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1D System Simulation for the Operation of Wind Turbines using SIEMENS AMESim

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AMESim

1

LARGE SPECTRUM OF LIBRARIES
(analytical, ODEs, 1D PDEs)

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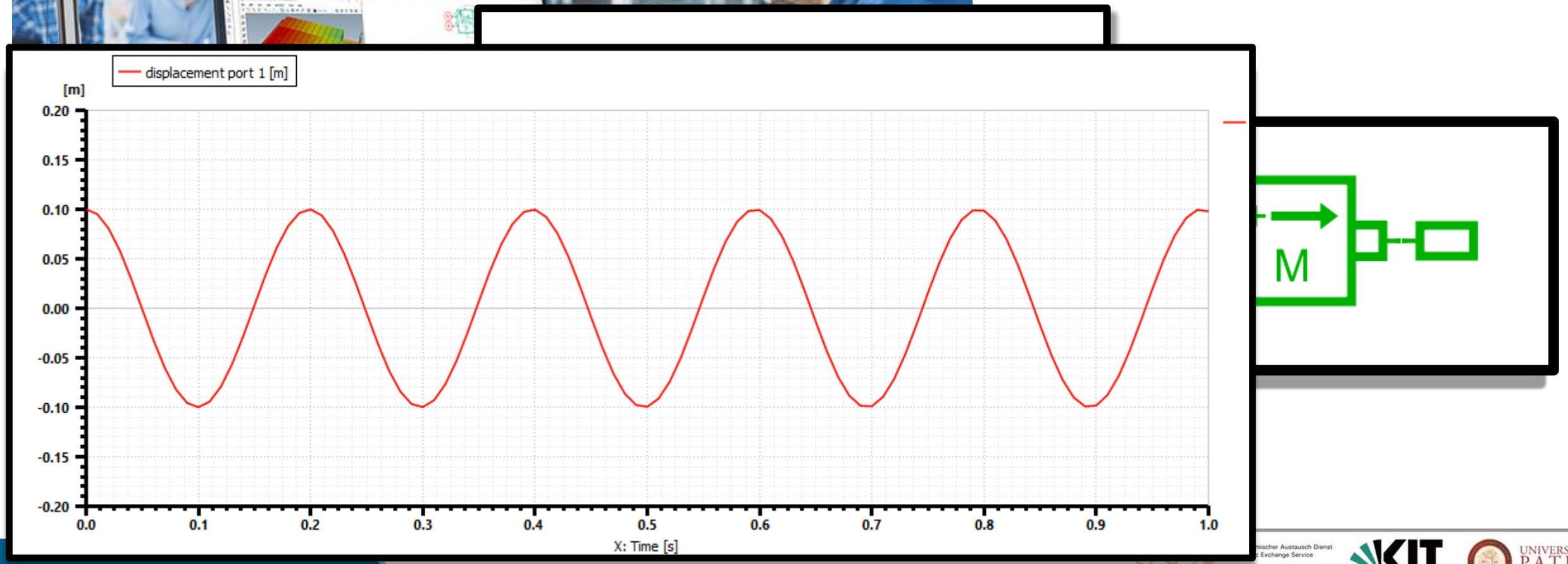

AMESim

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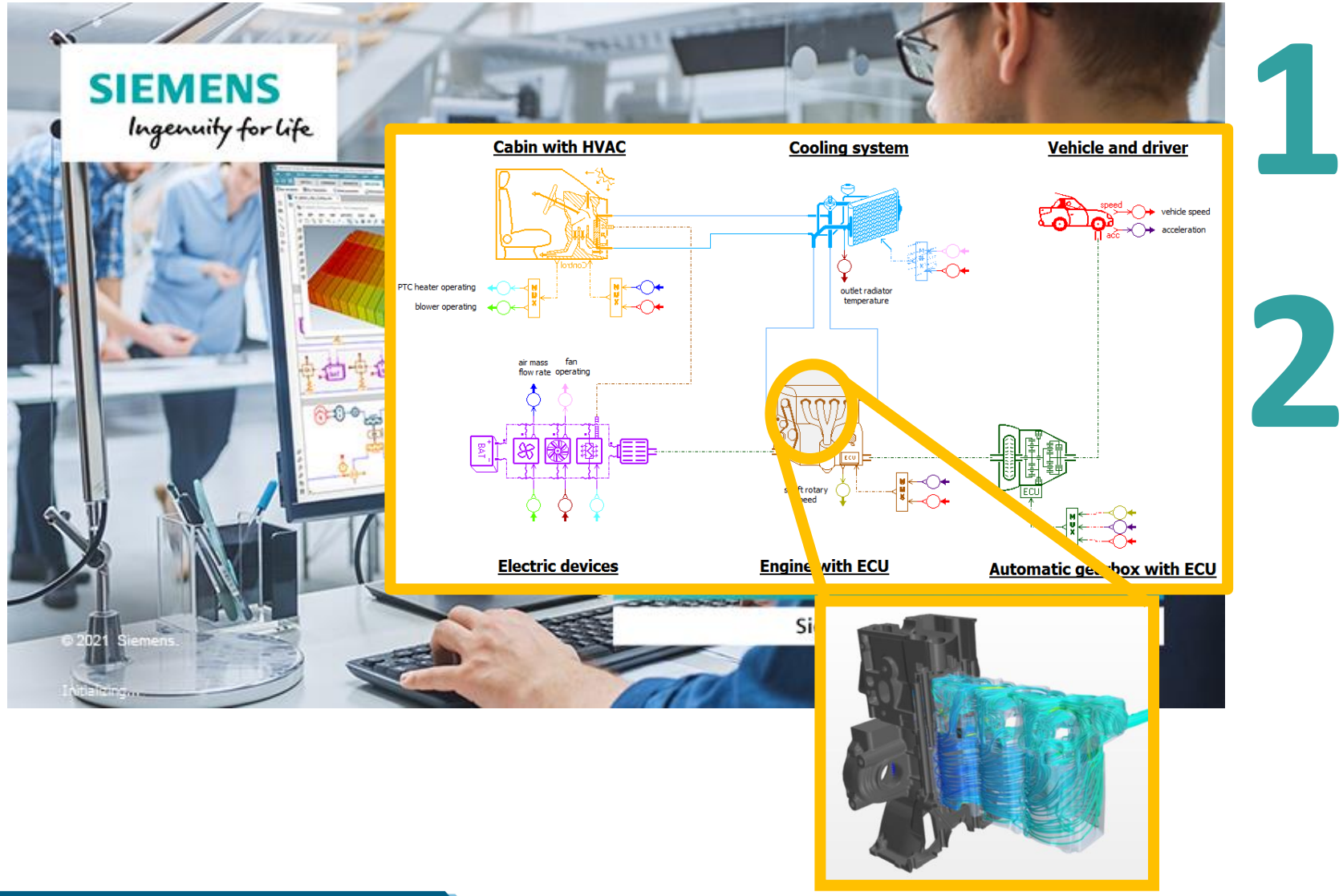
VERSATILE
Co-simulation, API, Star-CCM+, Simcenter 3D

