DIRECT DRIVE WIND TURBINES

Market and Technology in Europe and Innovations for China

直驱风能发电机

在欧洲的市场和技术

以及针对中国的技术革新

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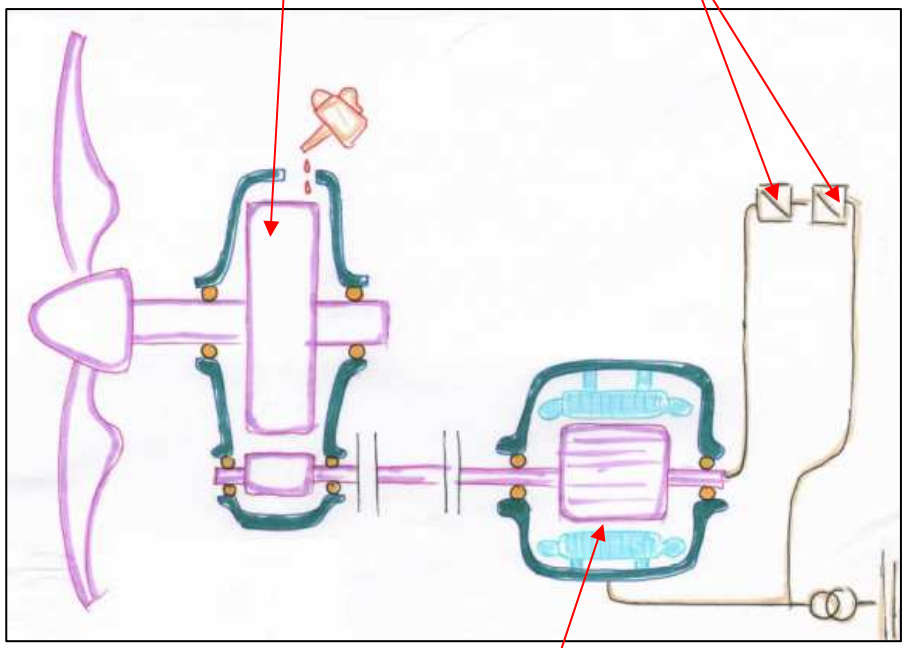
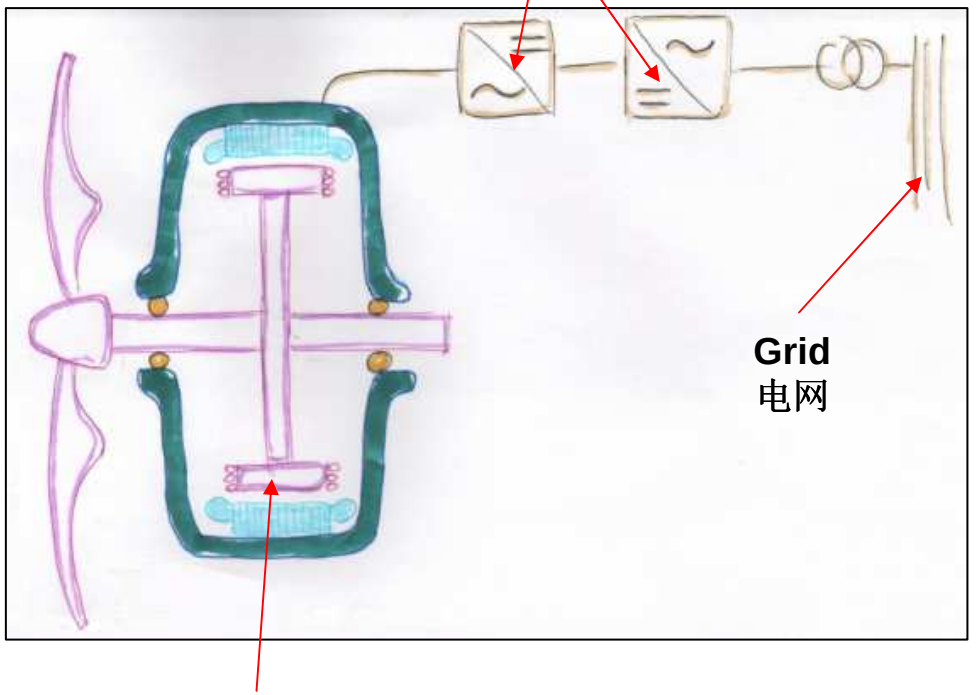
Comparison

与 变 速 箱 风 机 的 比 较





Advantages of Direct Drive
直 驱 风 机 的 优 势

Turbine without gear box has:

- **Higher efficiency** 高效率
- **Low maintenance** 低维修
- **No breakdown of gearbox** 没有齿轮的损耗
- **Low speed for bearings** 轴承转速慢
- **Higher availibility** 可靠性高
- **Higher energy yield** 收益高

Problems on Gearboxs
变 速 箱 的 缺 点

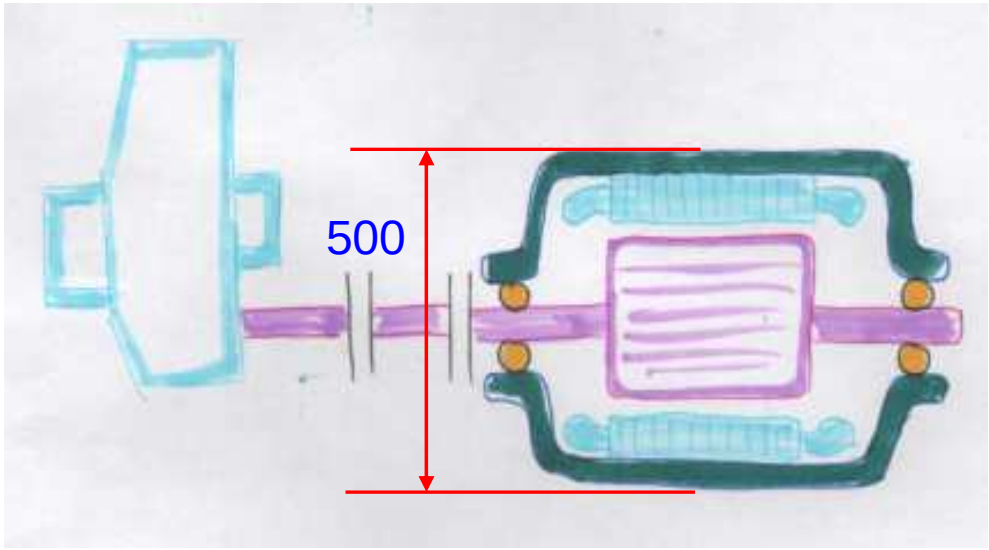
60% of turbine failures are coming from the gearbox, shaft, coupling and generator.

