

Wind Turbines

Large Small and Unusual

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1

Types of turbines

Horizontal axis
Vertical Axis

Sizes

From 1m to 100m diameter
From 5m high to 100m at hub

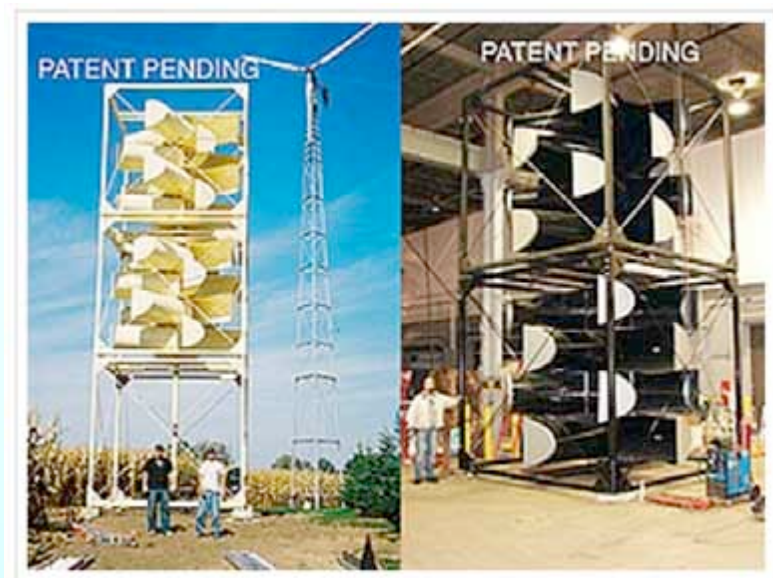
Locations

Land, Buildings, Water

2

Some unusual wind turbines

3



Vertical axis – drag type

4



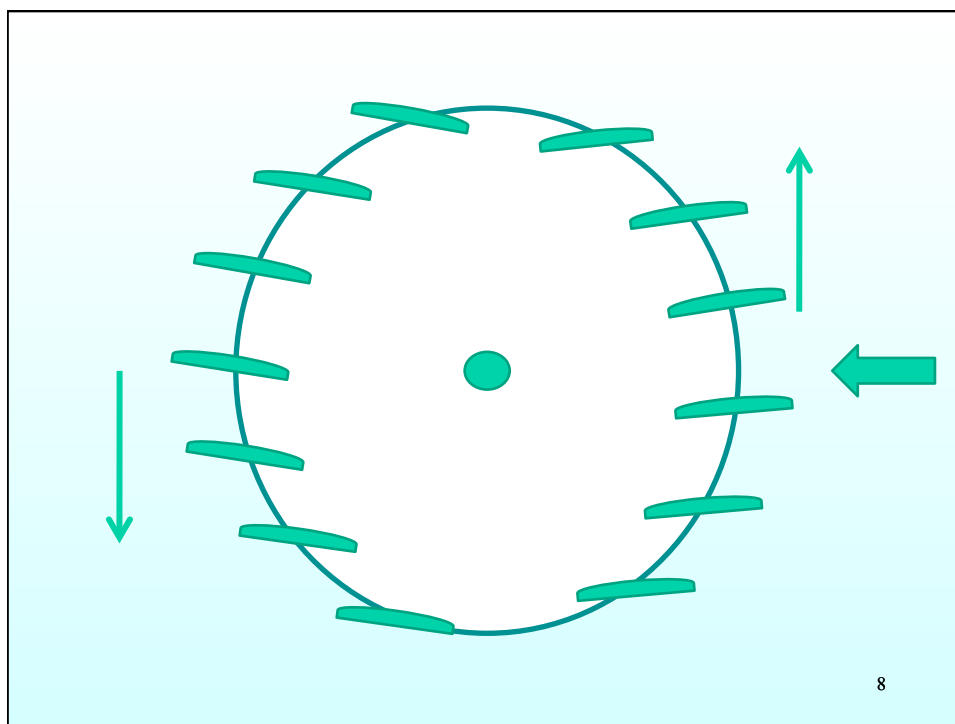
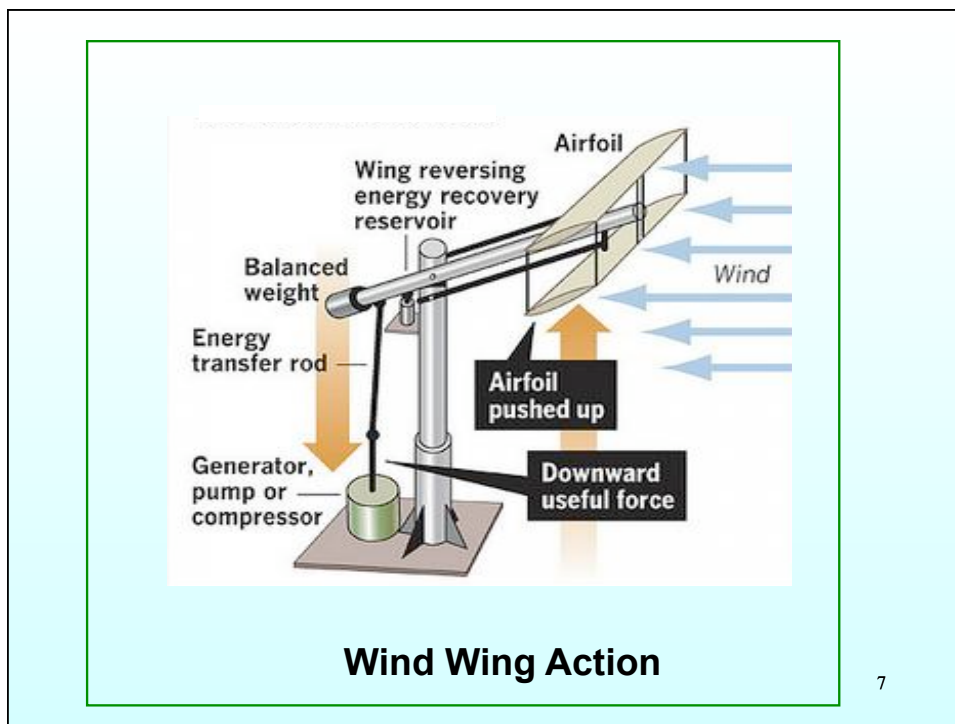
Magenn Power. Helium filled, 150 – 300m high
100kW ~14m by 30m. \$500,000. 2010 - 2011