AMESim



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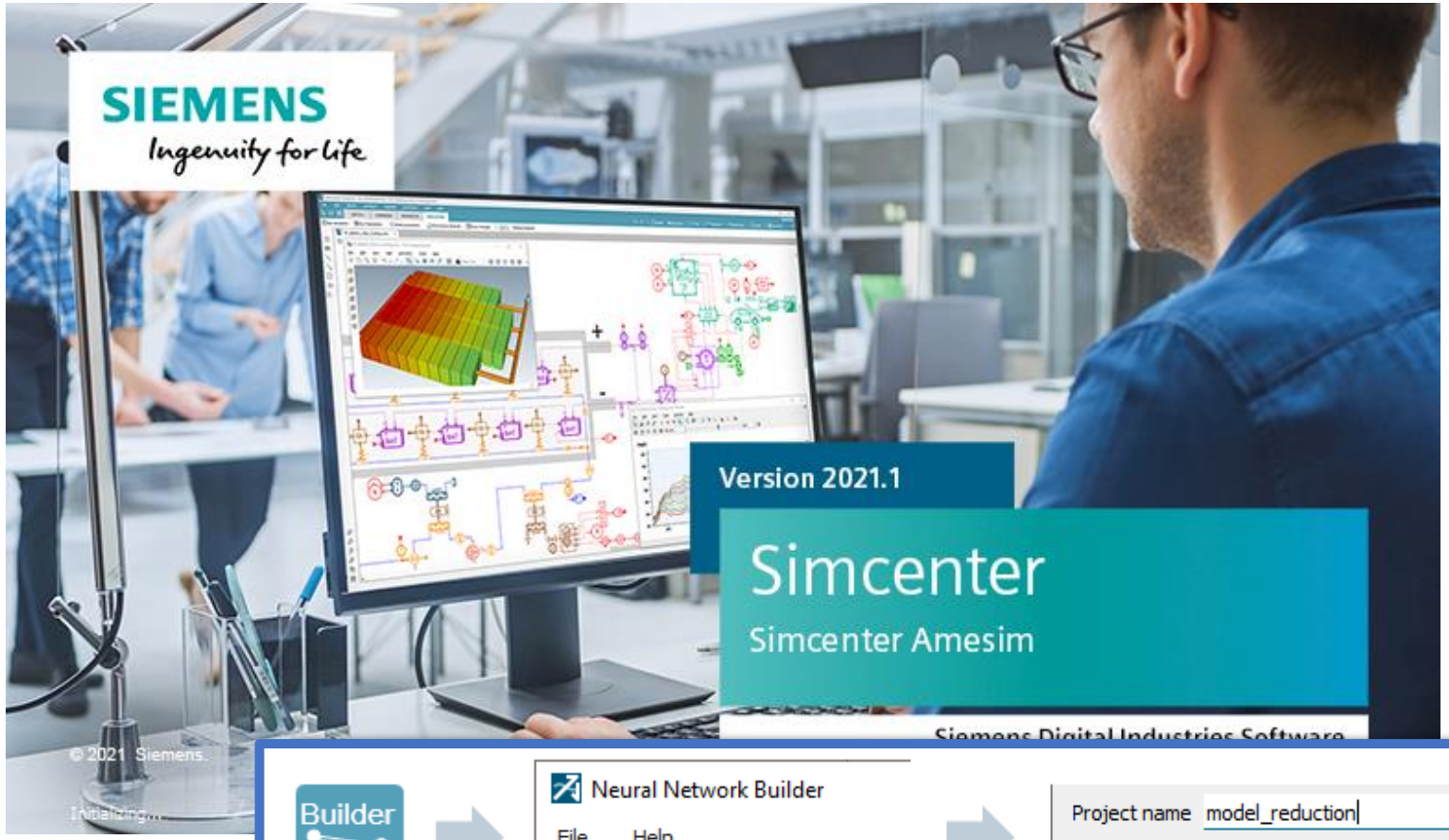

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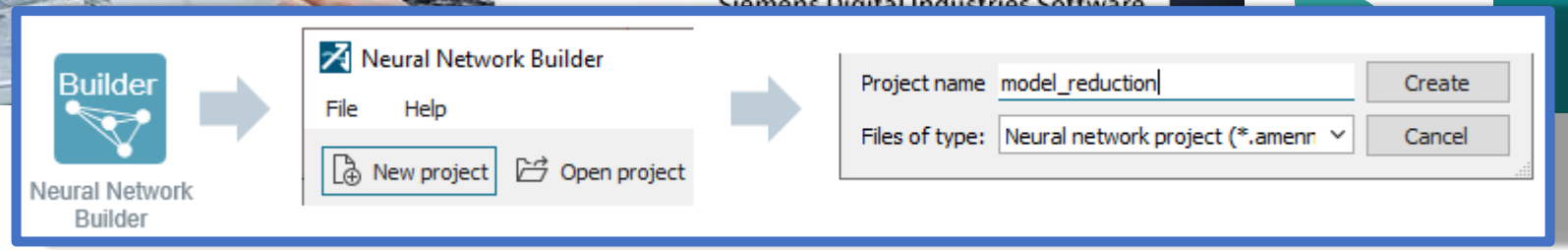
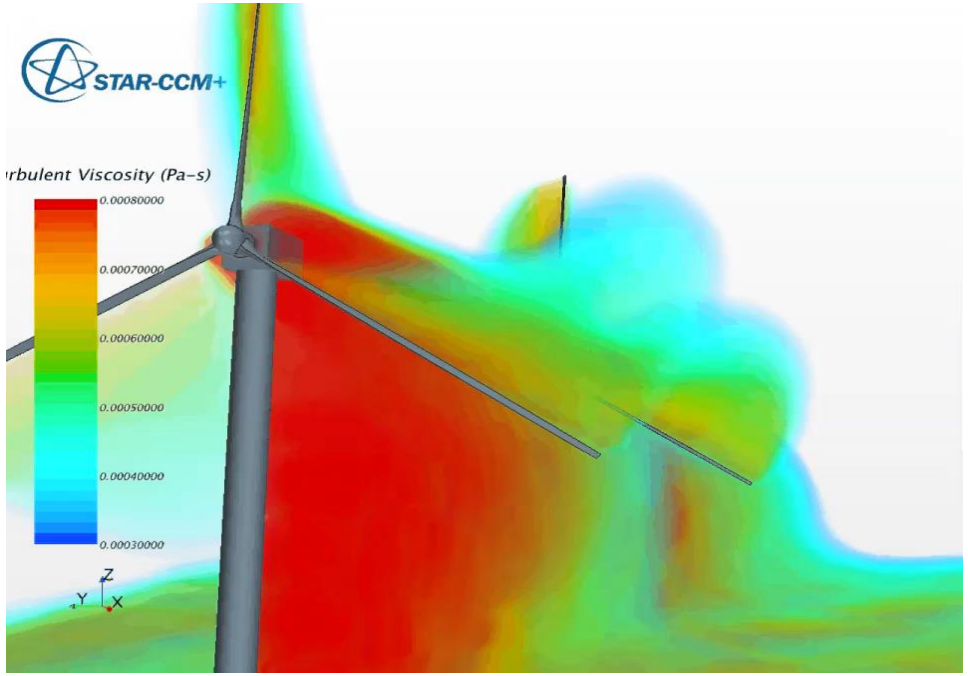
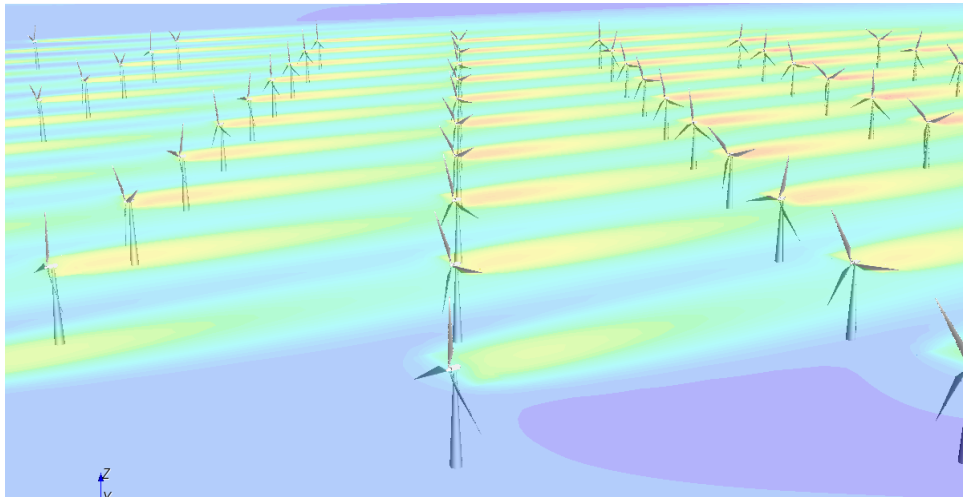
ROM
Embedded ROM builder