60%的风机不能工作的原因都在于
失效的齿轮箱，主轴，离合器和发电机。

High Torque Generator
高 扭 矩 发 电 机

2 MW

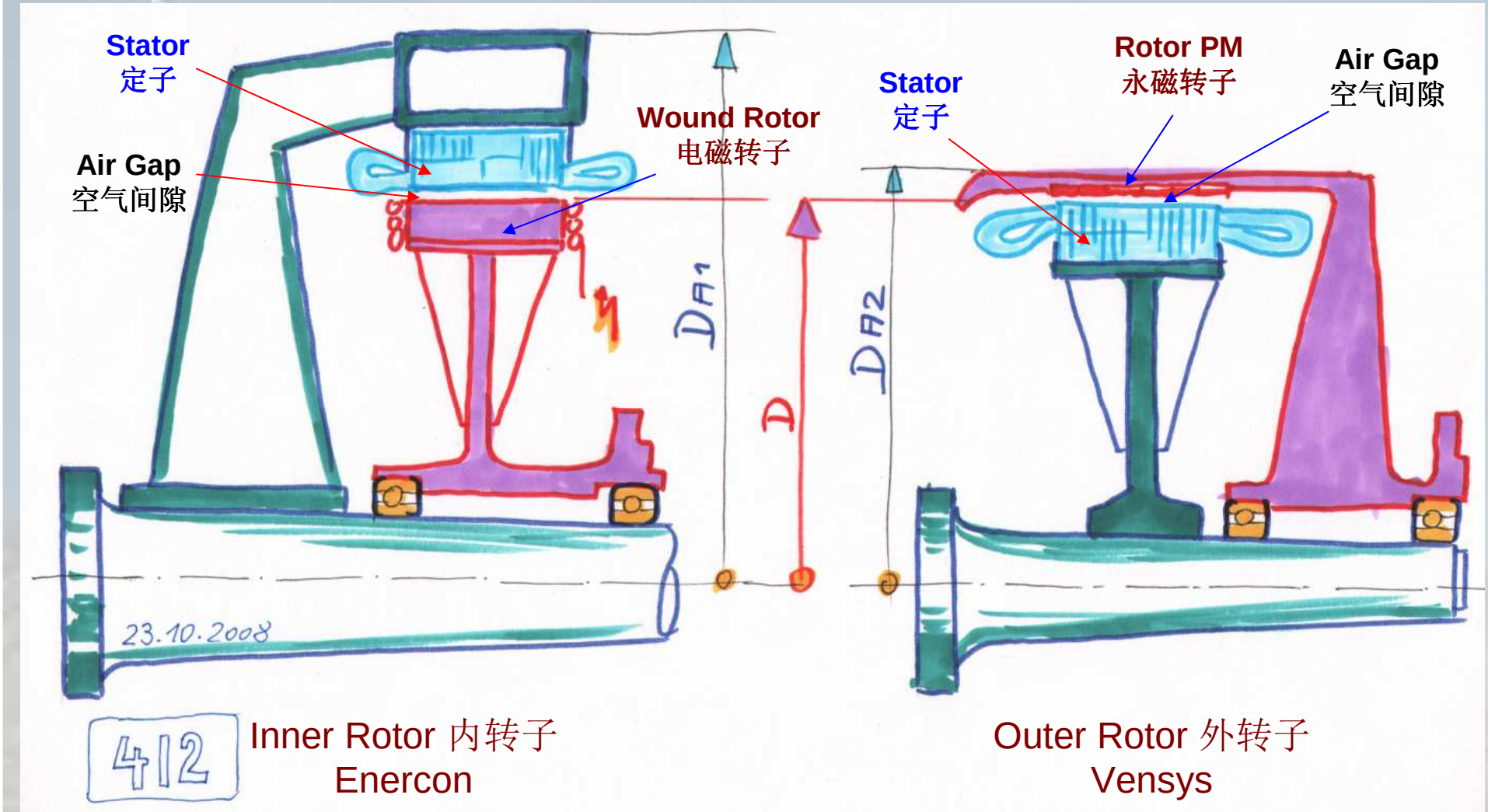
Gear Ratio
1:83



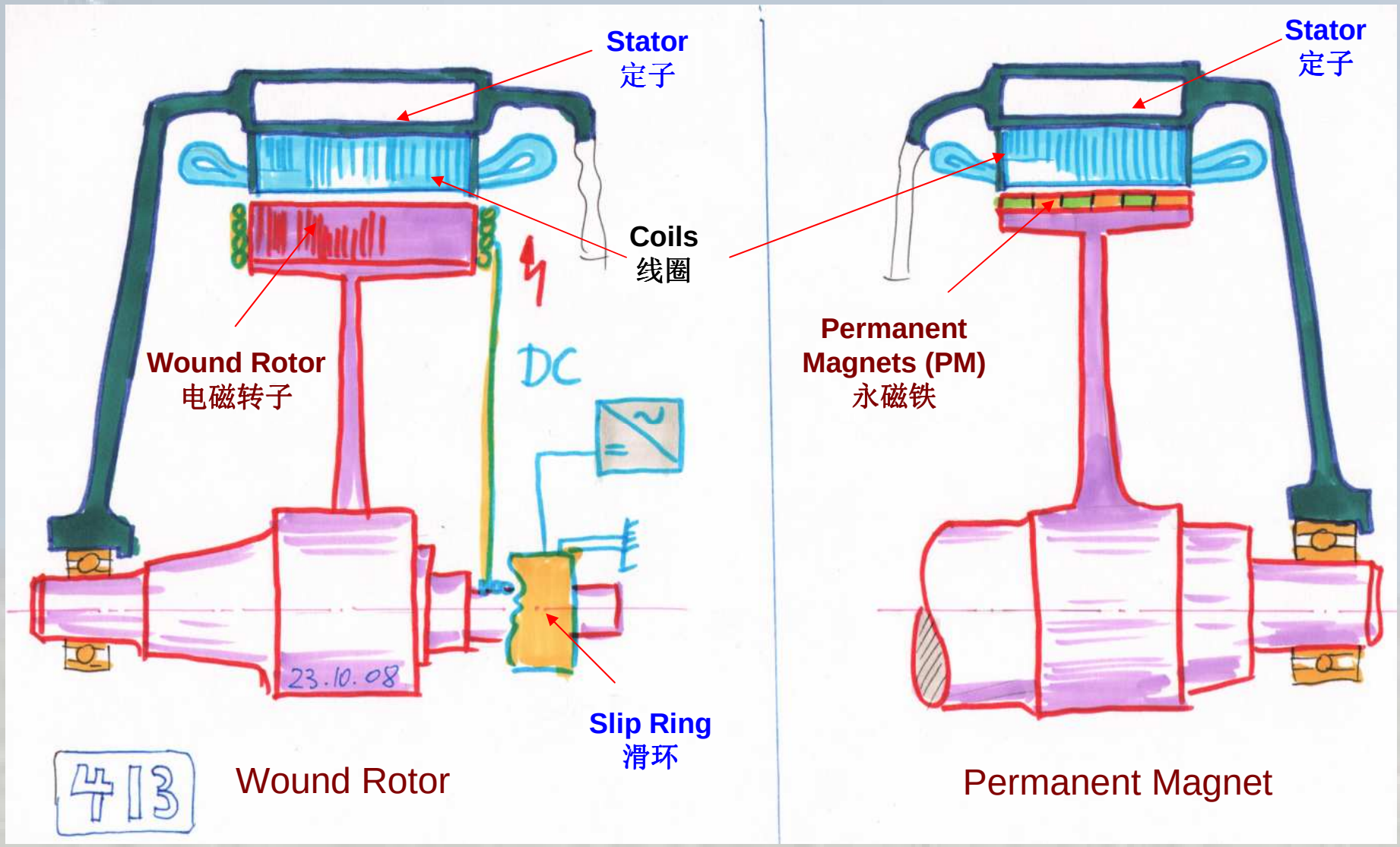
Torque 14 kNm