5



Wind Wing

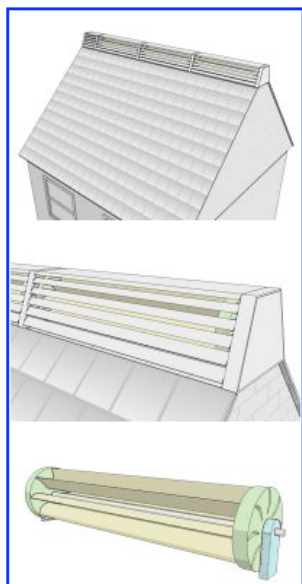
6





**Domestic
Noise
Vibration**

9



The RidgeBlade
www.thepowercollective.com

10

Amsterdam, September 25 2009

WIND TURBINE WINS GREEN CHALLENGE 2009 A nearly invisible rooftop wind turbine has won the €500,000 Postcode Lottery Green Challenge 2009. "It's beyond a dream," said English entrepreneur Dean Gregory when Skype founder Niklas Zennström, a contest juror, announced his name. "This means we can focus solely on bringing this to market." Gregory entered the Challenge on behalf of the English company The Power Collective Limited – after finding out about it two days before the deadline.

Each year, the Dutch Postcode Lottery gives away €500,000 to the inventor of the best climate-friendly invention.