CFD and Structural Analyses

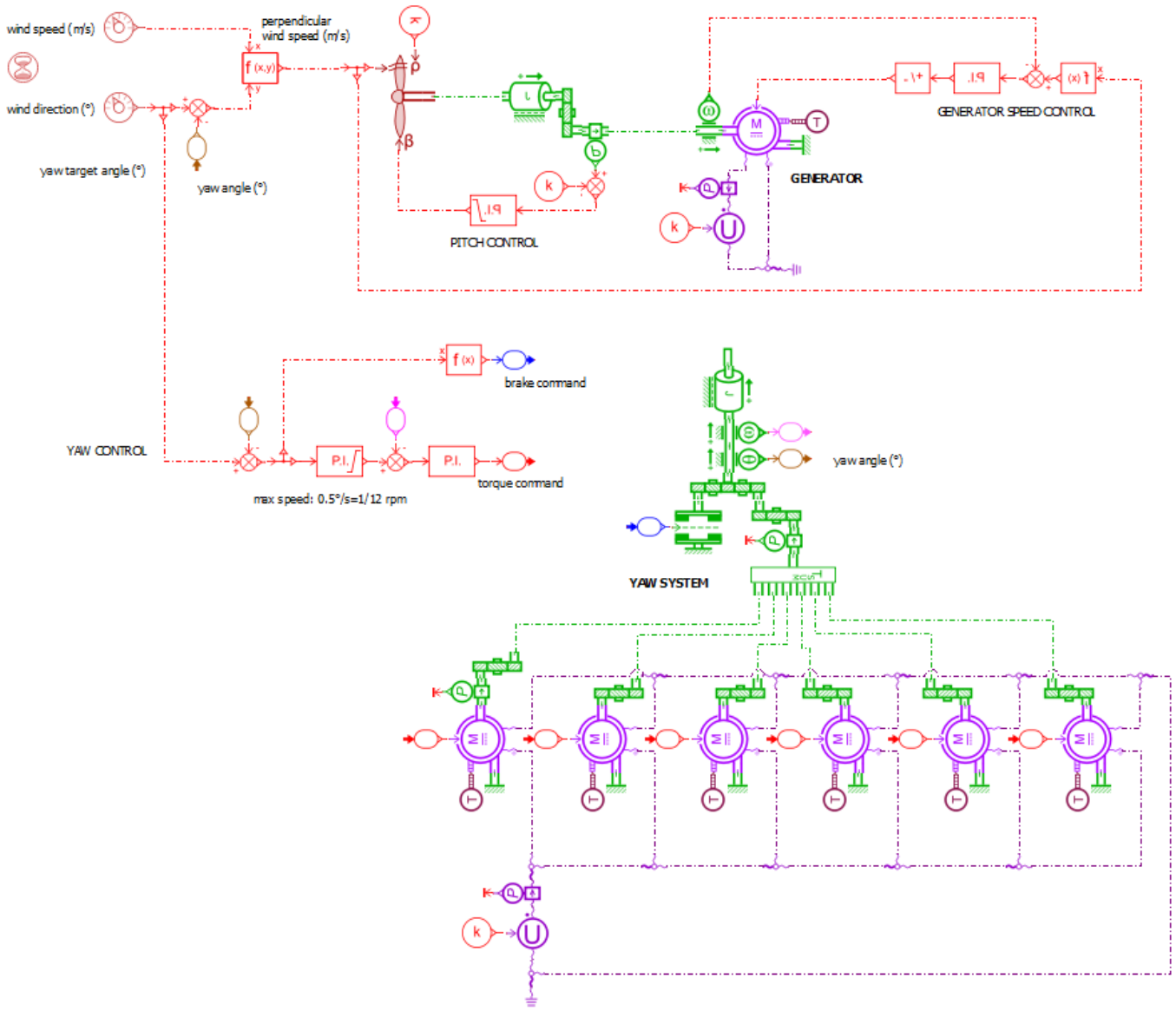




+ Realistic
+ Design Efficiency
+ Visualization of the Fields (e.g, Stress, Velocity)

– Expensive (consume huge load of CPU and Memory)
– Restricted by the minimum time scale of the system.

