



Wind Energy Facts - Technology

P Jamieson, Garrad Hassan, March 2009



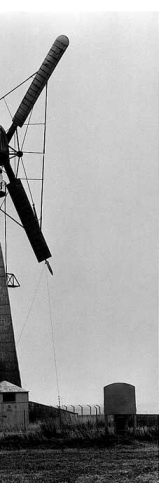
WIND TECHNOLOGY HAS COME A LONG WAY!

1980 QUESTIONS

- Will wind ever be sufficiently economic?
- Can it contribute significantly to national electricity demand?
- Can wind turbines survive 20 year lives in a challenging environment?
- Can electricity networks accommodate large amounts of wind capacity?

2009 ANSWER

YES!





WIND TECHNOLOGY HAS A UNIQUE IDENTITY

STALL - disaster for an aircraft – often useful in a wind turbine

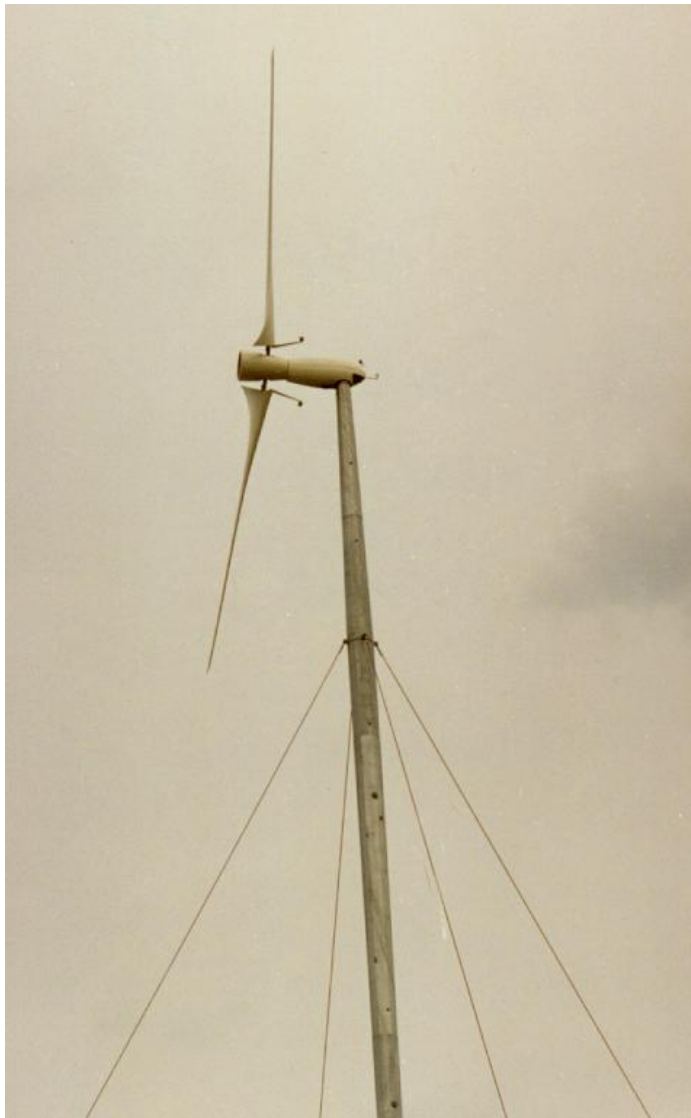
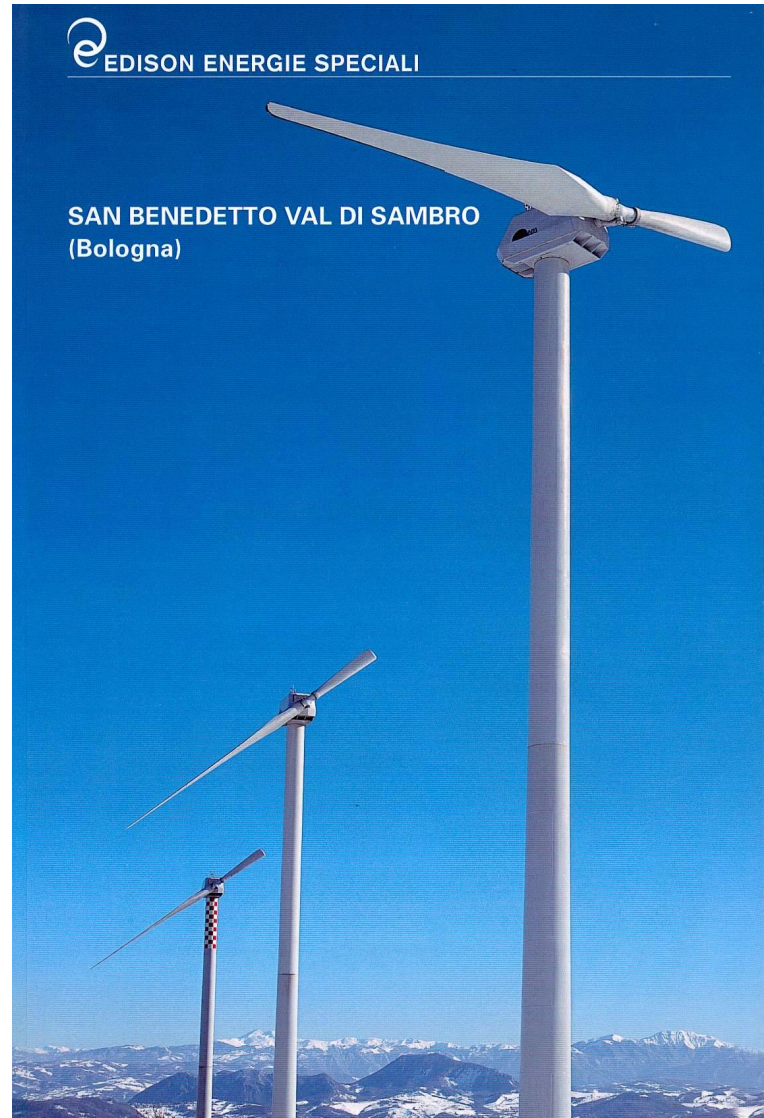
FATIGUE – motor car, lifetime operation = 4 months continuous – loving care
wind turbine, 13 years or more of continuous operation – lonely life,
six monthly visits



