency relative to Trent 700	20%+	25%+



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# Our Values

## Creativity and Innovation

We are open-minded and idea-driven. Our creativity helps us to innovate. We turn our ideas into real solutions for our customers. Our workplace needs to stimulate the right mind-set for creativity and support innovation.



## Collaboration

Collaboration is about coming together with our team, customers, partners and wider Rolls-Royce community to deliver the most innovative solutions in the industry. It's about good knowledge management and leveraging on the capabilities in our team. Our new workspace will provide the right spaces, tools and IT to help us collaborate effectively.

## Diversity

We value the cultural and functional diversity in our team. We come from all parts of the world and work in a range of roles doing different tasks. An Agile workspace will support a diverse team like ours.



## Courage

We're doing something no one else has done before. We believe that nothing is impossible. When something goes wrong, we are not afraid to take responsibility for it and be accountable for our actions and decisions. We are honest and open to giving and receiving feedback.

## Trust

We are trusted by our team, customers and partners to deliver as we've promised. We trust that everyone will use our new space appropriately.



How much Power does a Trent900 engine have? <sup>5</sup>

**~ 70 000 PS**

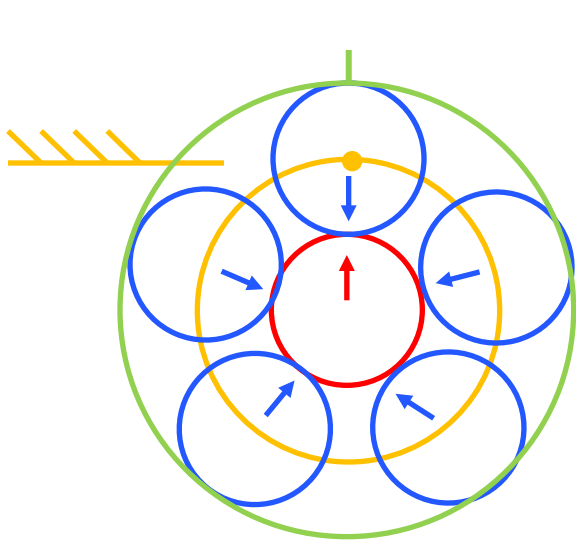


**70 Formula 1 Cars**

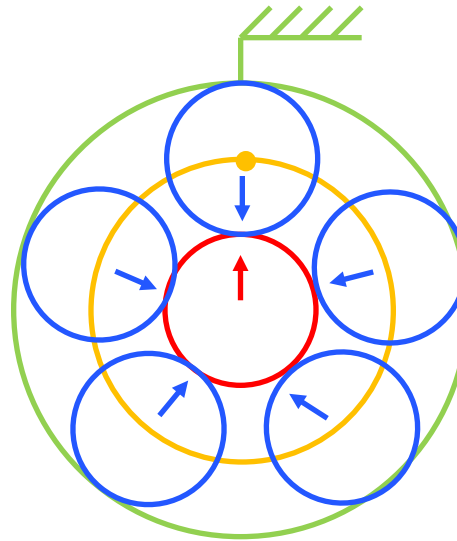
**200 waterboilders from  
20°C to 100°C per second**