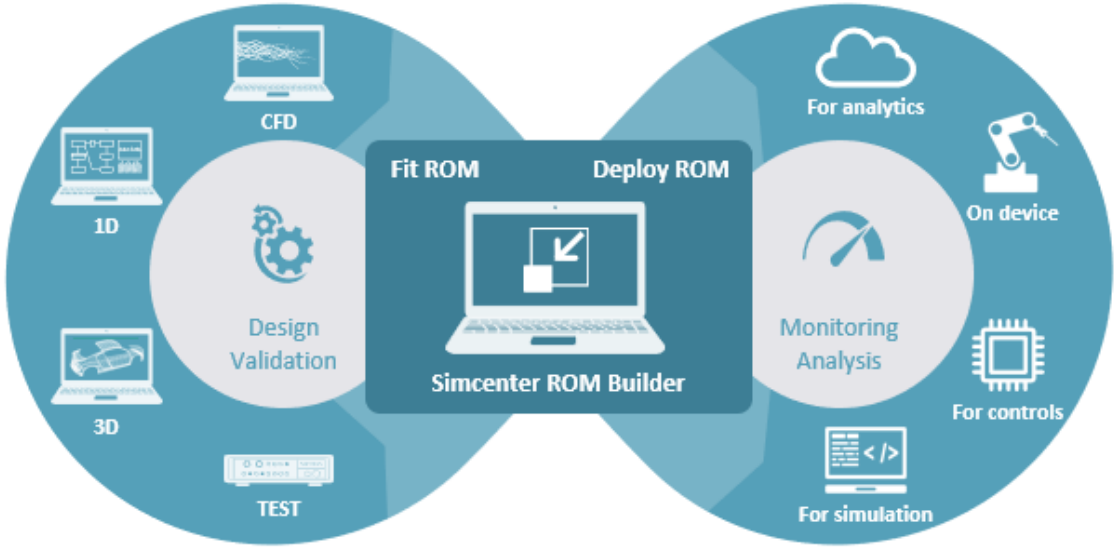
AMESim Sketch



Mechanical Parts

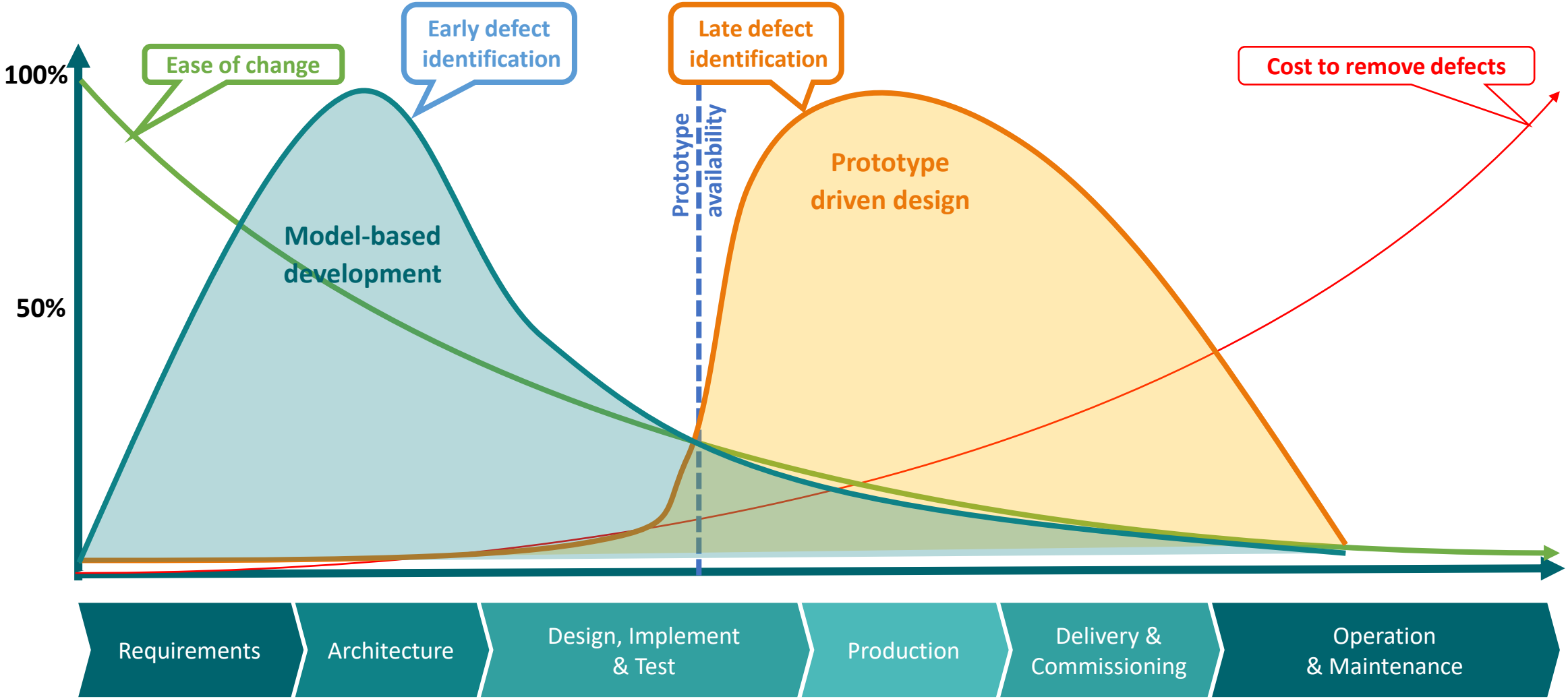
Electrical Parts

Signals



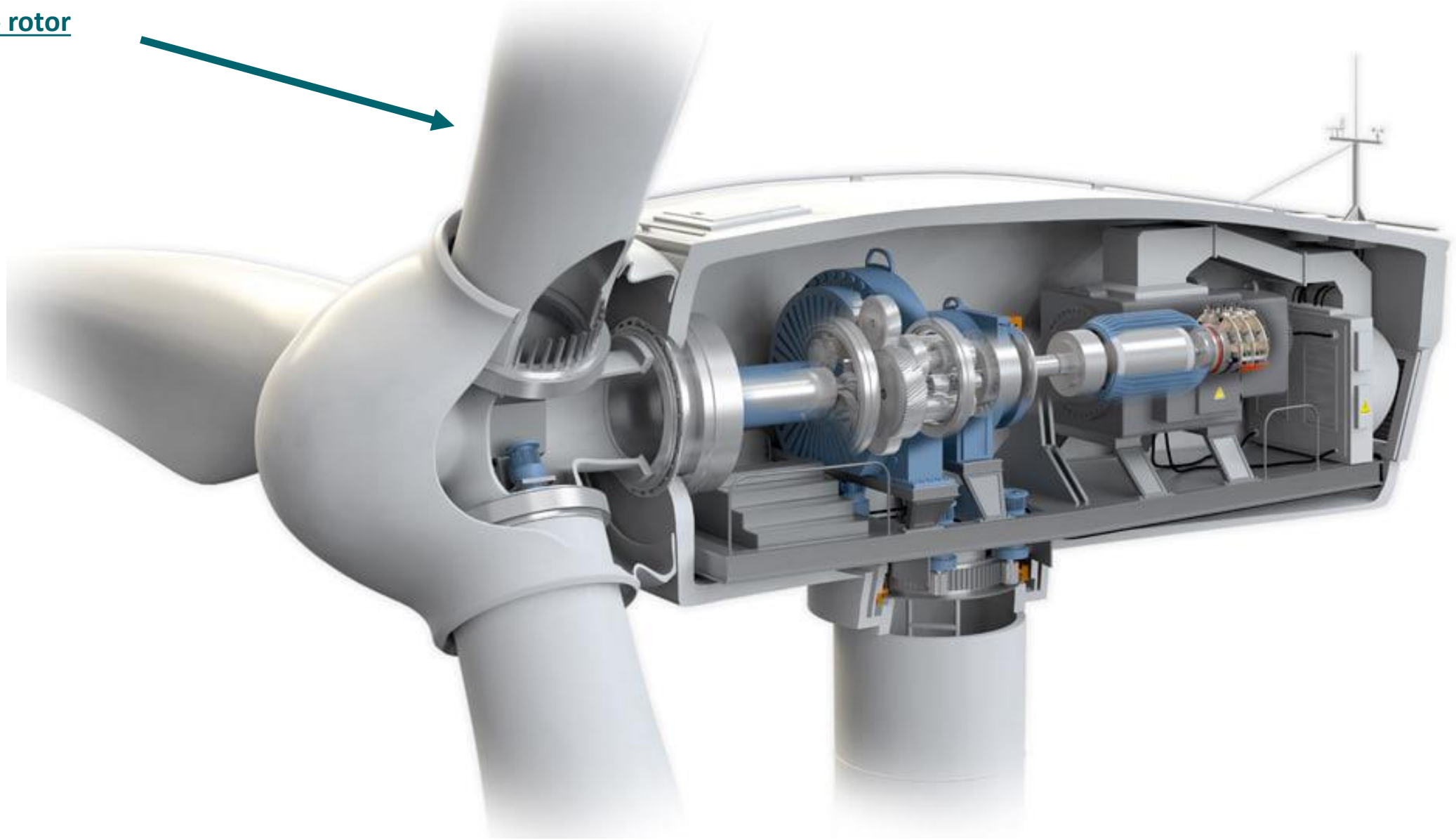
Model Based Development