11



Parapet

12



**Fortis Montana WT - 5m diam. 15 – 18m high
2.5kW at 10m/s >> 5kW at 17m/s**

13

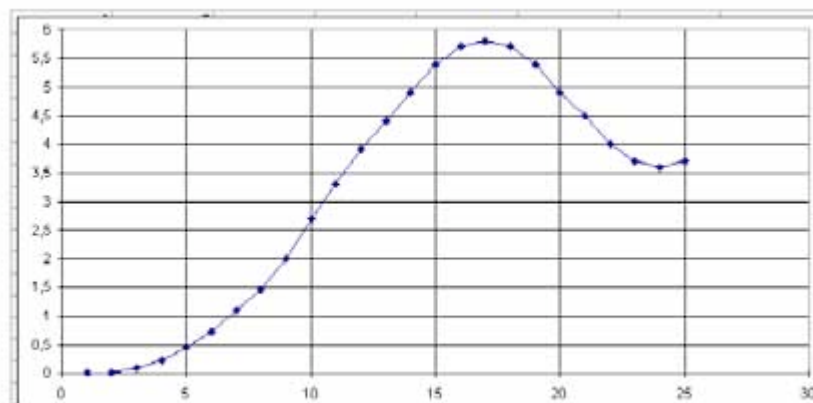


Figure 2-7: Montana power curve; Power (kW) vs wind speed (m/s)

14



Parapet

15



Vertical axis Croydon

16



**Quiet Revolution.Qr5 –
5m high, 3.1m wide,
>15m mast
4 – 7 kW depending on
conditions.
£35K – 40K**

17

Applications for Small Wind Turbines

- **Domestic electricity**
 - **Electricity in remote areas:
refrigeration, communication**
 - **Recovery of water from air - Aeolus etc**
 - 10m high 53 litres/24hr - € 9,900**
 - 12m high 149 litres/24hr – €18,000**
 - 14m high 514 litres/24hr - €25,000**
- For wind speed 10m/s at 25C 60%RH**