DESIGN OPTIONS – Blade number?

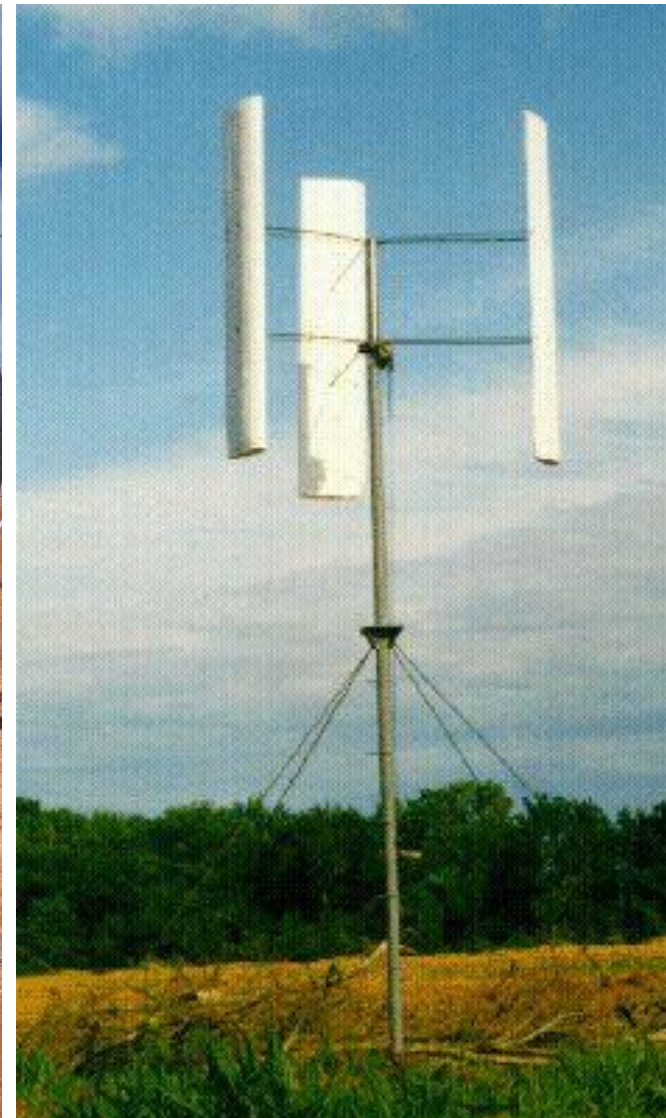
 EDISON ENERGIE SPECIALI

SAN BENEDETTO VAL DI SAMBRO
(Bologna)