Reducing the development costs, time and risks via simulation



Basics of a Wind Turbine

Blades - rotor



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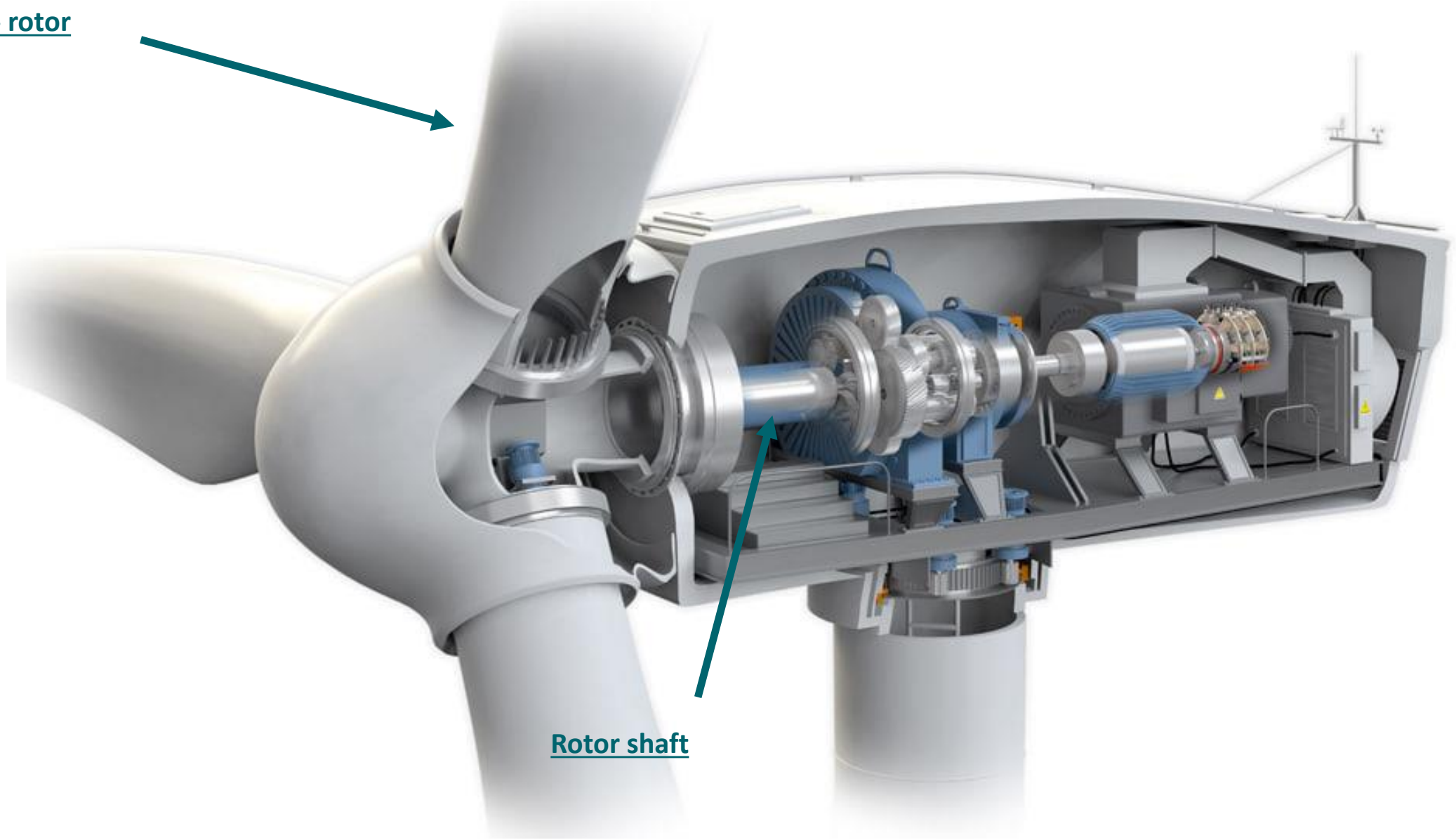
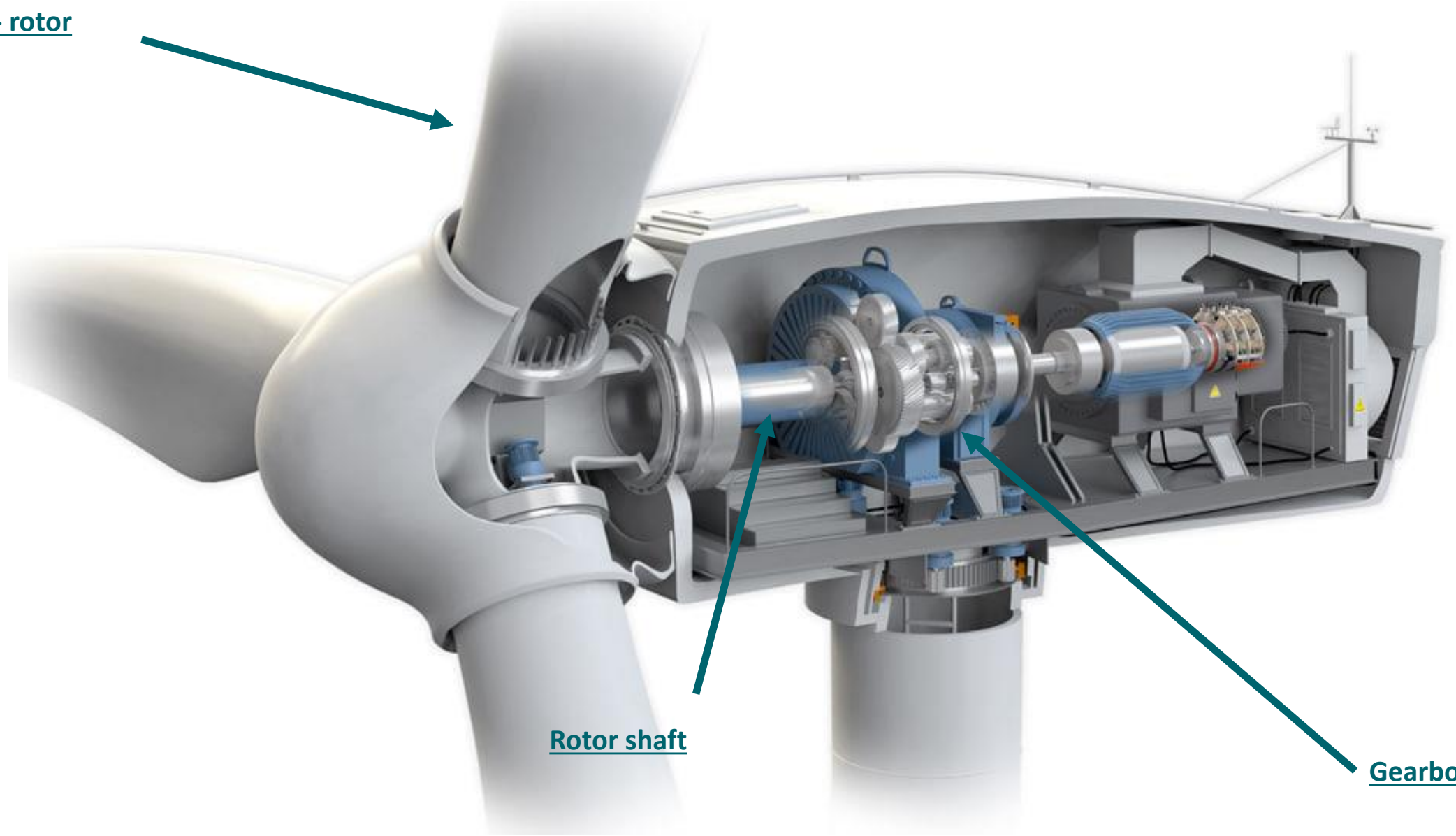
Blades - rotor