18



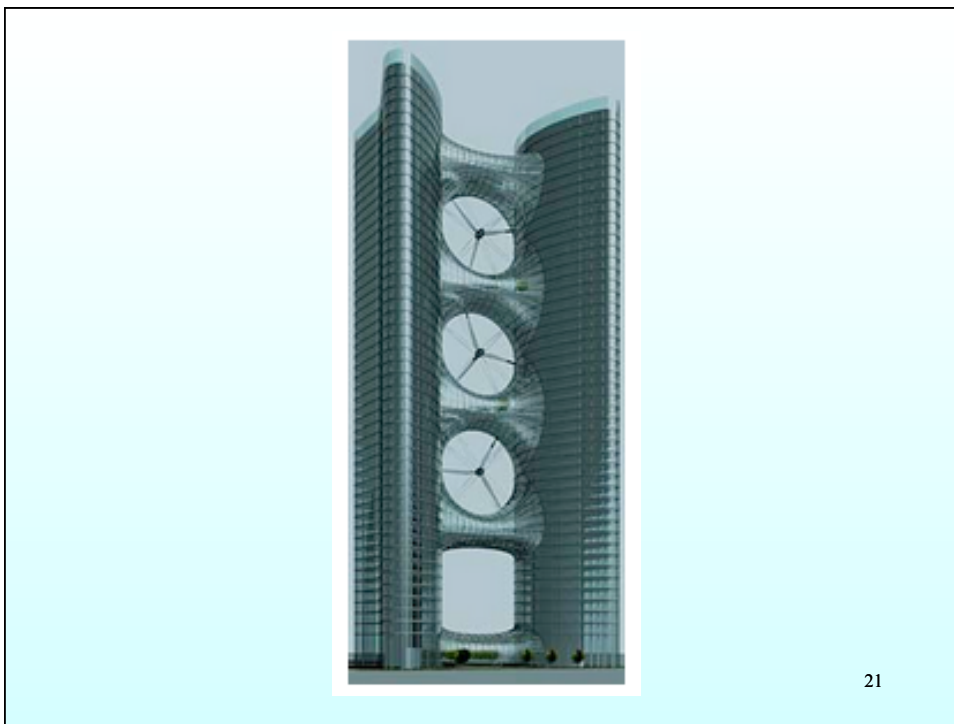
Bahrain world trade centre

19



**Bahrain World Trade Centre 240 m high
3 x 29m diam. 225kW each**

20

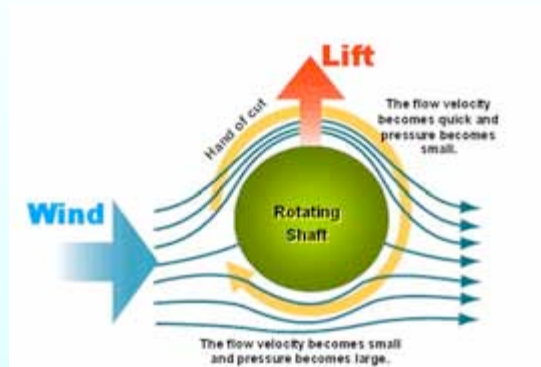


21



Building Concept - Dubai

22



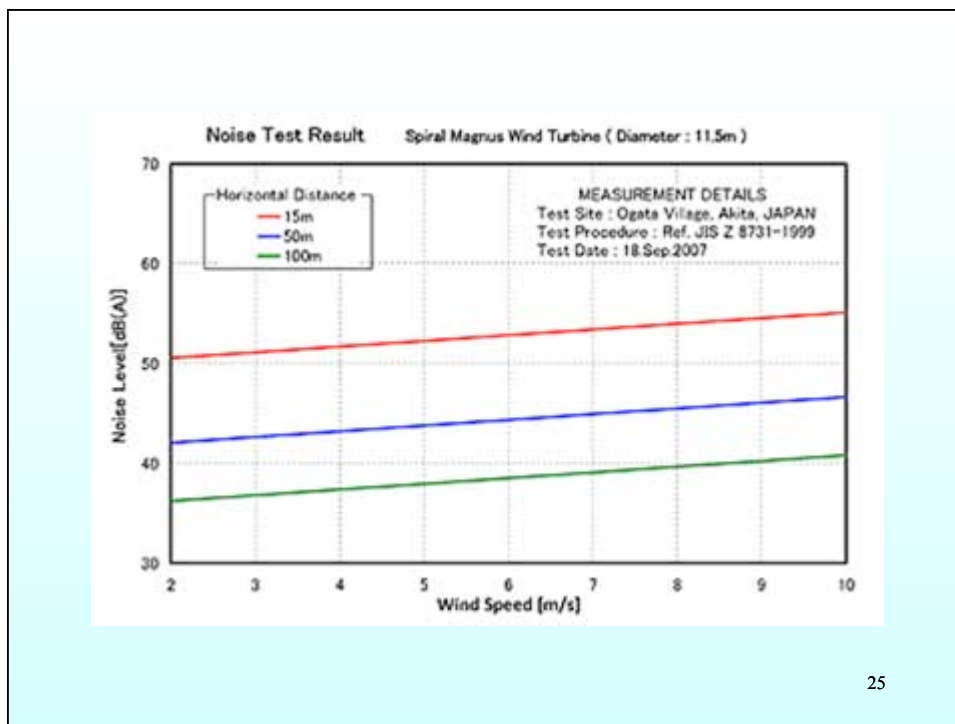
Magnus effect

23

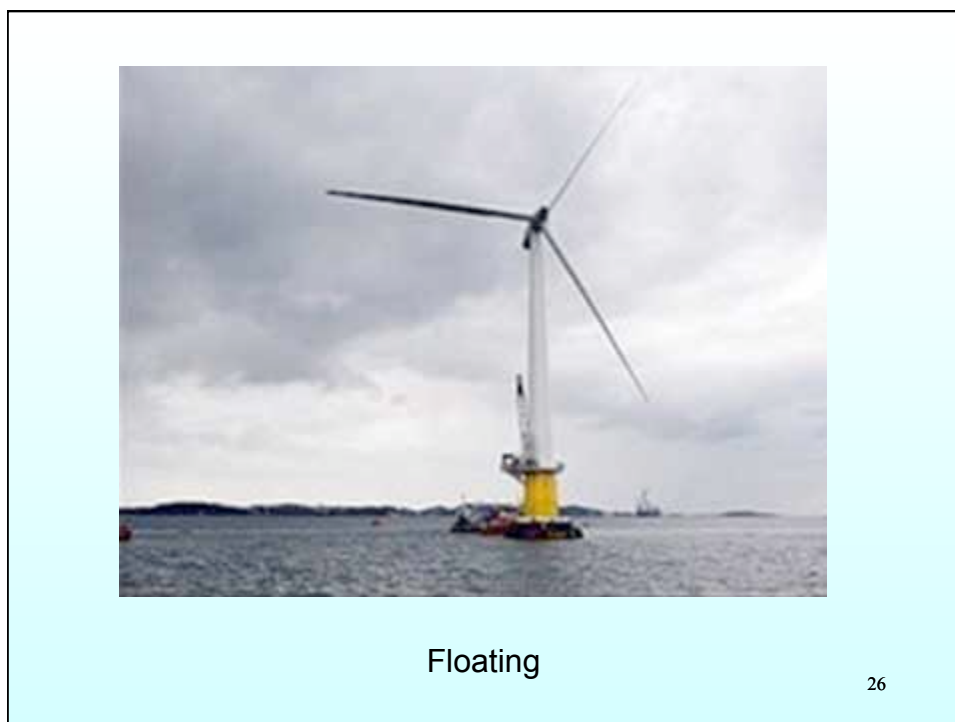