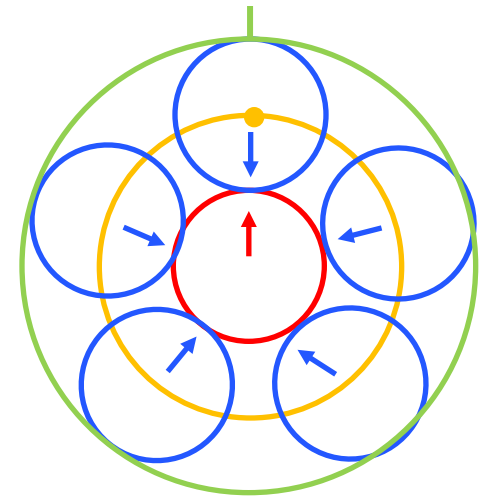
# Gearbox Styles



Star



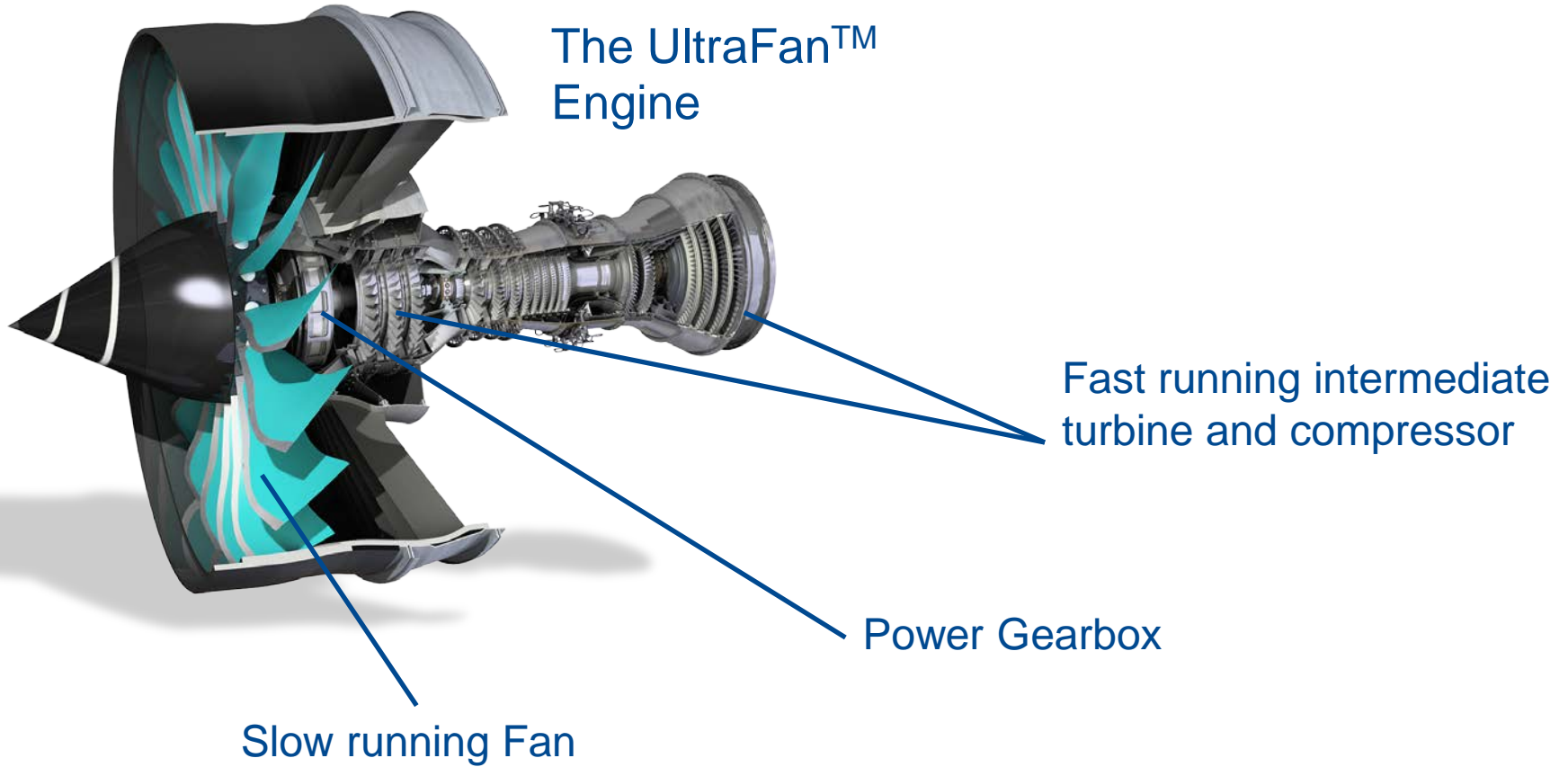
Planetary



Differential



# Why to have a Power Gearbox?

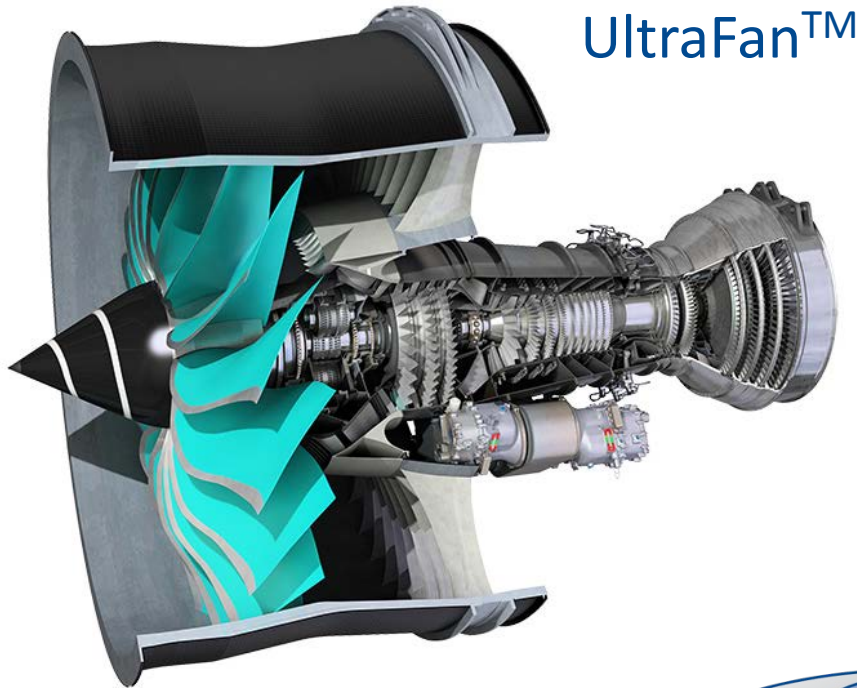