Speed 1520 rpm

2 MW

Inner and outer Rotor in Synchronous Machine
外部转子和内部转子的同步电机



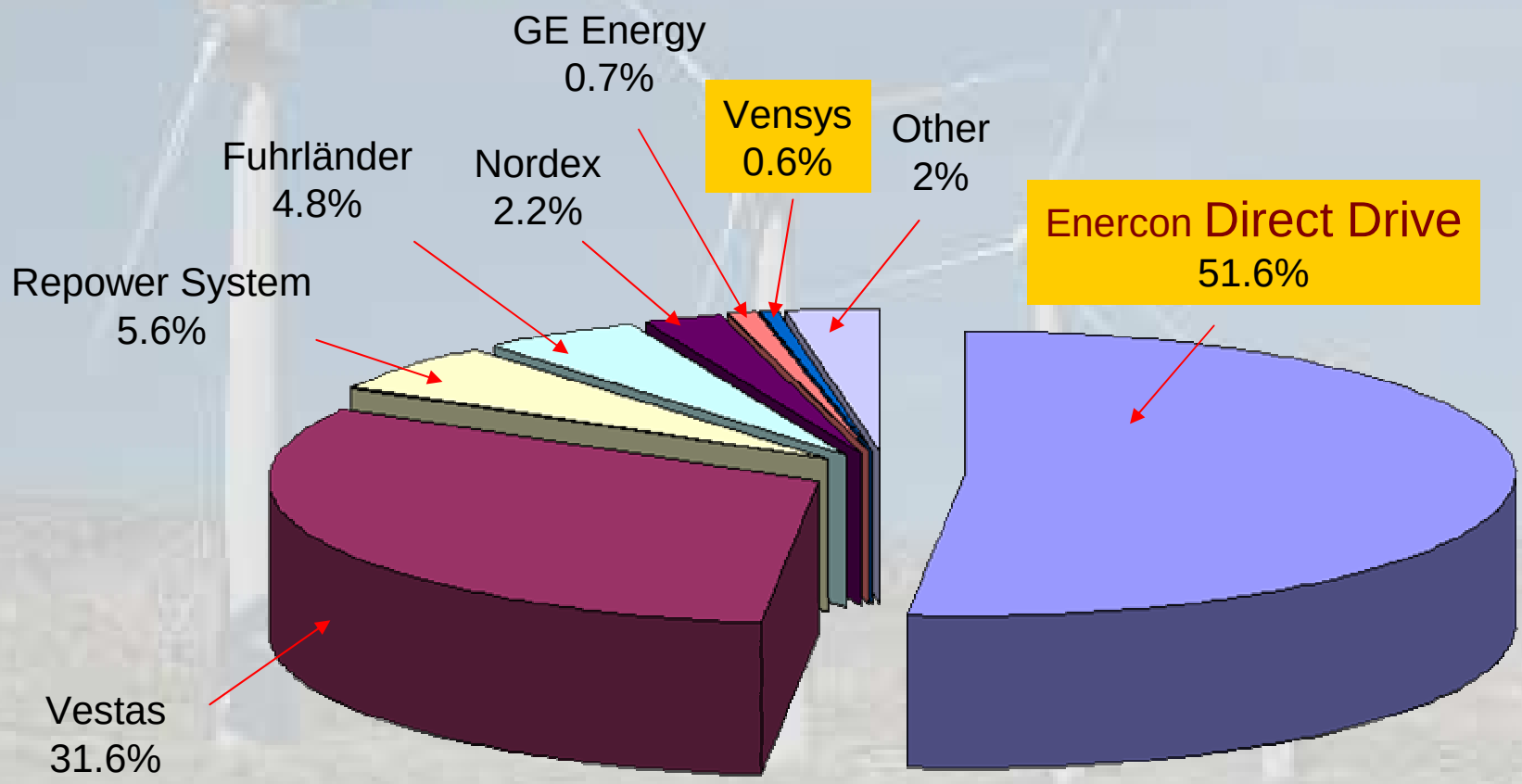
Excitation Systems in Synchronous Machine
同步电机励磁的激发