**Spiral Magnus - 11.5m diam.
Several KW www.mecaro.jp**

24



25



Floating

26



Statoil Floating Turbine

100m immersed below surface

Anchored three points

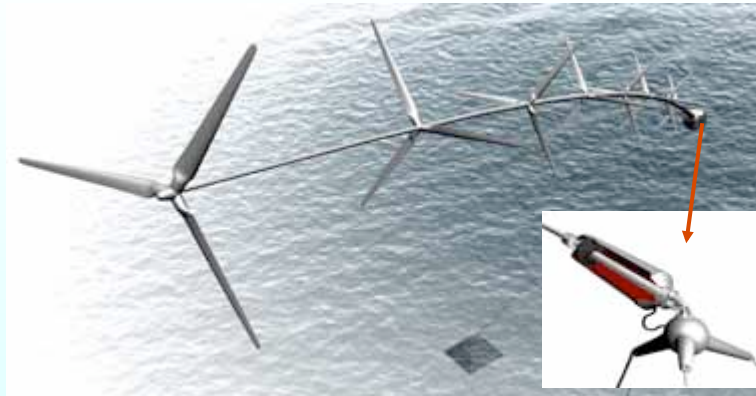
Install in 100m to 700m depth

27



Blue H Group. Floating turbine - Italy

28



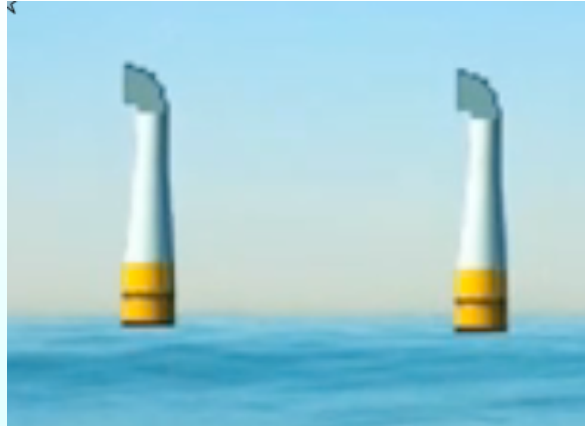
Selsam Deep Water - Floating multiple turbine