**More efficiency and less noise by uncoupling rotational speeds from Fan and Turbine**

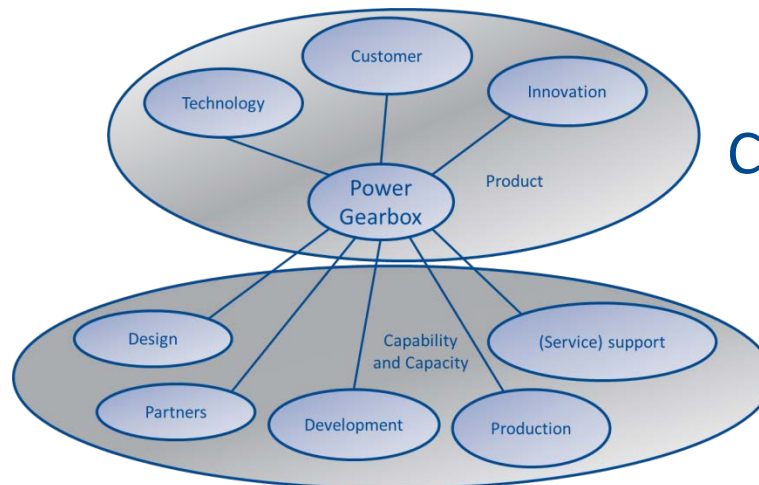
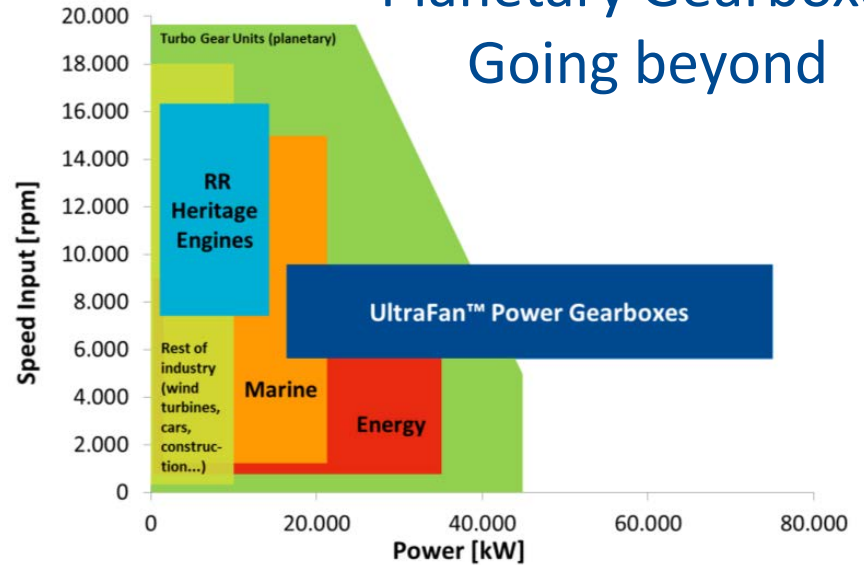




