Intelligent Energy Europe

Small wind turbine technologies

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Presentation Plan

- Introduction to small wind turbines
- Applications of small wind turbines
- Turbine systems, manufacturers and specifications
- 5 tips when choosing urban wind sites
- Wind Energy in the Urban Environment – The WINEUR project

Small wind turbines

- Small?
- Anything from 0.5 kW to 50 kW
- Many shapes and sizes (unlike large wind turbines)
- First developed for yacht applications but now used for a variety of purposes....

Applications

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Wind Energy for remote areas

- Off-grid electricity for remote areas
- Wind-diesel systems
- Wind-PV systems
- Weather stations
- Oil rigs

Wind Energy on Yachts

- Very small turbines for yacht applications
  - Battery charging
  - Light
  - Radio
  - TV
  - ...even computers!

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Wind Energy on Buildings

- Two main options:
  - 1. Small wind turbines mounted on top of buildings

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Wind Energy on Buildings

- Or…
  - 2. Fully building integrated wind energy systems

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Wind Energy on Buildings

- New area for wind energy
- Issues to consider:
  - Turbulence
  - Wind speeds affected by buildings
  - Vibration
  - Flicker
  - Noise
  - Planning Issues
- So what are the technologies available?

Technologies

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Small Wind Turbines

- Horizontal

- Vertical

- In between?

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Types - Horizontal

- Advantages
  - Efficient
  - Proven to work
  - Widely used – many examples
  - Most economic – produces more energy
  - Many products available – UK and abroad
- Disadvantages
  - Does not cope well with frequently changing wind direction
  - Some say visually unappealing
  - More noise

Types – Vertical

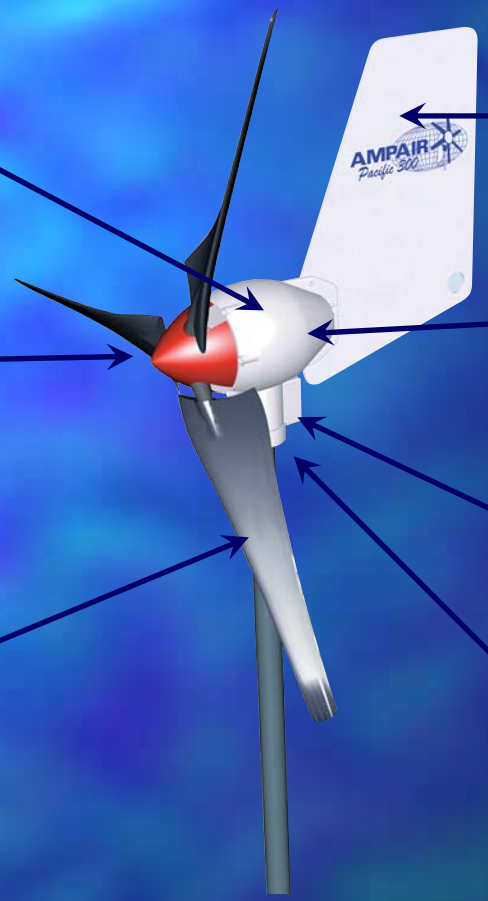
- Advantages
  - Less noise
  - Wind direction immaterial
  - Less sensitive to turbulent flows
  - Creates fewer vibrations
  - Some say easier to integrate into building architecture
- Disadvantages
  - Comparatively uneconomic – produces less energy
  - Fewer models available
  - Fewer working examples

Turbine components

Alternator *(brushless, rare earth magnets, good startup & high efficiency)*

Furling hub *(furls into wind even in turbulence, rapid passive over speed control, continuous power)*

Three bladed *(advanced aerofoil, rigid & low speed for low noise and long term reliability)*



Large tail *(quick response in urban turbulence)*

Alternator housing *(sealed, non-corrosive, compact, light)*

Brush gear housing *(ocean proven)*

Pivot assembly *(ocean proven, on balance point)*

Colour scheme to suit *(white+red; grey; black; blue; green)*

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System configuration

	0.6 kW	2 kW
Wind turbine	£1000	£4000
Mast or wall bracket	£300	£500
Grid tie inverter	£500	£1000
Other electrical	£500	£1000
Installation	£3000	£3000
	£5300	£9500

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Manufacturers

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Manufacturers - UK

- Over 10 UK manufacturers
- Over 15 products already on the market
  - Eclectic Energy 0.4kW
  - Windsave 1kW
  - Swift (Renewable Devices) 1.5 kW
  - Proven 0.6, 2.5, 6, 15 kW
  - Iskra 5kW
  - Gazelle 20kW
  - XCO2 6kW
  - Sigen 1kW
  - Ampair 0.6 kW
  - Marlec 0.3 kW
- At least 4 prototypes under development