29



Vertax Wind Turbine
up to 10MW 15,000 m² swept area
www.vertaxwind.com

30



Wind scoop. KE converted to PE at base

31



Typical modern wind turbines

32

Energy in the Wind

$$\text{Rotor power } P = \frac{1}{2} \rho A U^3 4a(1-a)^2$$

Power coefficient

$$= \text{rotor power/wind power} = P / \frac{1}{2} \rho A U^3$$

$$= 4a(1-a)^2 \quad \text{Max value 0.59}$$

ρ = density of air

A = area of sweep

U = wind velocity

a = fractional change in velocity

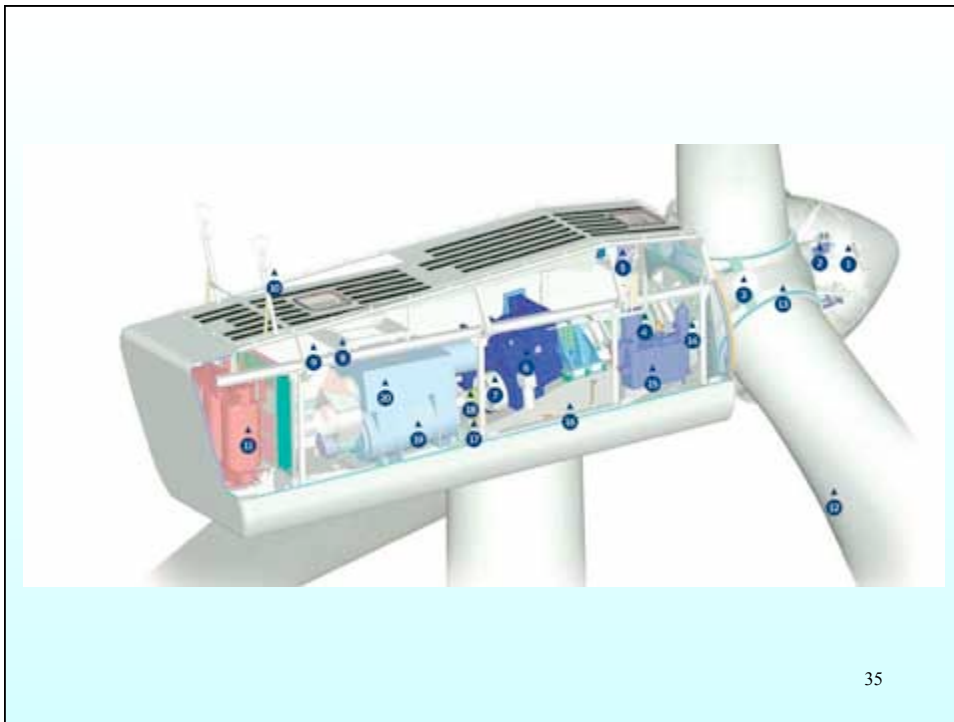
33

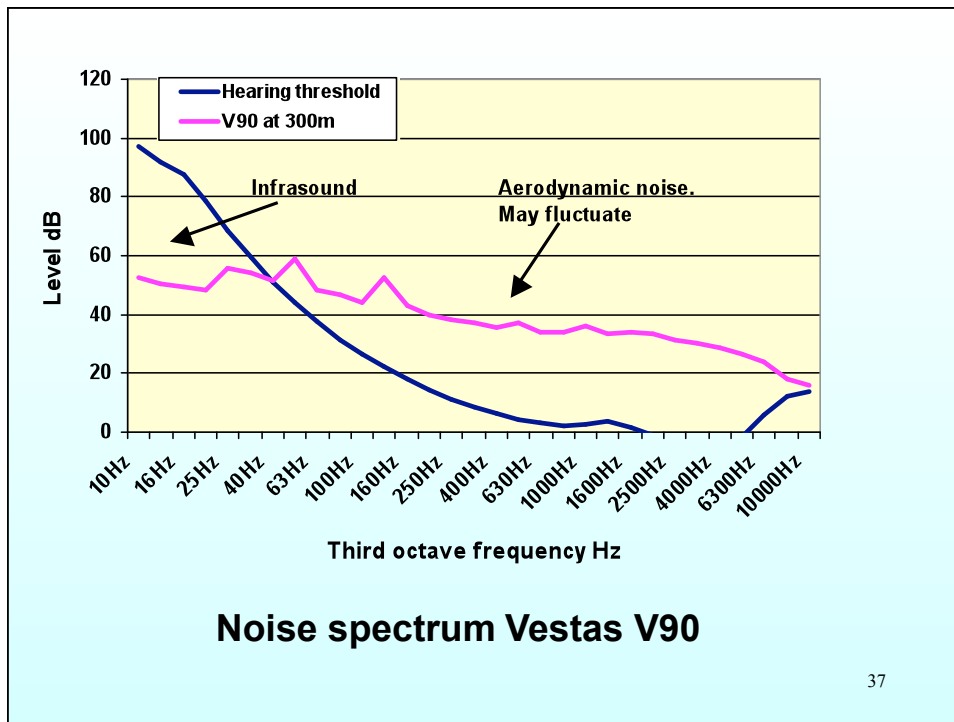
Vestas V90

Hub height	107m
Rotor diameter	90m
Rotor centre to tower axis	5m
Rated electrical power	3MW
Sound power level	105 dBA
Weight	379 tonnes