# Our future – Something nobody has done before



Planetary Gearboxes  
Going beyond



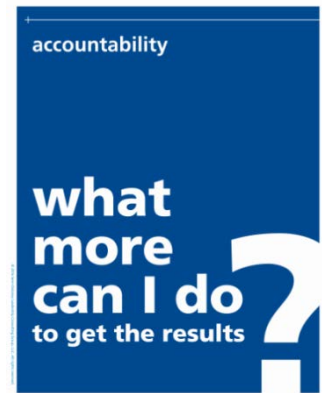
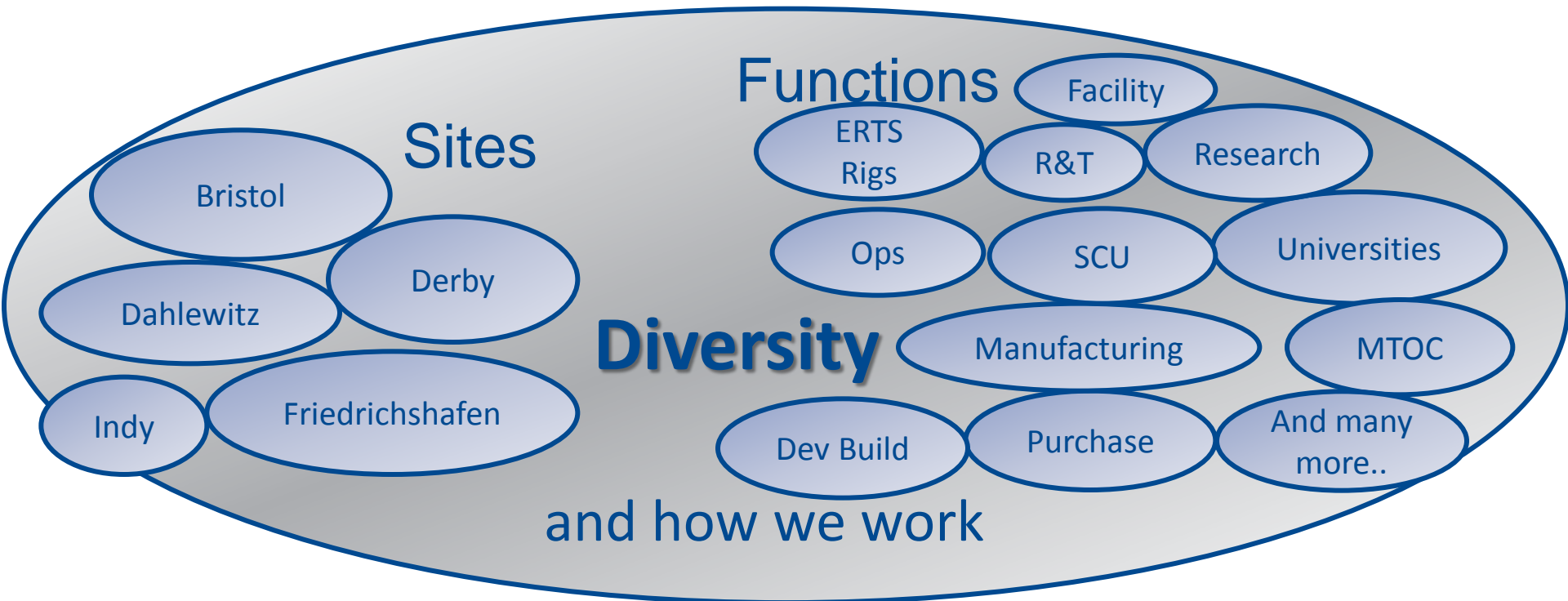
Capability we need  
to build



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# Think Outside the Gearbox – Team



# Partners

## Research Partners

### UK

- AFRC, AMRC, MTC
- Tata, McLaren, Newcastle Uni, Swansea Uni, Uni of Nottingham

### Germany

**TU Claustal**  
Prof. Schwarze: Journal Bearings

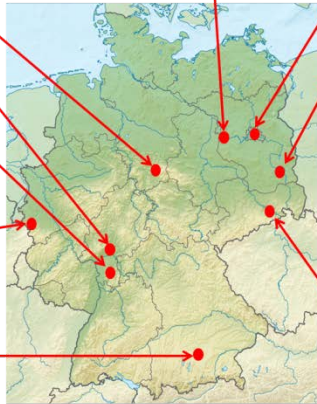
**FVA e.V. Frankfurt**  
German Drive Train Industry Joint Research

**UTC TU-Darmstadt**  
UTC for Combustor and Turbine Aerothermal Interactions  
- Prof. Rinderknecht: rotor dynamics & mechatronics, active damping

**RWTH Aachen**  
Machining and Laser repair  
- Gear Manufacturing  
- Gear Surface Texturing  
Prof. Jakobs: Linear Guiding Bearing

**TU-München (FZG)**  
Prof. Stahl:  
- Sub-scale & Component tests  
- Efficiency analysis  
- NVH (Noise Vibration Harshness)  
- Novel tooth forms

**Uni Magdeburg**  
Prof. Deters: Tribology



**TU-Berlin**  
- Acoustics  
- Prof. Gühmann: EHM

**UTC BTU Cottbus**  
UTC for Multidisciplinary Process Integration  
- Prof. Bestle: Optimisation / Key System  
- Prof. Kühhorn: Topology Optimistaion & Parameter Design  
- Prof. Hoeschler: PGB Structural System Design Integration  
- Prof. Henschel: Virtual Reality for PGB