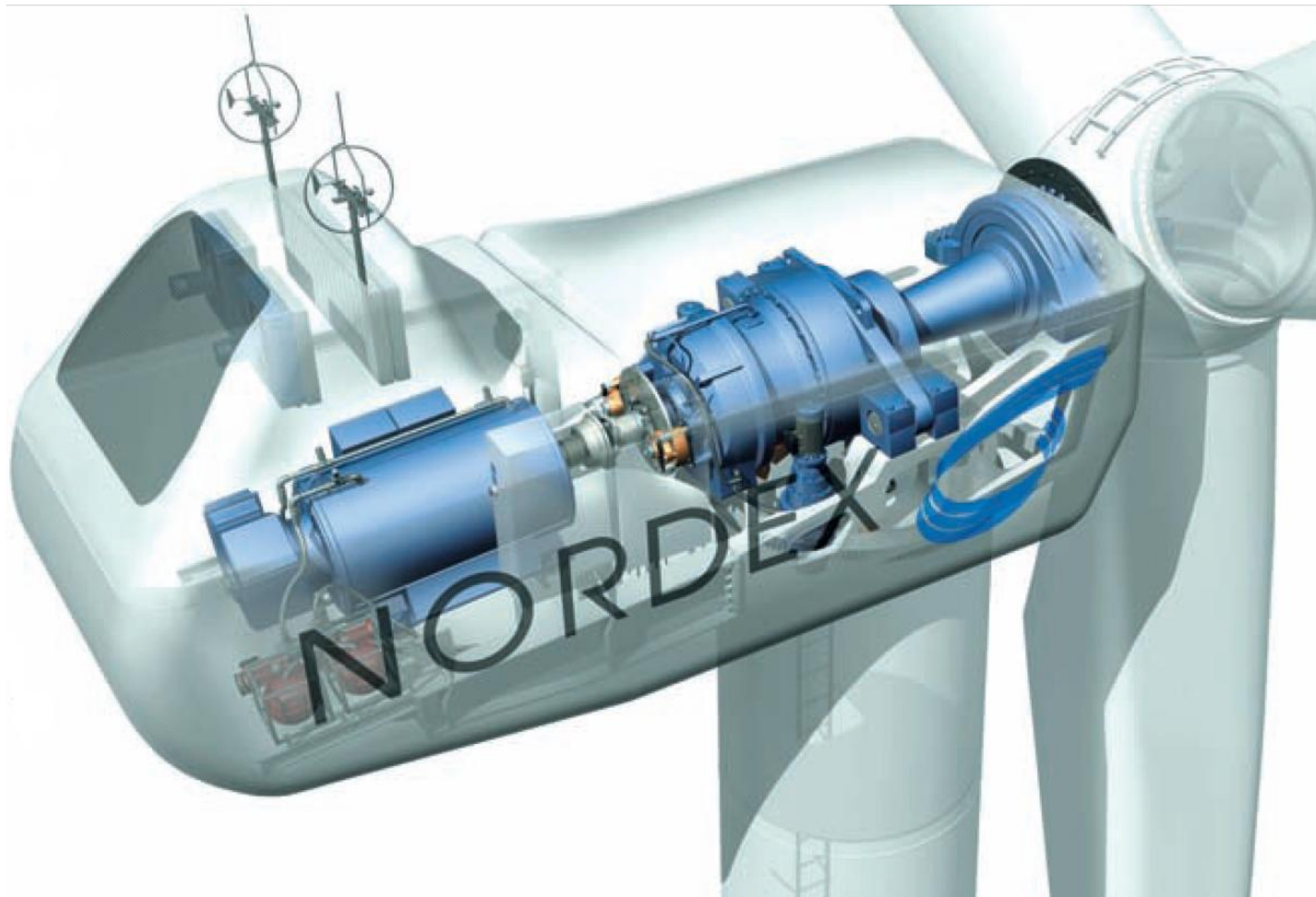


DESIGN OPTIONS – Horizontal or vertical axis?