Sound power 120dB = 1W, 110dB = 0.1W, 100dBA = 0.01W
 Sound pressure = Sound power - 20logr - 11 + XYZ

34





37

The things they say about....INFRASOUND

- **Vibroacoustic Disease**
- **Wind Turbine Syndrome**
- **No appreciation of magnitudes**
- **Safe and unsafe doses**
- **Attitude to a noise is an important factor in response**

38

The infrasound fallacy

Infrasound is inaudible X

Infrasound can be felt by the body ✓

**Therefore inaudible infrasound is
affecting the body X**

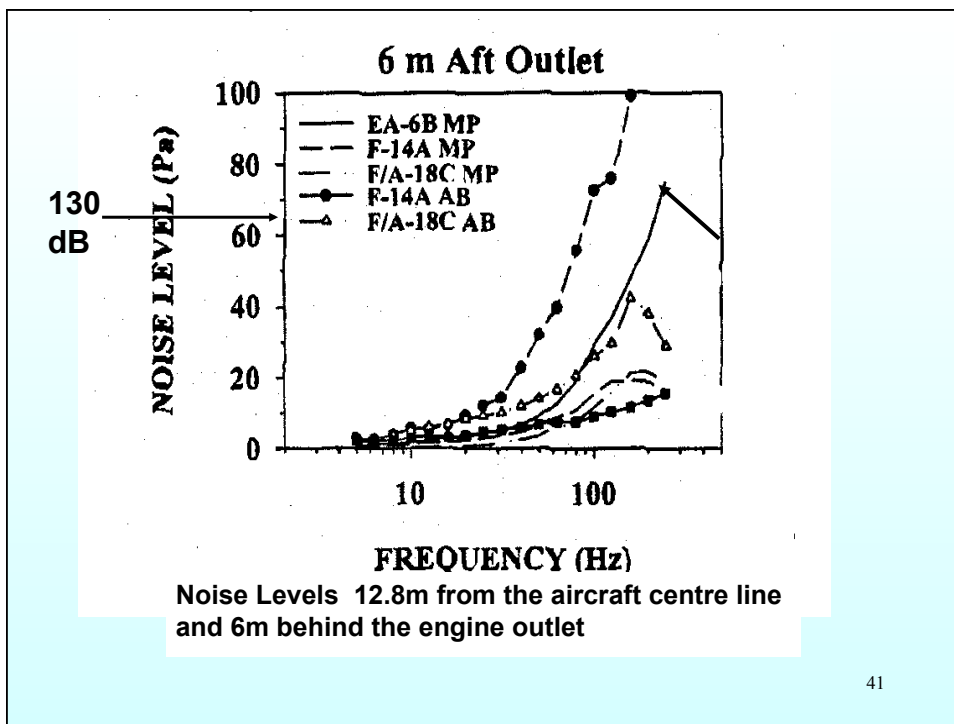
**Infrasound is clearly audible before it
affects the body**