Marlec

- 6 blades
- Up to 0.34 kW
- Variable diameter
- 15 years

Eclectic Energy

- 5 blades
- 0.4 kW
- 1.1 m diameter
- Lifetime 20 years

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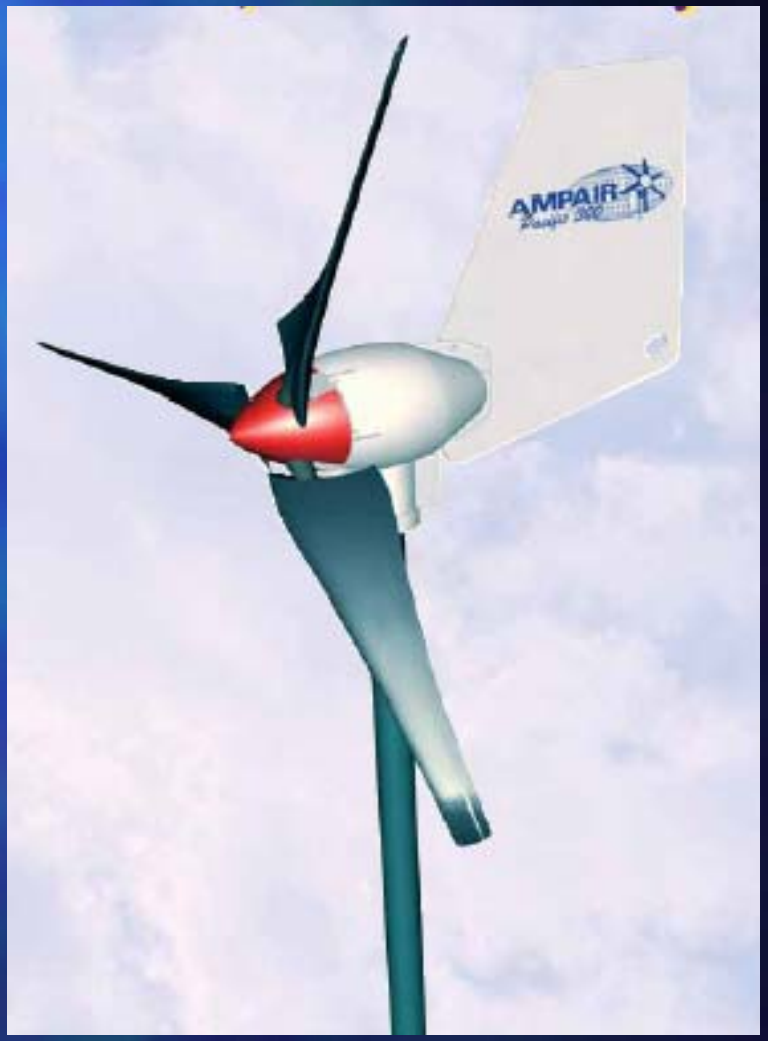
Ampair

- 3 blades
- 0.3, 0.6 kW
- Variable diameter
- 10 years



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Windsave

- 3 blades
- 1 kW
- 1.75 m diameter
- 10 years

Power

Sigen

- 3 blades
- 1 kW

Power

Swift

- 5 blades
- 1.5 kW
- 2m diameter
- 20 years

Photo: Berwickshire Housing Association

Power

Iskra

- 3 blades
- 5 kW
- 5.4 m diameter
- 20 years

Power

XCO2

- 5 m high x 3.1 m
- 6 kW
- 20 years

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Proven

- 3 blades
- 0.6, 2.5, 6, 15 kW
- Various diameters
- 20 – 25 years

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Gazelle

- 3 blades
- 20 kW
- 11 m diameter
- 20 to 25 years

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Manufacturers - Europe

- Over 20 manufacturers based in Europe (8 in the Netherlands)
- Over 40 products to choose from
  - Ecofys 3kW
  - Eoltec 6kW
  - Fortis 0.8, 1.4, 5.6, 10 kW
  - OY Windside 1, 8 kW
  - Ropatec 0.75, 3, 6 kW
  - Turby 2.5 kW
  - Venturi 0.5 kW
  - Windwall 2.9 kW
  - Mechatron 1 kW
- Some have been around for longer than others