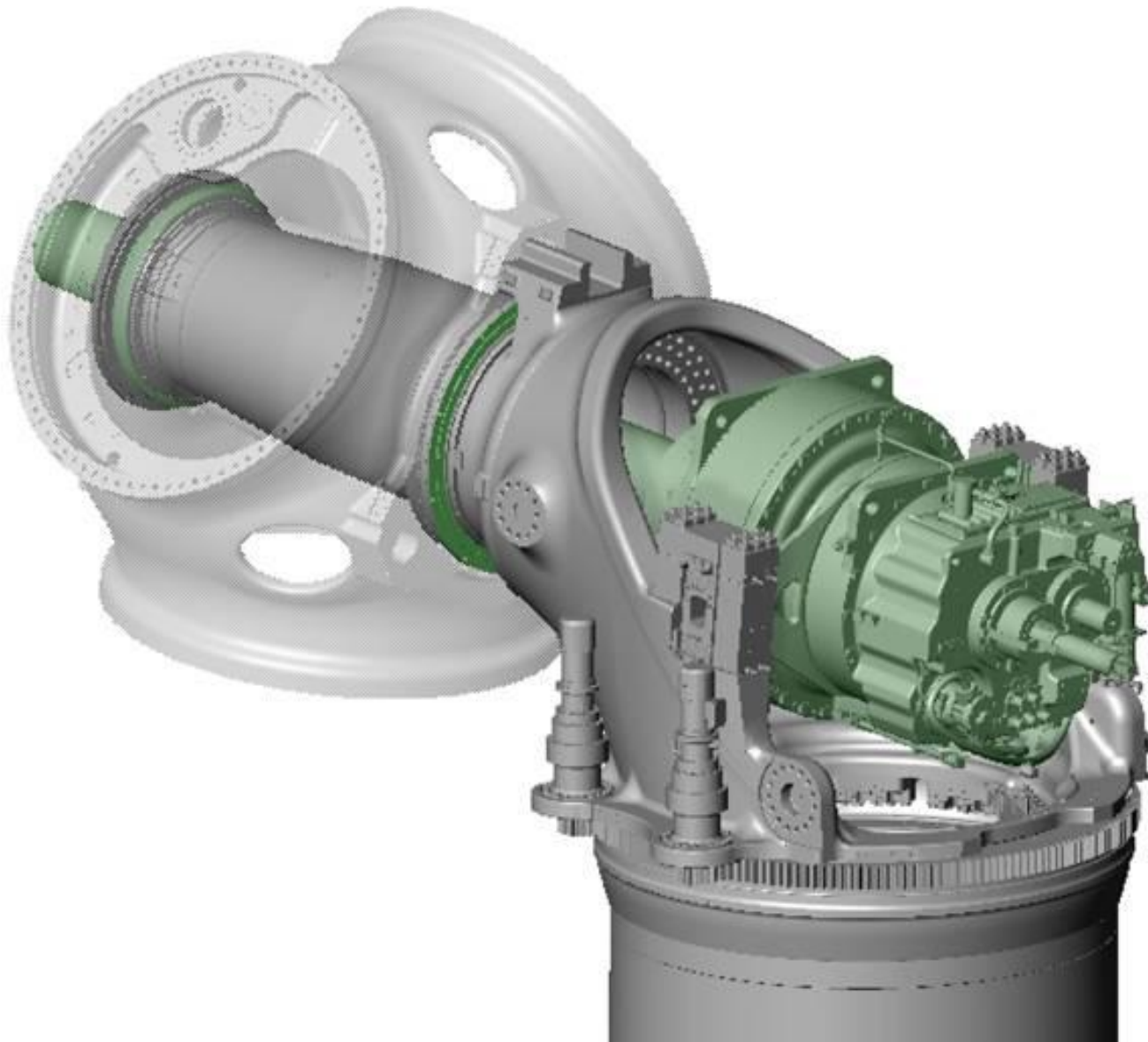


WIND TURBINE – WHAT'S INSIDE?