Rotor shaft

Basics of a Wind Turbine



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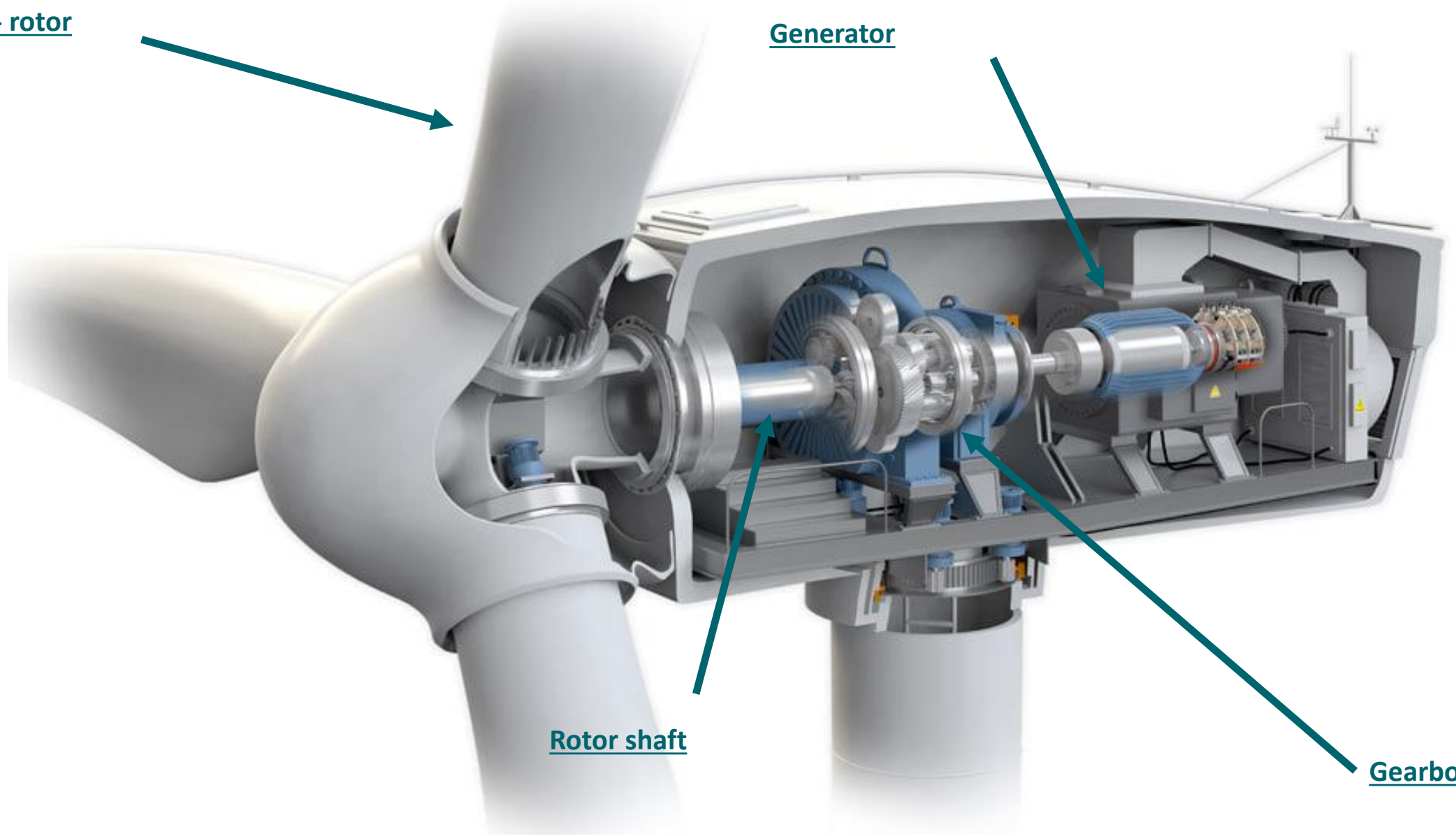