Ecofys

- Neoga 3 kW
- 2.8 m rotor diameter
- 4 m high
- 20 year lifetime
- Dutch

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Eoltec

- 6 to 250 kW
- 25 year lifetime
- 2 blades
- 25 year lifetime
- French

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Fortis

- 5.6 kW
- 5 m rotor diameter
- 12 - 24 m height
- 200W to 30kW
- Manufacturing for over 20 years
- Dutch

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OY Windside

- From 100 W to 1 kW
- Inefficient
- But easier to integrate into buildings?
- Examples:
  - Ecohouse Nottingham University
  - Canal boat in Amsterdam
- Finnish

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Ropatec

- 0.75 to 6 kW
- 3.3 m diameter
- 2.2 m high
- 15 – 20 years
- Italian

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Turby

- Relatively new turbine
- 2.5 kW
- 2 m diameter
- 3 m high
- 20 year lifetime
- On market for 2 years
- Dutch

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Venturi

- 0.5 kW
- 1.1 m diameter
- 15 year lifetime
- Dutch

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Windwall

- Modular design
- 2.9 kW per module
- Example: on top of office building in suburbs of Amsterdam
- Dutch

Windwall - video

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Wind turbine specifications – what do they all mean?

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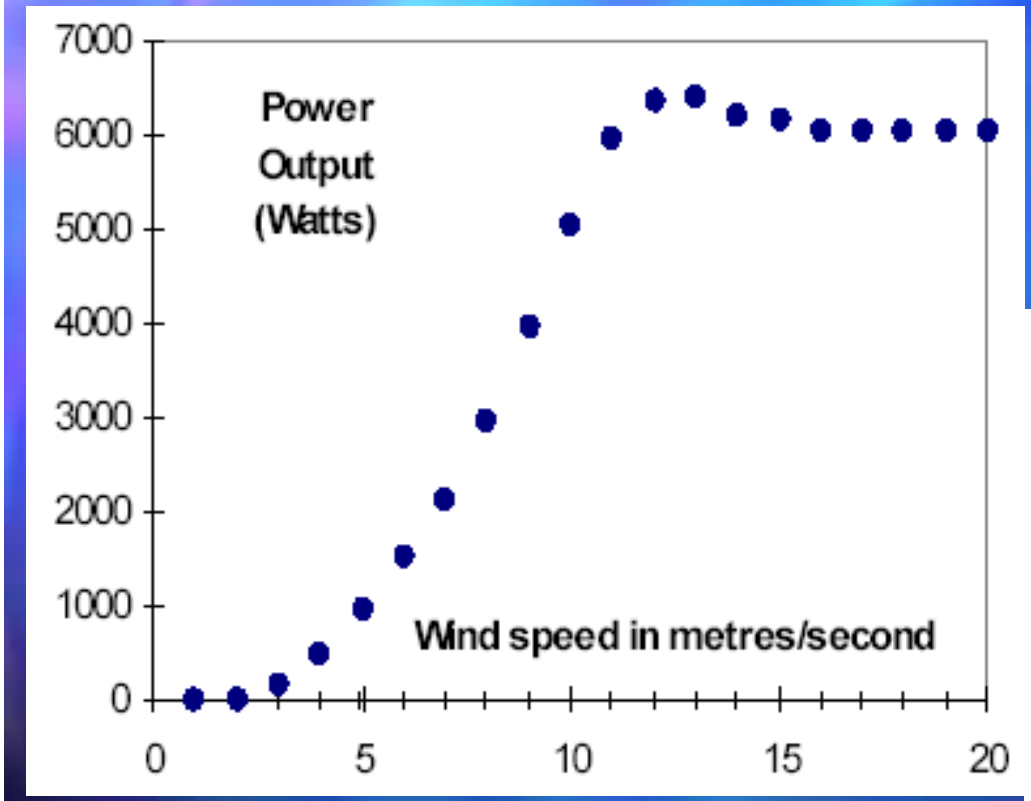
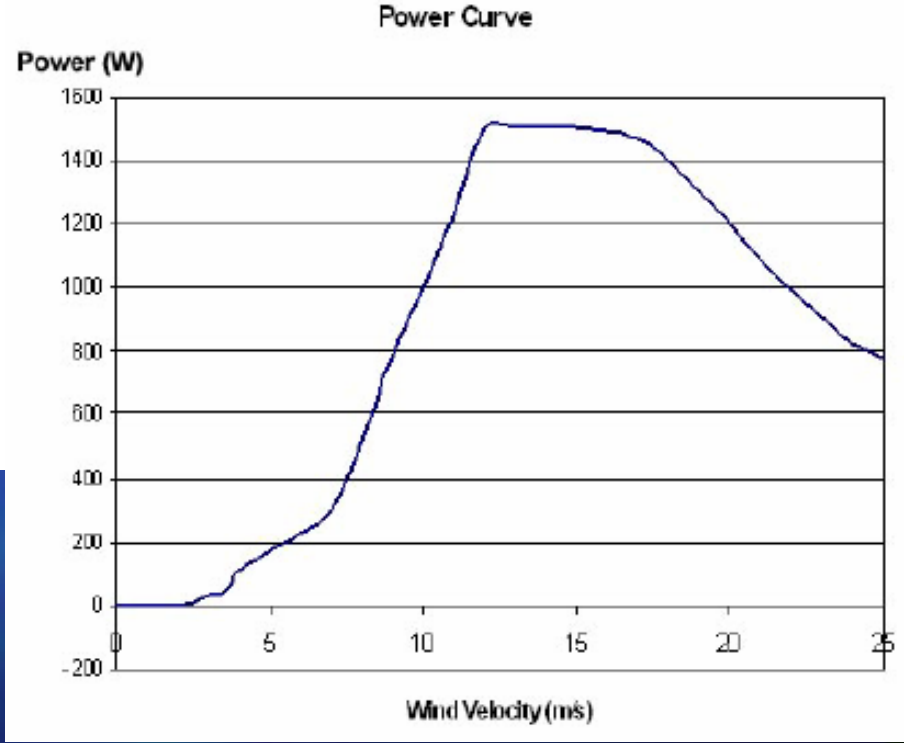
Power and energy production