Wind Turbine Market in Germany
德国风能发电的现状

51% direct Drive
51% 直驱

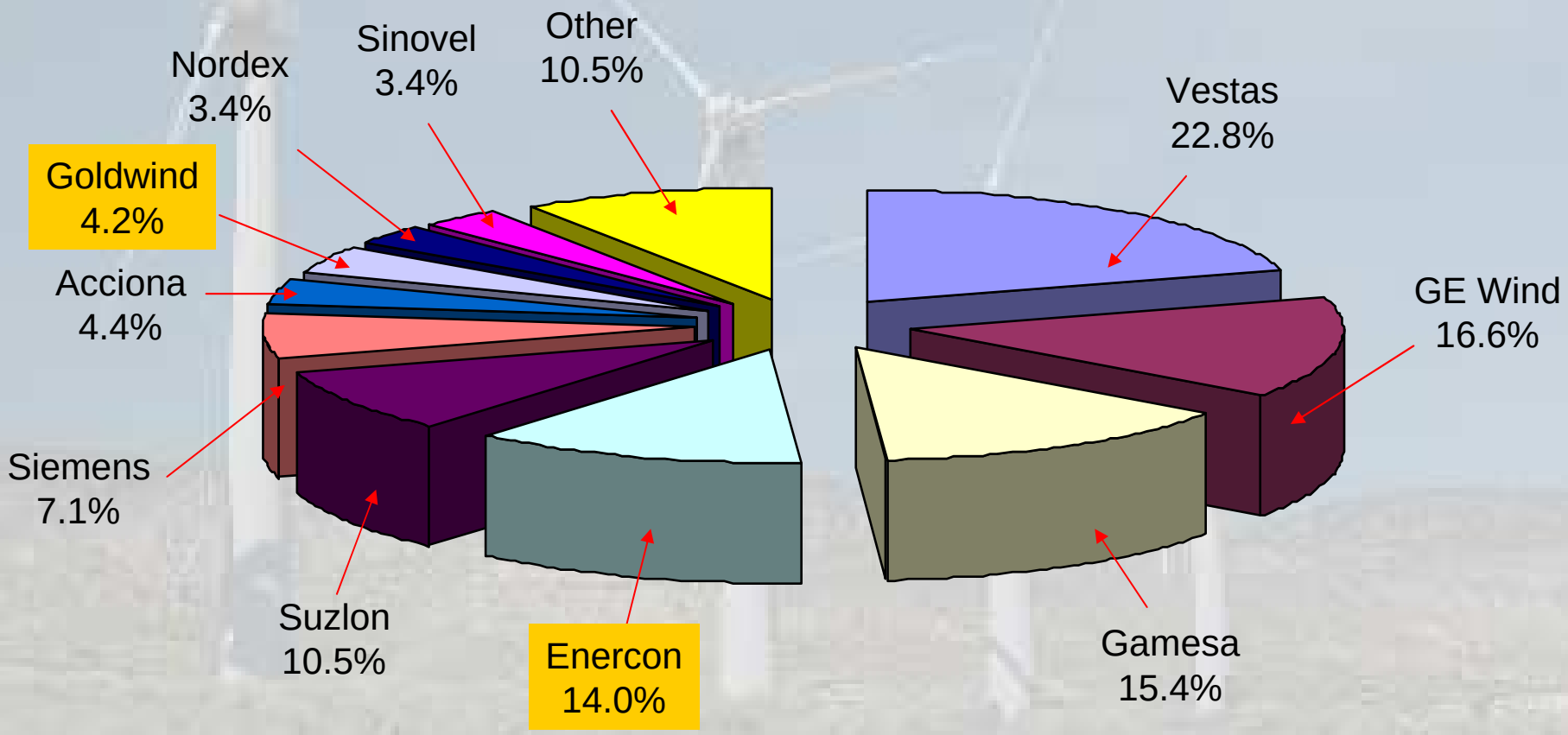
Share of manufacturer of Wind Turbines of the new installed Power in Germany in 2008



World Market for Wind Turbine
世界风能发电的现状

18% direct Drive
18% 直驱

Share of manufacturers of Wind Turbines of the new installed Power worldwide in 2007