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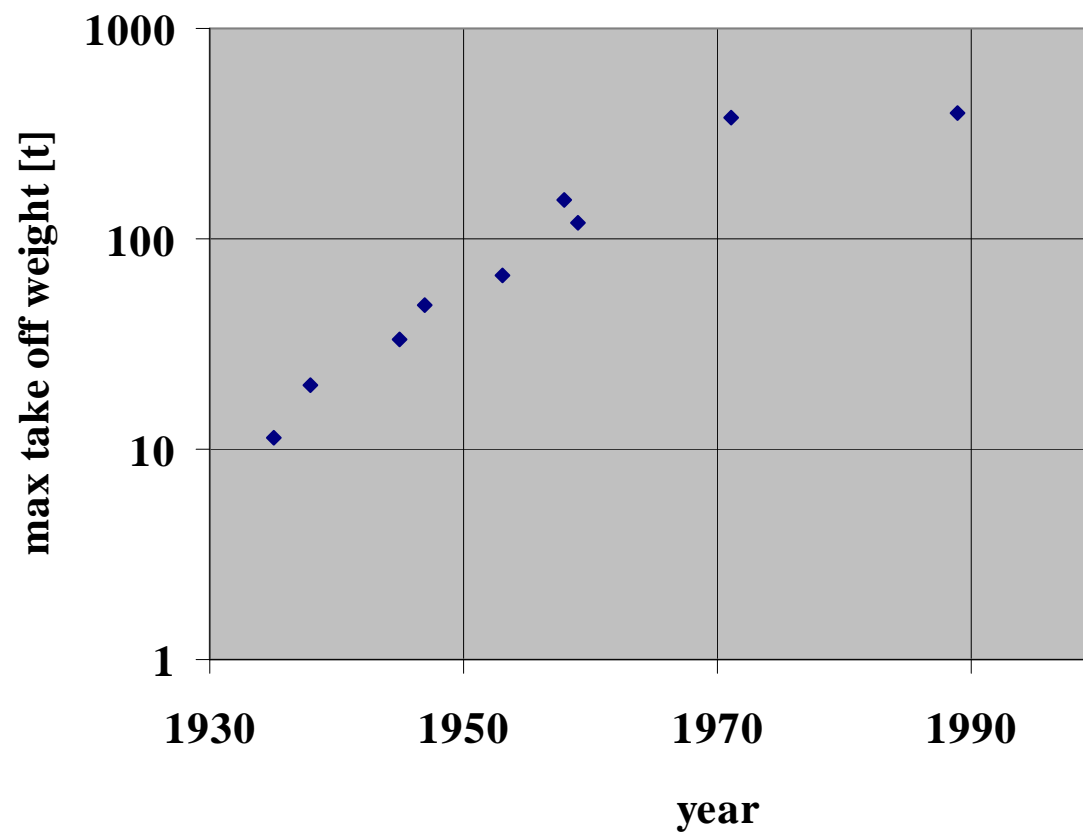
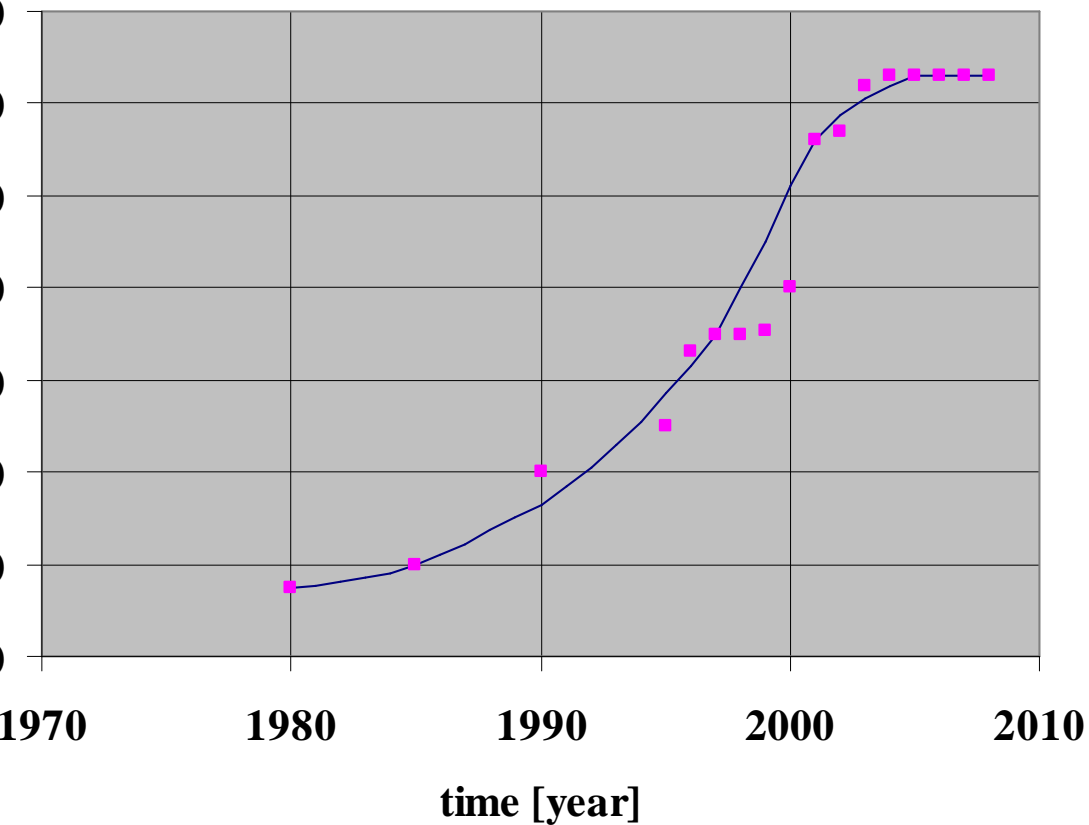