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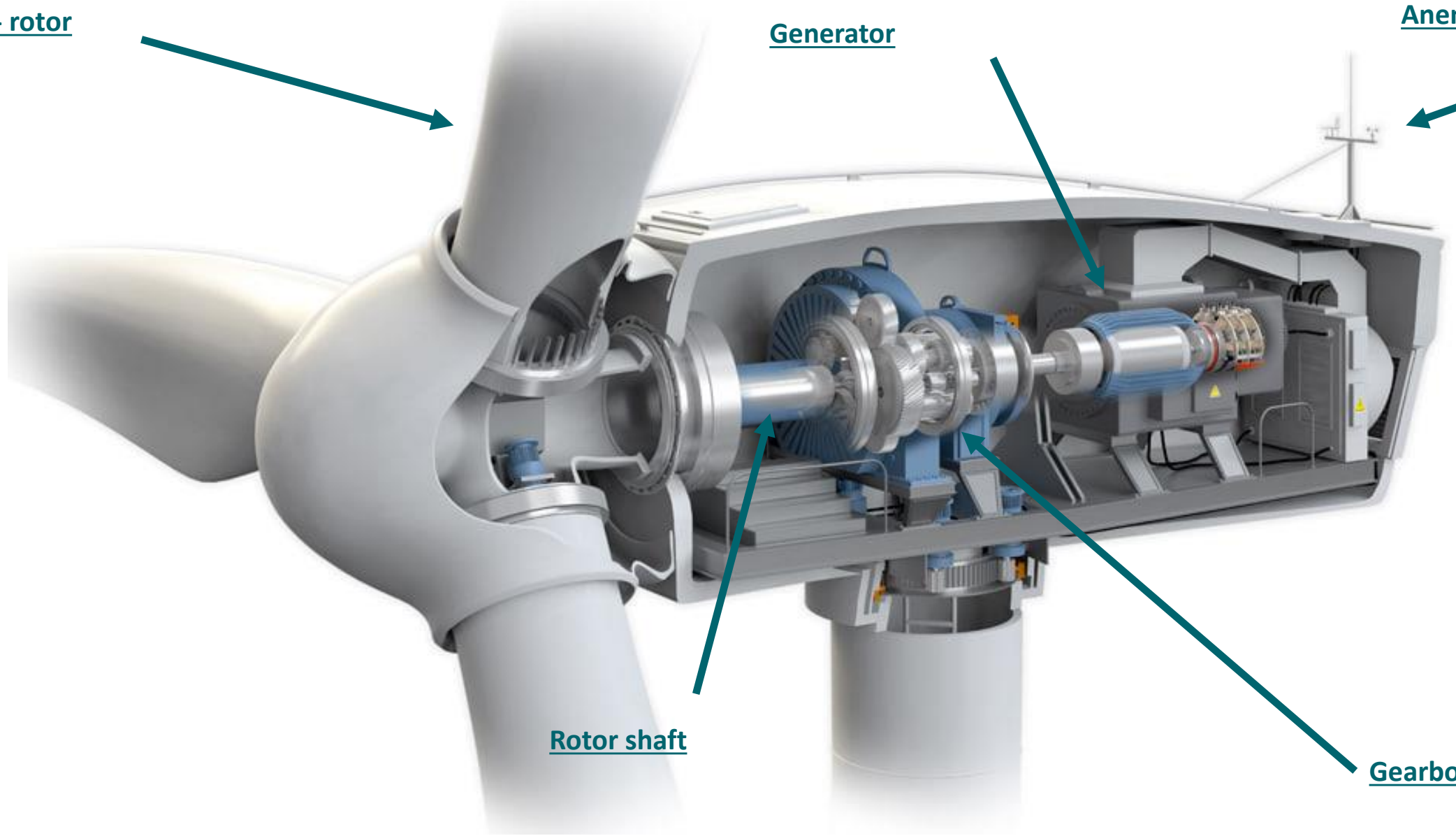

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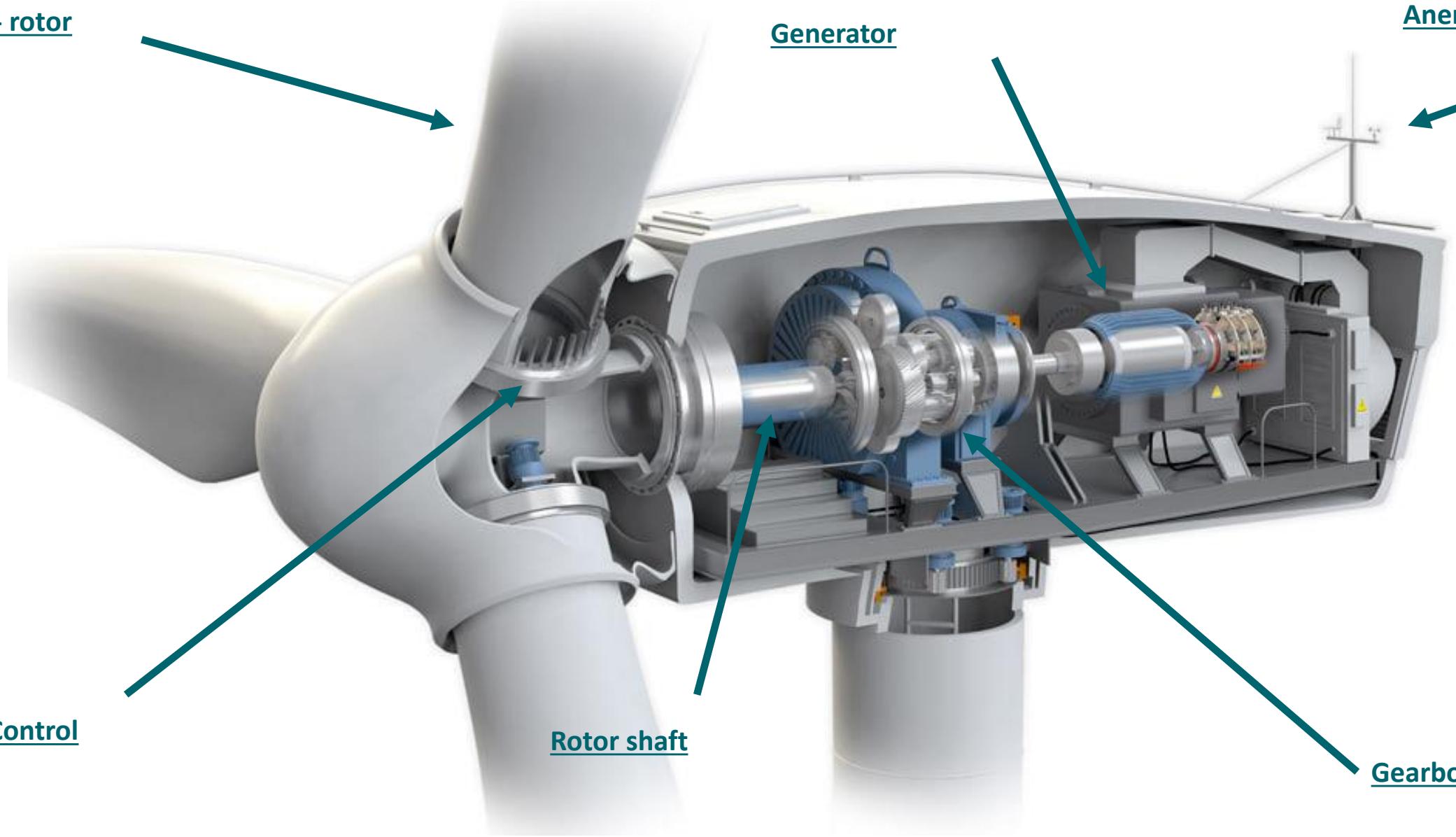