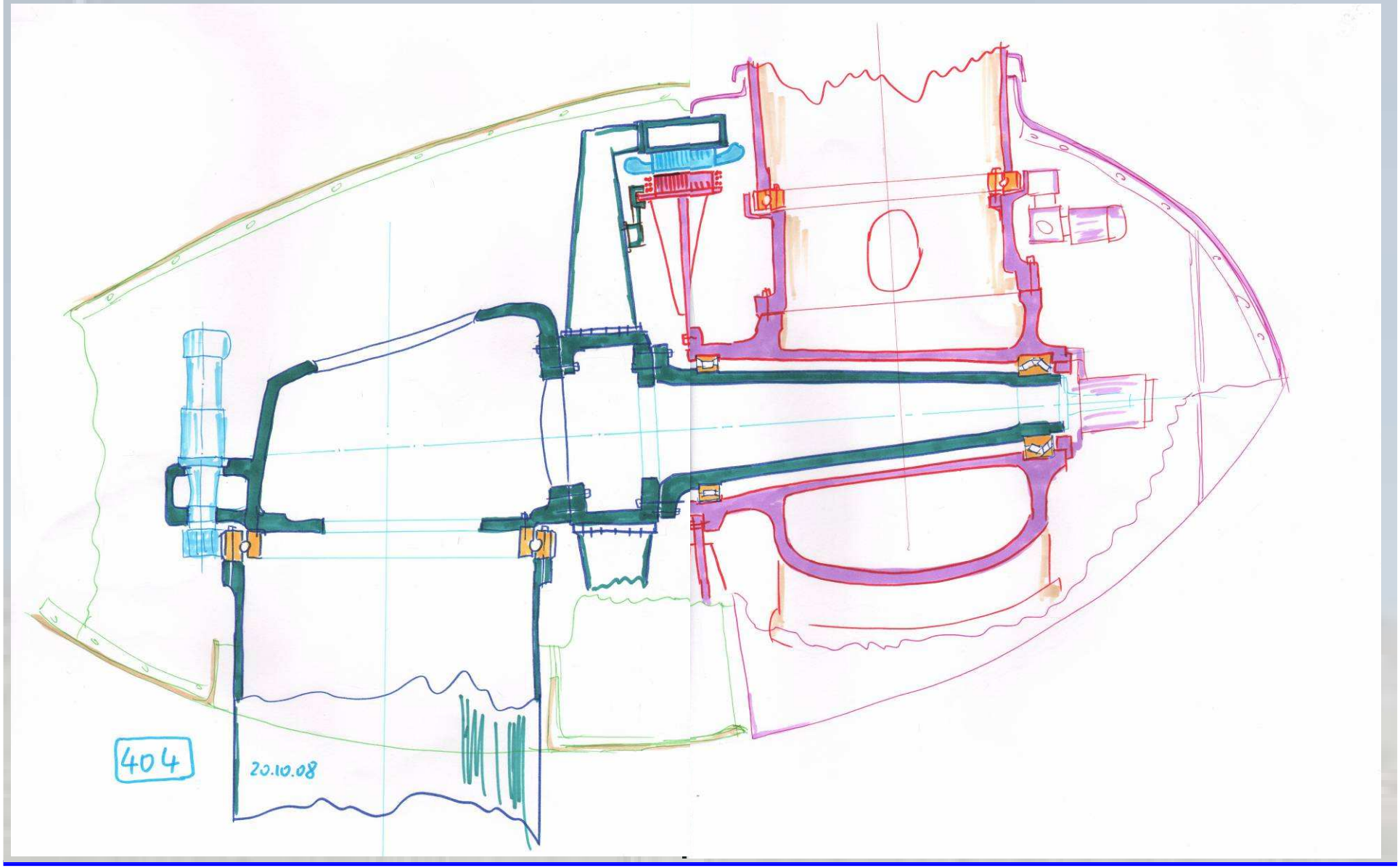


Suppliers of direct Drive 直驱风能发电机的生产商

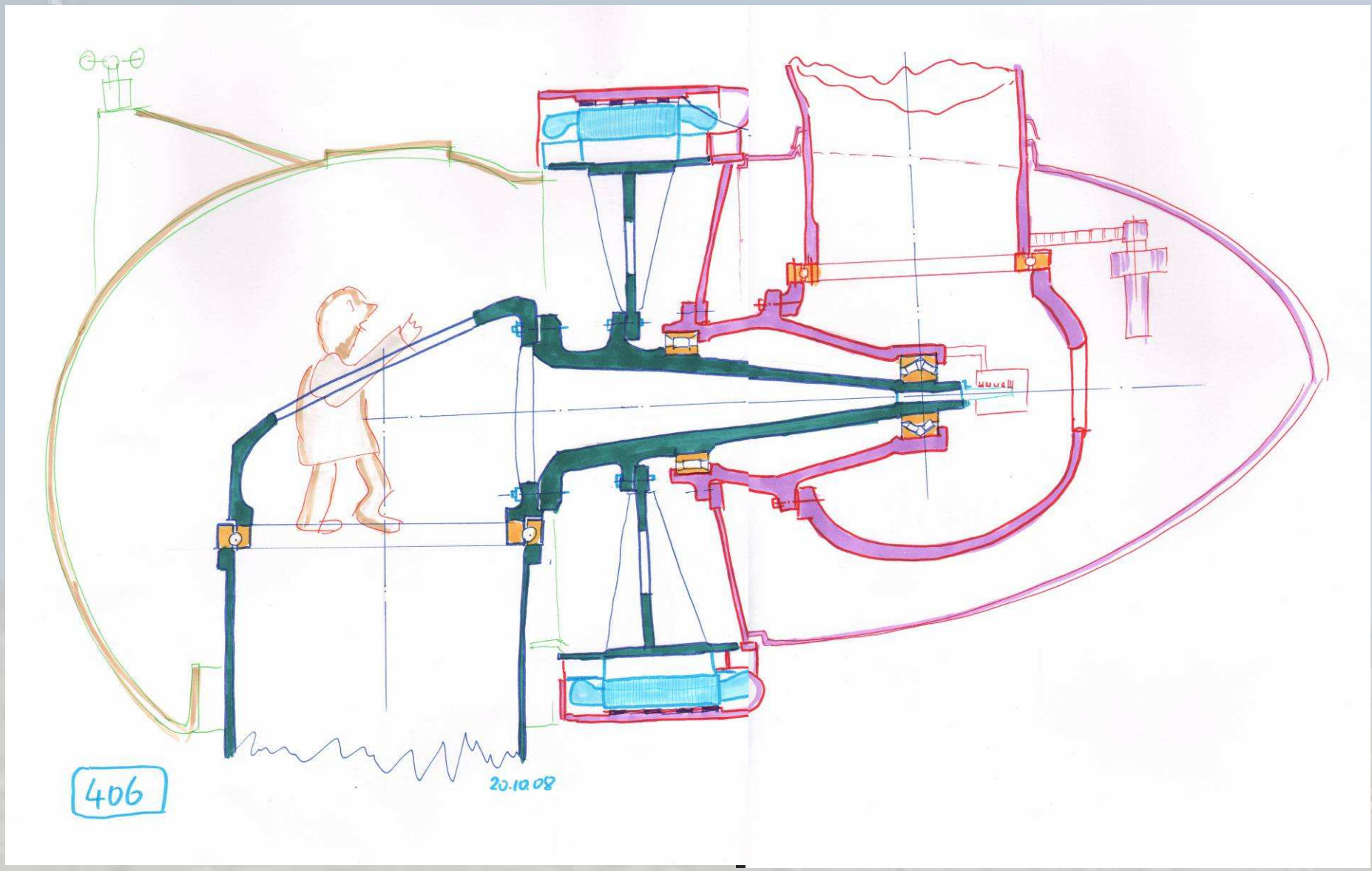
	Company	Country	Rotor Diameter	MW Sold	Excitation synchronous Generator
1	ENERCON	Germany	10, 20, 30,48,70,82,126	17000	wound rotor
2	VENSYS	Germany	70, 77, 90, 100	90	Permanent Magnet (PM)
	GOLDWIND	China	70, 77	1200	PM
	EOZEN	Spain			PM
	IMPSA	Brazil			PM
	CKD	Czech			
	XY	India			PM
3	ZEPHYROS	Netherland	72		PM
	HARAKOSAN	Japan	72		PM
	XEMC	China	72		PM
4	SCANWIND	Sweden			
5	MTORRES	Spain	82	100	wound rotor
	ELSEWEDY	Egypt			Wound rotor
6	LEITWIND	Italy	62, 70, 77		PM
7	UNISON	Korea	50, 54, 57 (0.75MW)		PM
8	MITSUBISHI	Japan	75		
9	AVANTIS	Germany, China	93		PM
10	WIND ENERGY RESEARCH	China	82		PM
12	SIEMENS	Germany	Testing Prototypes		PM
11	WIND ENERGY RESEARCH	Europe	85		PM