WIND TURBINE – E 126 - Largest in the world





GROWTH CURVES



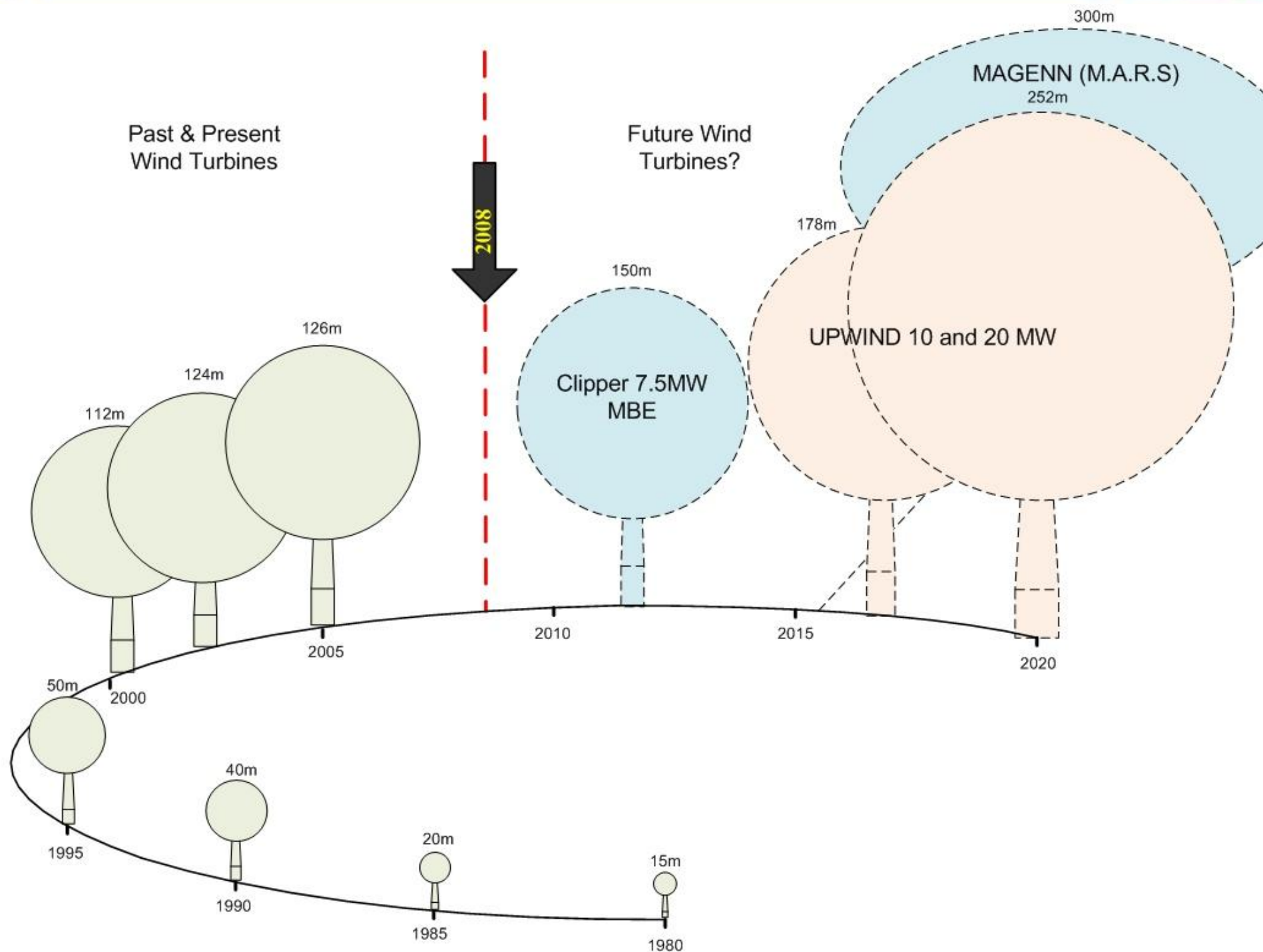
LARGEST WIND TURBINES

LARGEST AIRCRAFT



WIND TURBINES

How big
will they
get?





ROTOR SAFETY – VITAL!