**UTC TU-Dresden**  
UTC for Lightweight Structures and Materials  
Prof. Schlecht (Institute for Machine Elements):  
- Load Sharing Analysis  
- Multi Body Simulation  
- Ring Gear Design

## Industrial Partners



A Joint Company of Liebherr-Aerospace and Rolls-Royce

**LIEBHERR**

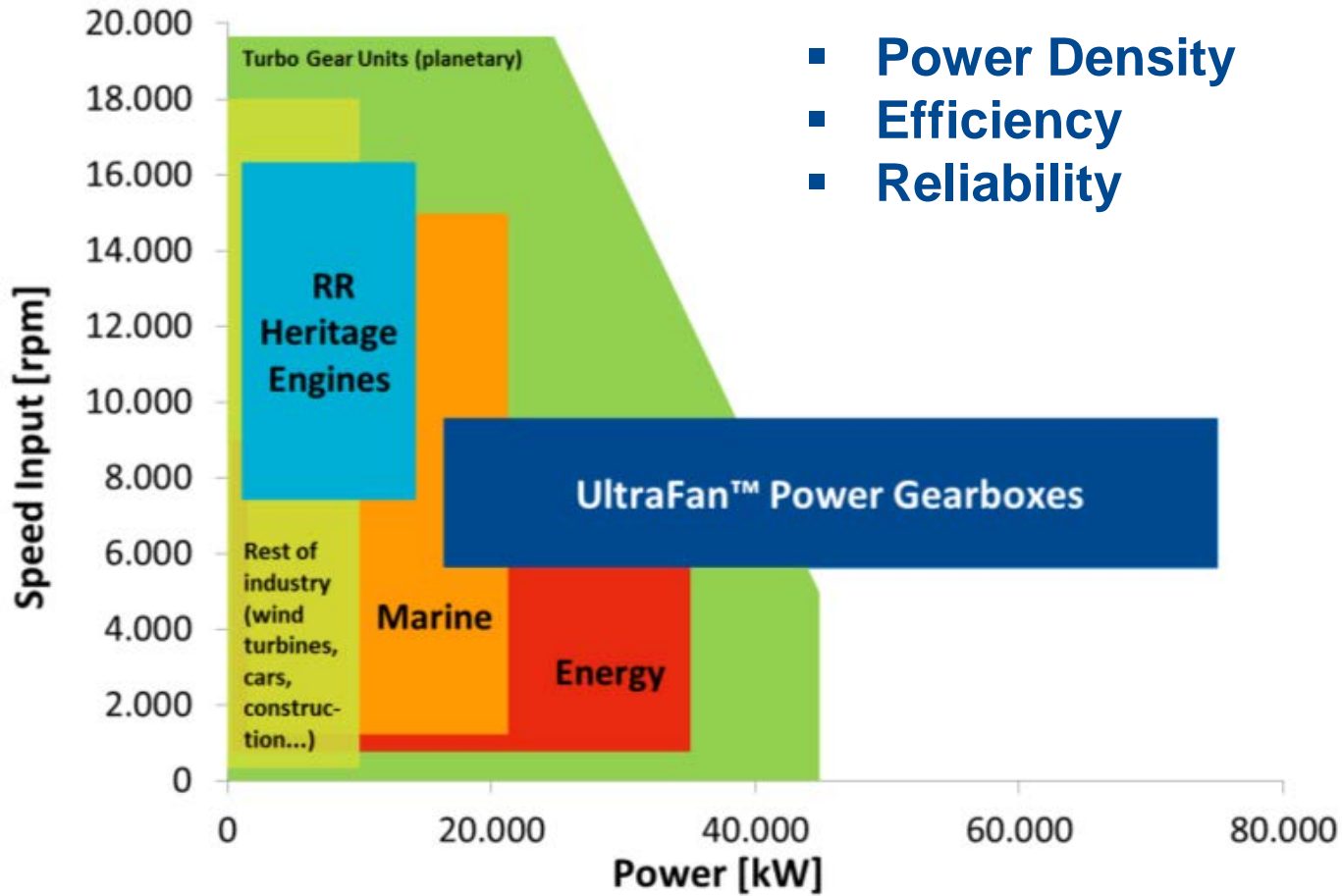
Journal Bearing Supplier

Oil Transfer Unit Supplier



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# UltraFan™ Power Gear Box



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# Power Gearbox Test Facility

- Construction started 16th March 2015
- Specified to cover full UltraFan product range
- Attitude Rig and Power Rig