Origin Designer

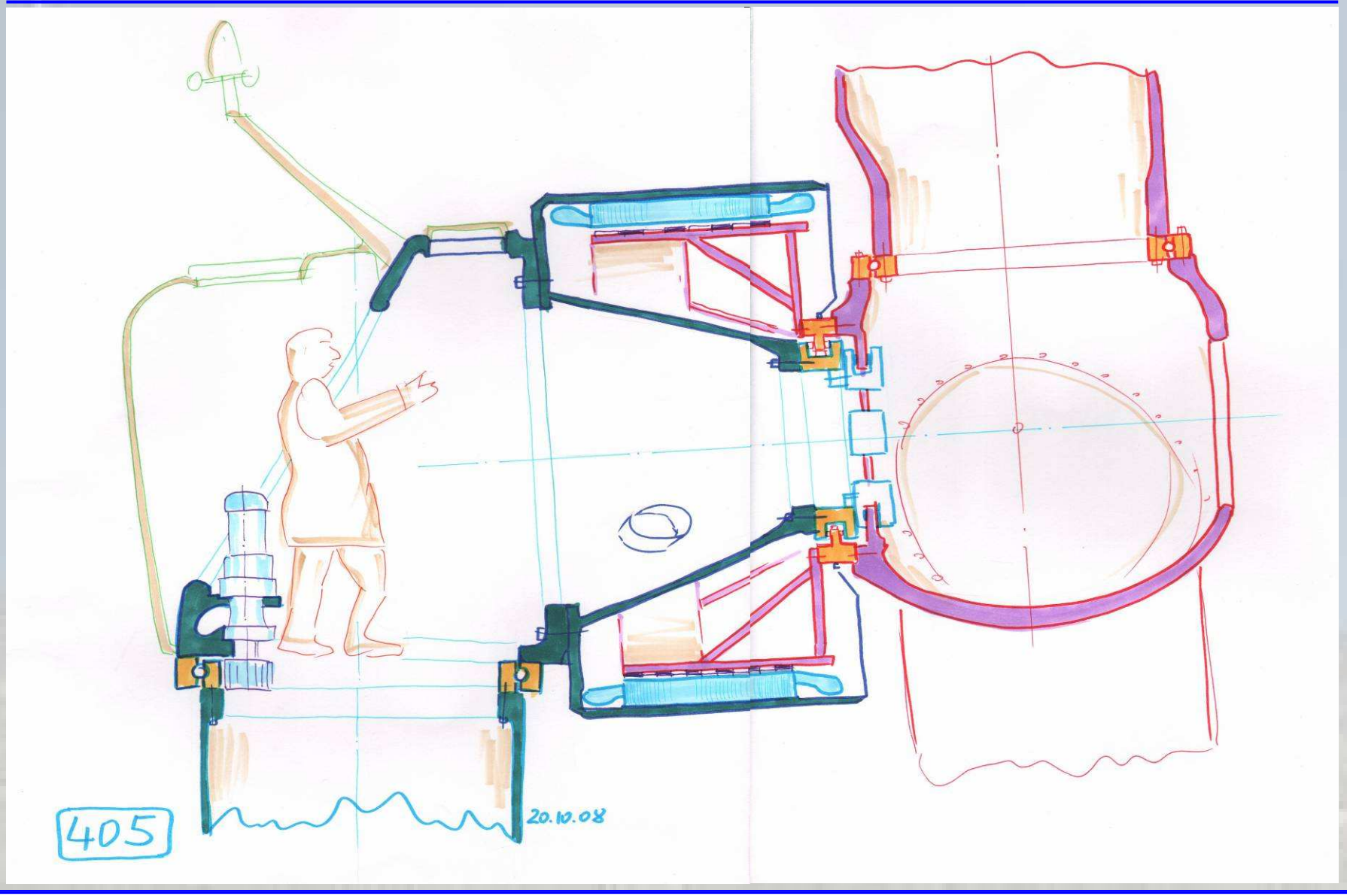
Direct Drive Turbine: Enercon



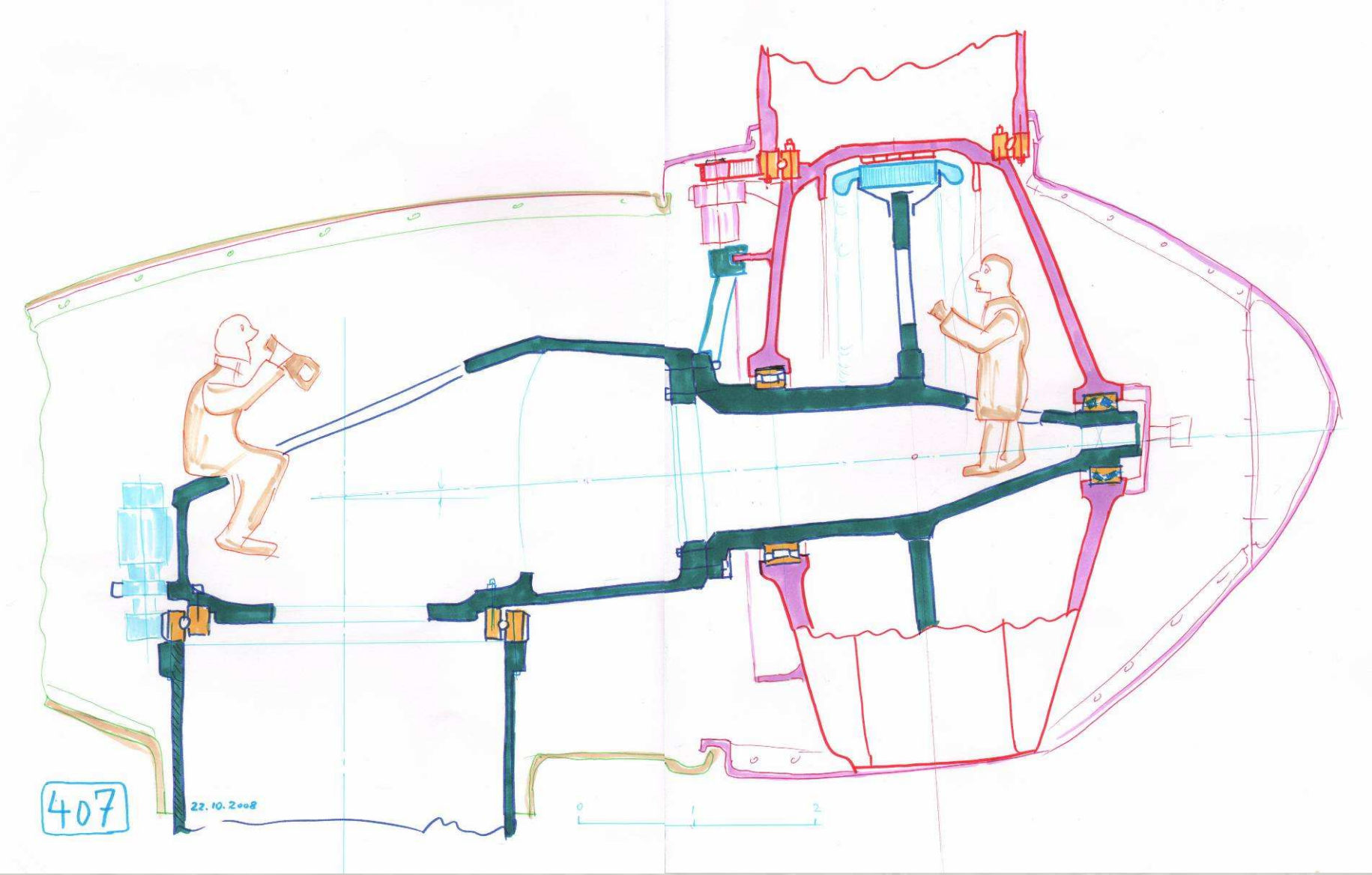
Direct Drive Turbine: Vensys, Goldwind, Eozen, Impsa, CKD