DOUBLE THE WIND SPEED – EIGHT TIMES THE WIND POWER



PITCH CONTROL - VARIABLE SPEED

STALL REGULATION – FIXED/TWO SPEED

PITCH CONTROL



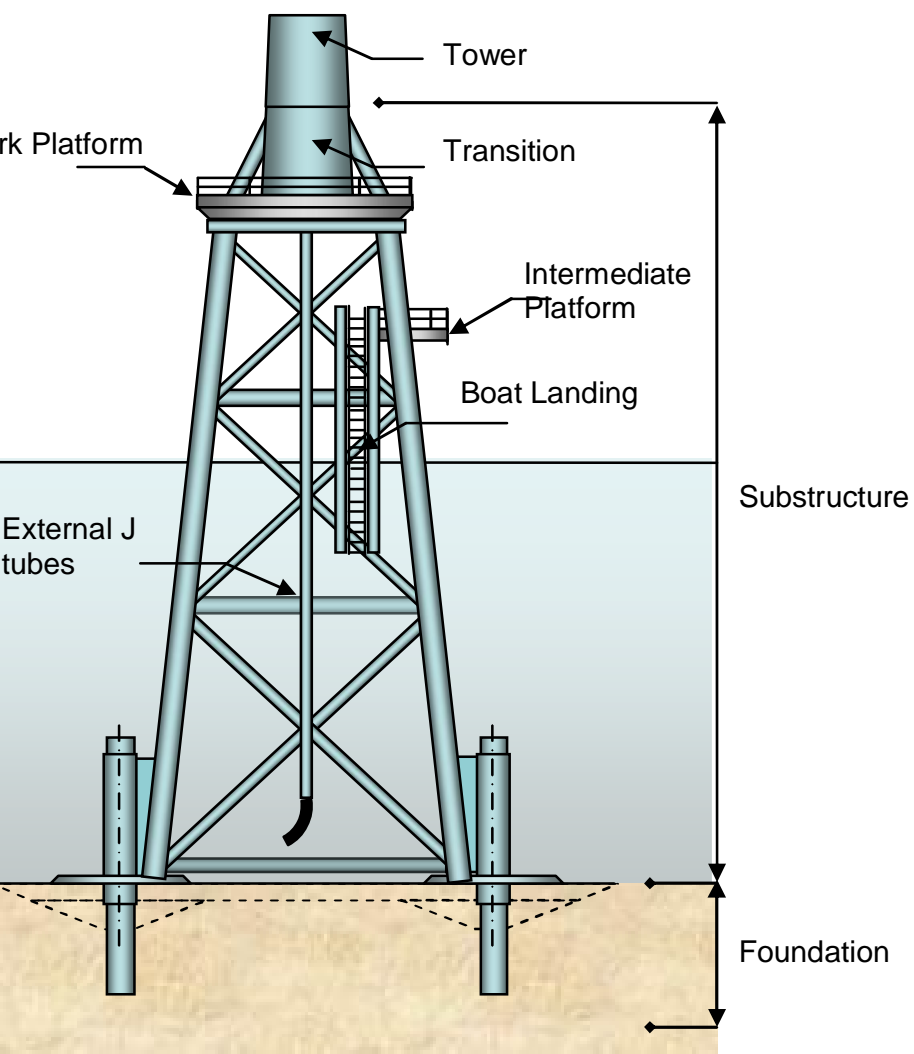
TESTING

essential for
wind products



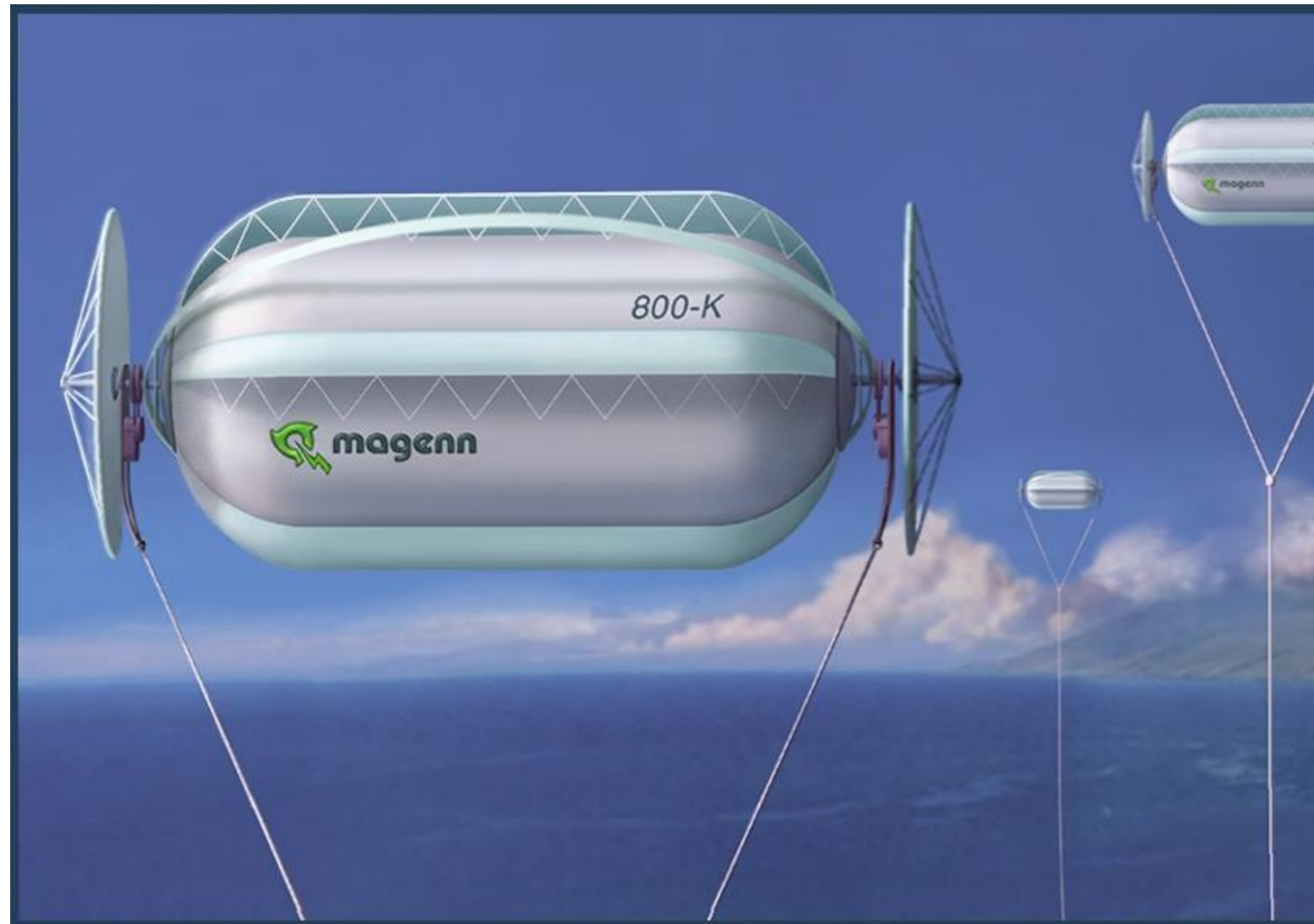
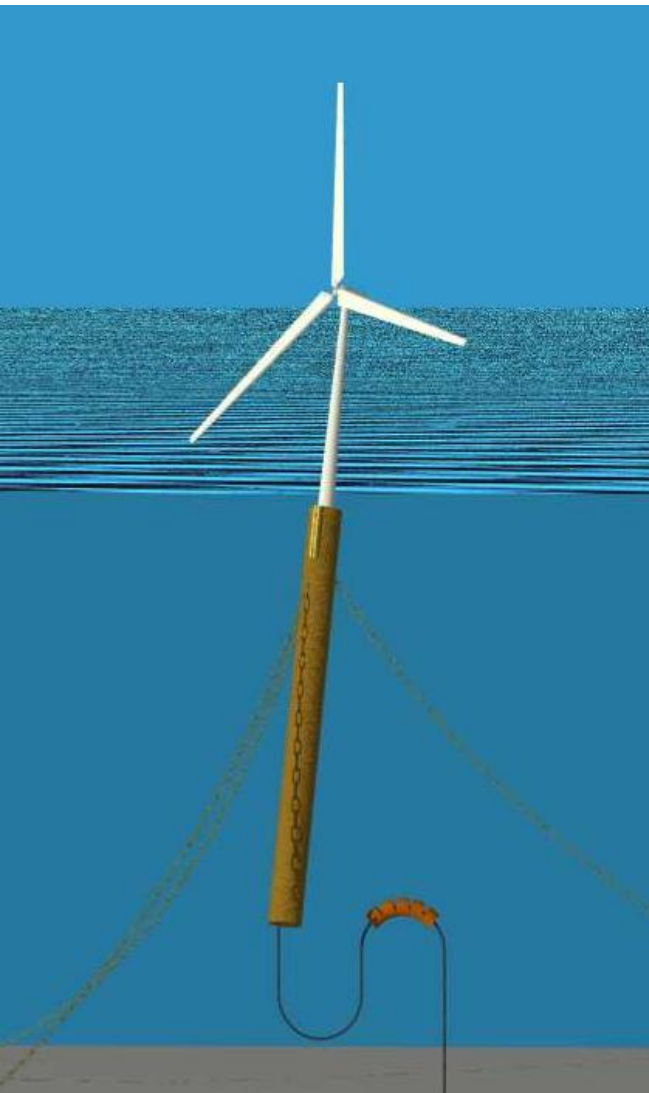


OFFSHORE WIND – DRIVING THE TECHNOLOGY





THE FUTURE – Floating in the sea or up in the air?





WIND TECHNOLOGY HAS COME A LONG WAY!

- Increasingly significant contributions to national electricity supplies
- Advanced design tools, testing facilities and certification procedures
- Striving to establish the technology offshore and access more resource
- Much active innovation continues driven by the challenges of offshore and cost reduction