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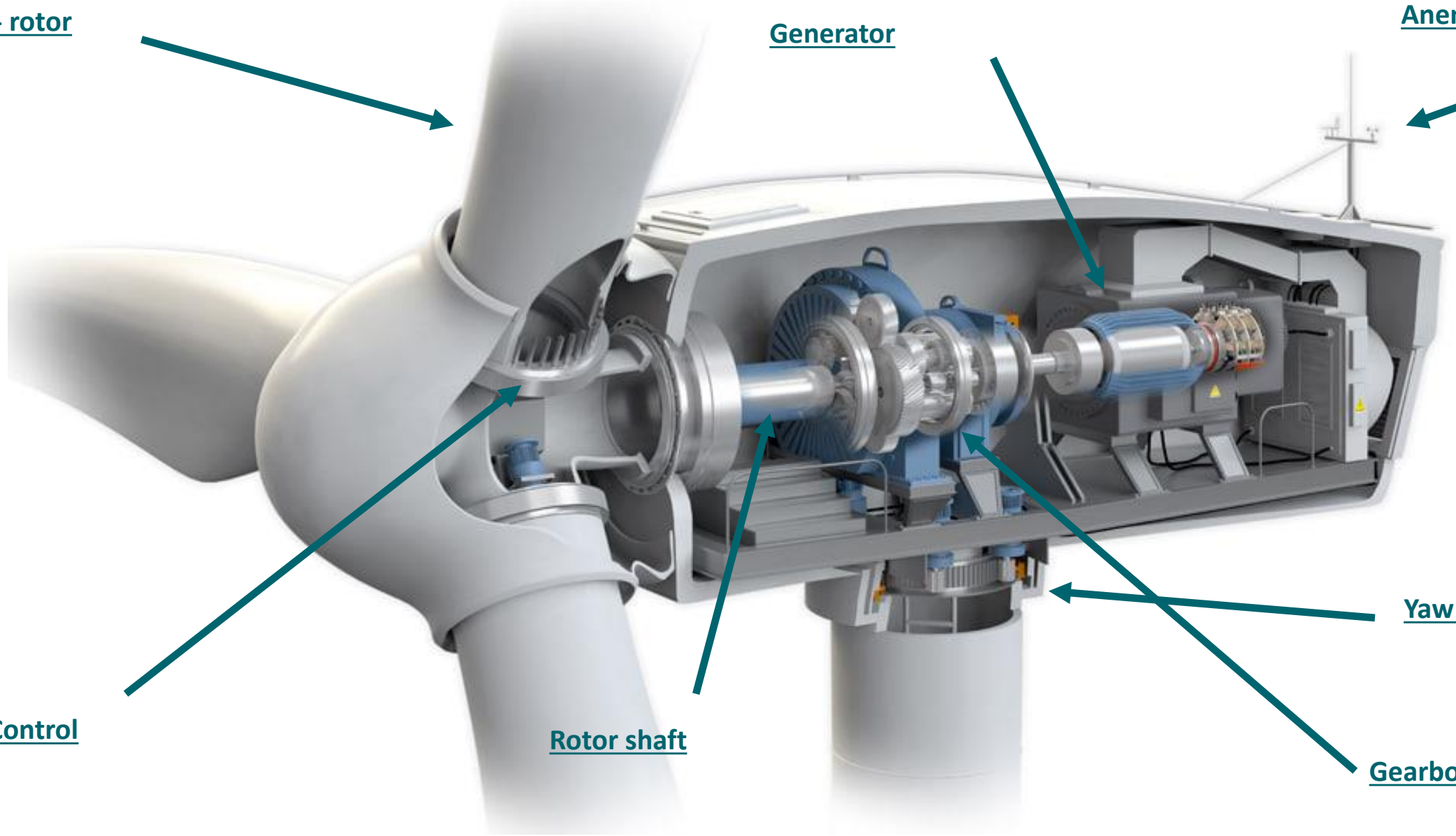

Wind Turbine of 2.5 MW

- **Wind Blades**
  1. Radius $R = 60\ m$
  2. Maximum Torque $T_{max} = 10^9 Nm$
- **Shaft**
  1. Moment of Inertia $I_{shaft} = 20 \cdot 10^6\ Kg \cdot m^2$
  2. Viscous Friction $F_{vf} = 2300 \frac{N \cdot m}{rev/min}$
- **Gear Box**
  1. Gear Ratio Motor Gear Ratio $= 1/131$
- **Motor**
  1. Voltage 380 V
  2. Max Torque: $11000\ N \cdot m$
  3. Max Power : $2.5\ MW$
  4. Max rpm : $1800\ rpm$
  5. Constant Temperature at $20^o C$
- **Yaw Control**
  1. Moment on Inertia: $1.7 \cdot 10^6\ Kg \cdot m^2$
  2. Friction :
     Striction 100000 Nm, Coulomb 100000 Nm, viscous 10000000 Nm/rev/min
  3. Gear Ratio : $\frac{1}{12}$
  4. Number of Motors
- **Yaw control Motor**
  1. Voltage 380 V
  2. Max Torque: 5 Nm
  3. Max Power: 1500 W
  4. Max rpm : 3000 rpm