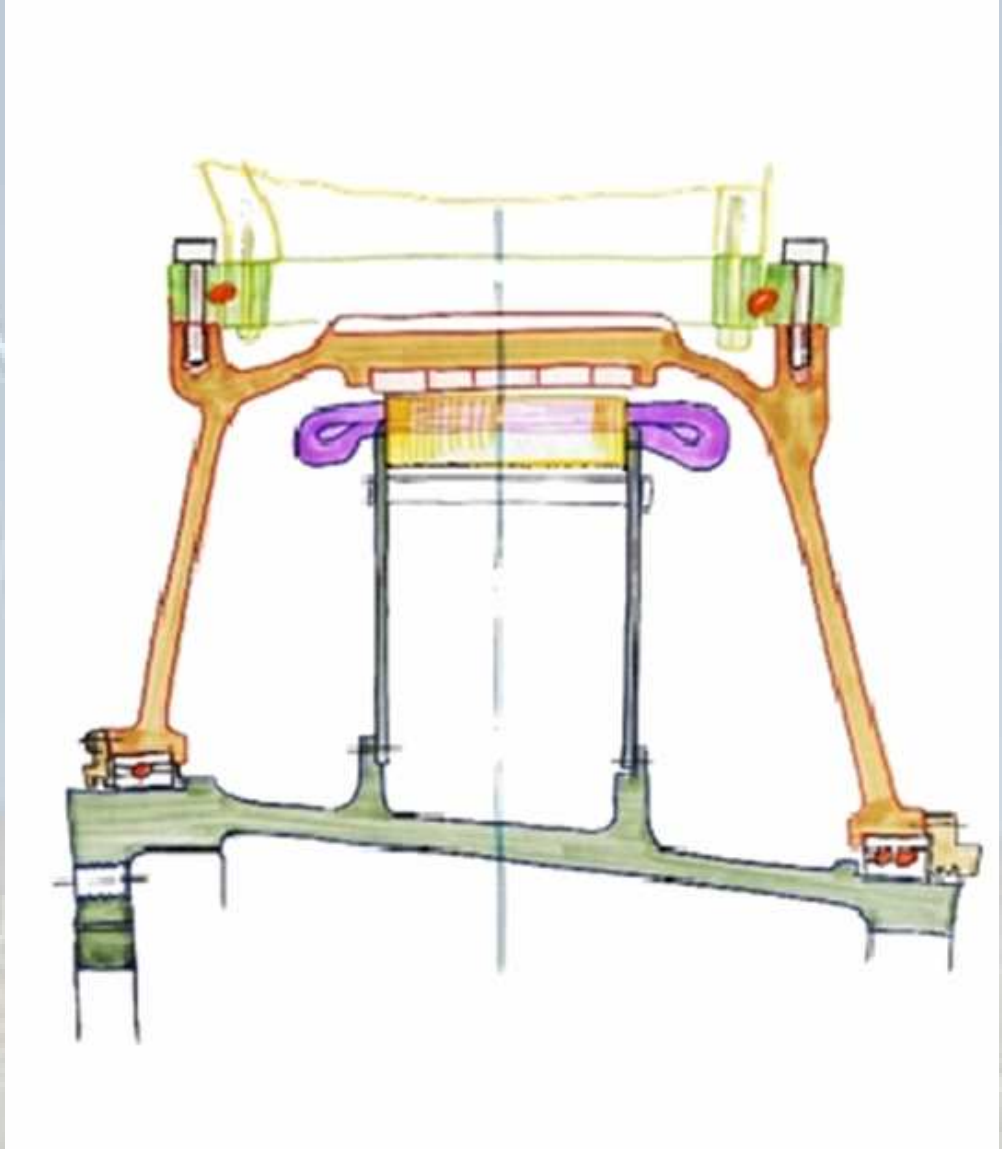
Direct Drive Turbine: Zephyros, Harakosan, XEMC



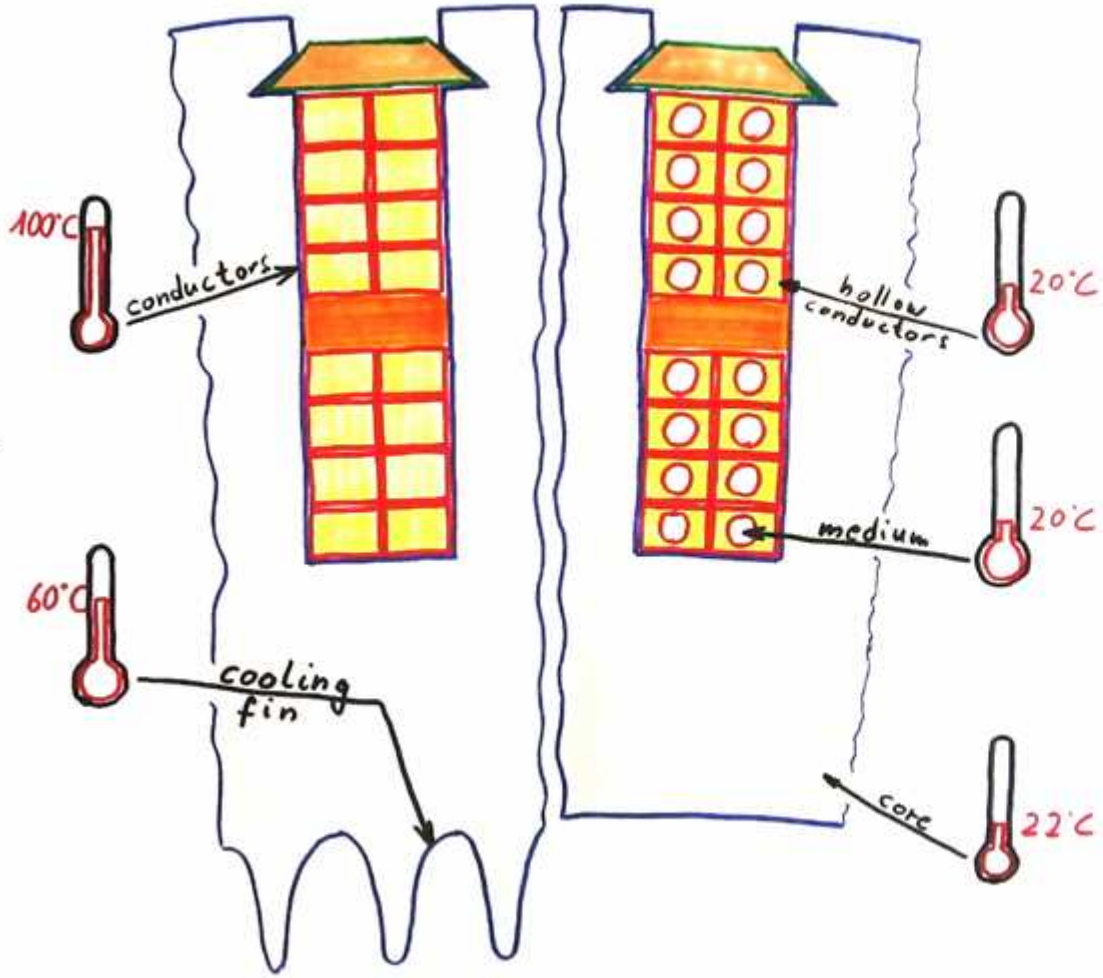
Gearless Generator: Wind-Energy-Research



In Hub Generator 集 成 一 体 的 发 电 机 和 轮 毂



Cooling in Coils 导 线 中 的 冷 却



- high power density
- low temperature level
- no air
- no water
- full sealed generator
- low temperature gradients in core
- no hot spots in coils

Innovative Generator Design for Chinese Manufacturer 为中国的厂商设计的风机