- Rated power: maximum power output occuring at the rated wind speed
- Rated wind speed:
  - not the same for all turbines
  - Check when comparing rated power
- Cut-in wind speed: the lower the better
- Cut-out wind speed:
  - the higher the better
  - Some turbines do not cut out
- Power curves: impact on energy production

Power curves



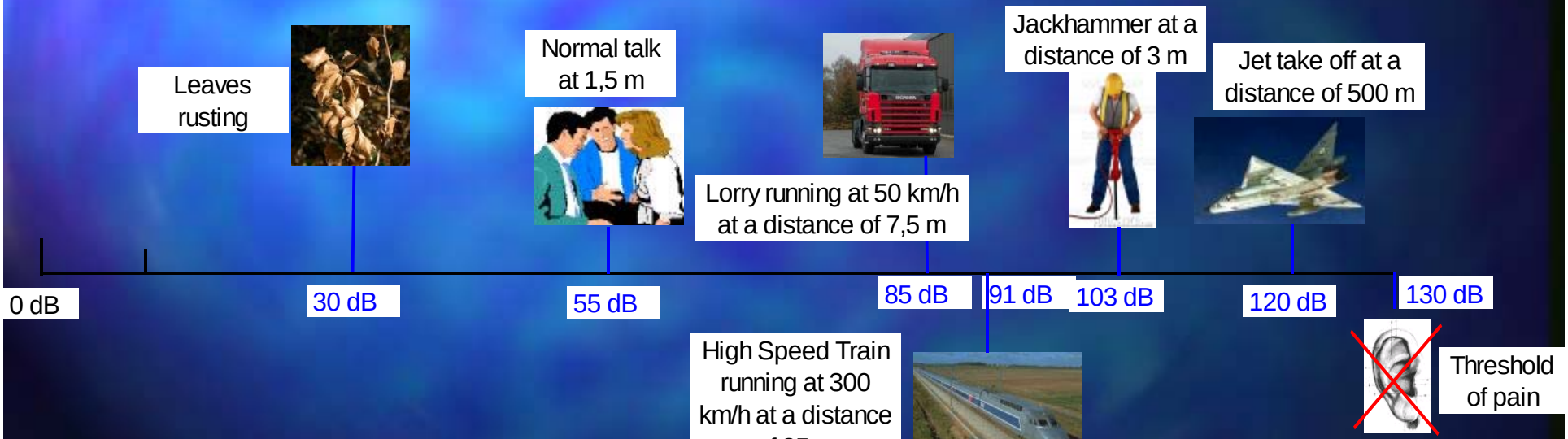


Dimensions

- Rotor diameter and swept area:
  - relates to energy production
  - larger swept area means more energy
- Rotor weight
- Rotor height
- Height of mast
  - Higher could mean better wind speeds

Other information

- Noise levels:
  - testing still going on
  - Impact depends on background noise



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Other information

- Lifetime
  - Longer lifetime gives a better return on investment
- Self-starting: most small wind turbines are self-starting
- Upwind and downwind: direction that the turbine captures the wind
- Maintenance:
  - Some smaller models require no maintenance
  - Bigger urban turbines = 1 every year

Any questions?