39

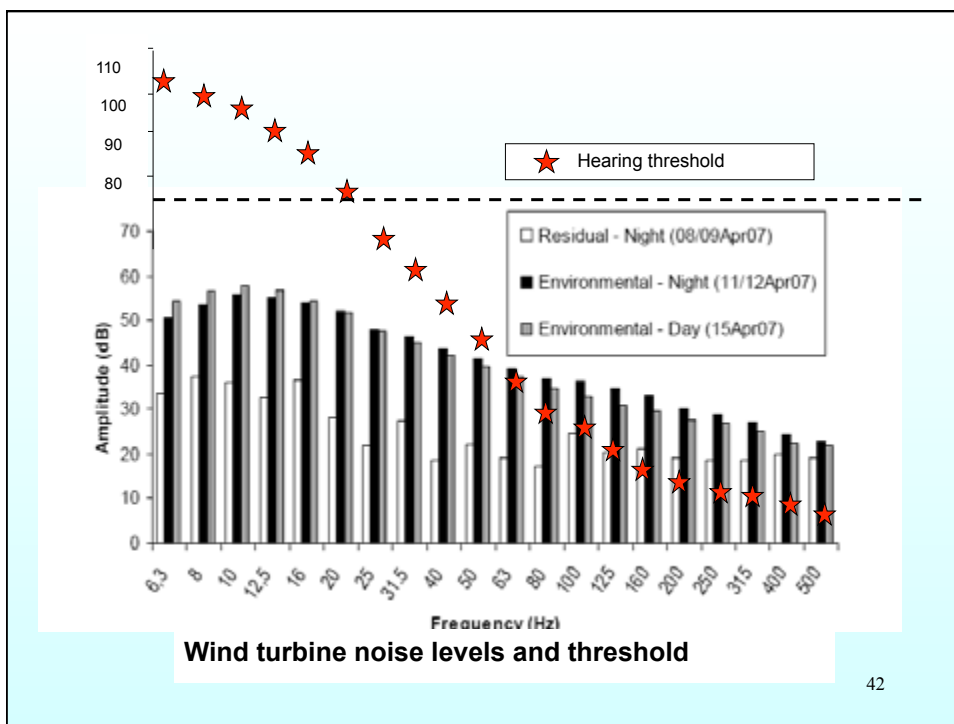
Vibroacoustics Disease

**Initially described for aircraft
technicians**

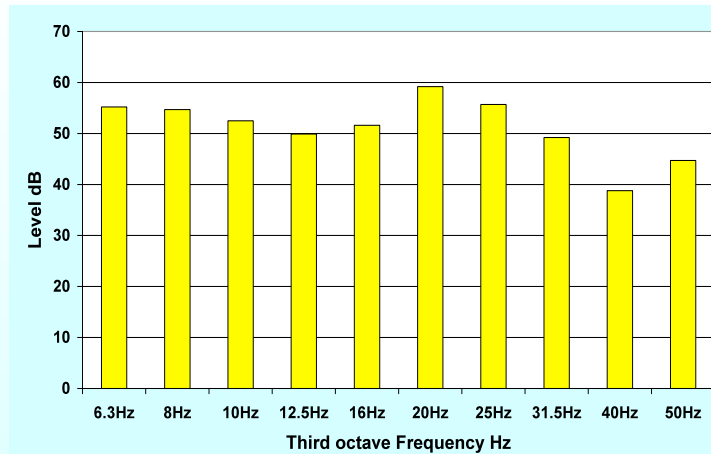
40



41



42



Infrasound and low frequency noise in a quiet suburban indoor location on a still day.

43

Pressure Magnitudes

1 atmosphere = 100,000 Pa

94dB SPL = 1Pa

54dB = 0.01 Pa

54dB = 10^{-7} atmosphere

1 Atmos = 10m water = 10,000mm water

54dB = 10,000 / (10,000,000) mm of water

= 0.001mm water (Skin ~ 1mm)

44

Wind Turbine Syndrome

Effects of Infrasound on the vestibular and other balance organs **X**

Symptoms same as those of noise annoyance. Psychological, not physiological **✓**

45

WTSyndrome

sleep disturbance, headache, tinnitus, ear pressure, dizziness, vertigo, nausea, visual blurring, tachycardia, irritability, problems with concentration and memory, and panic episodes associated with sensations of internal pulsation or quivering which arise while awake or asleep”

Noise annoyance

insomnia; headache; pressure in the ears or head;

Dizziness; nausea;

eye strain; fatigue; distraction;

nose bleeds;

feeling vibration; muscle spasms;

palpitations; skin burning; stress; tension etc

46

THE FUTURE - 2030

**November 2009 issue Scientific American.
Article on energy needs***

Water 1.1TW 9% < 1% in place

**Wind 5.8TW 51% 3.8million 5MW
turbines**

**Solar 4.6TW 40% 1,700,000,000 ~3kW
rooftop systems plus large systems**

*** A path to sustainable energy. Jacobsen and Delucchi**

47

The things they say about....INFRASOUND****

Why the crew abandoned the Marie Celeste

The mystery was unsolved for decades, until it became clear that infrasound was the explanation of the phenomenon. As it turned out, infrasound of seven hertz emitted by ocean waves under some definite conditions was the reason of it. But infrasound of seven hertz is terrible for people: they may go mad and throw themselves overboard to save their lives.

<http://ghosts.monstrous.com/infrasound.htm>

48