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5 tips for urban wind sites

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Urban wind characteristics

- Small wind turbines require less wind and land resources than large turbines, so their installation is feasible in a wider variety of locations.
- However, small scale wind projects in urban areas do face some constraints:
  - Lower annual mean wind speed
  - Turbulence
  - Potential difficulties in obtaining planning permission

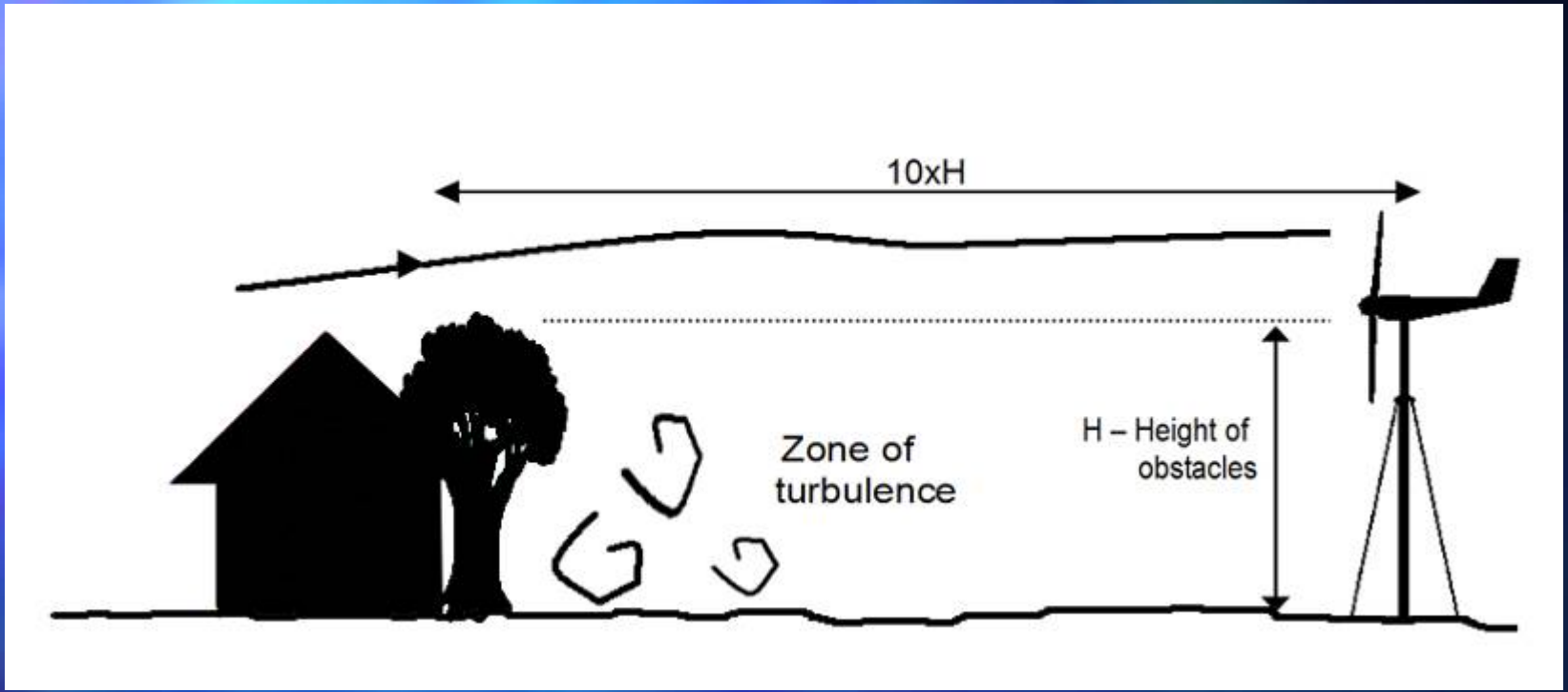
1. What is your objective?

- Good practice to consider all the aims and objectives of the project:
- Obvious objective = Generate electricity
- But there may be other significant objectives...
  - Promotion of electricity generation from renewables
  - Demonstration of support to sustainable energy
  - Use of the installation as an educational tool.
- For example, educational value could be maximised by placing the turbine near a school, environment centre or on a community landmark building.

2. Location

- Output is dependent on wind speed
- In addition to measuring or using the NOABL database, it is essential to know the direction of the prevailing wind
- Ideal positions are elevated positions with smooth approaches
- The wind speed increases significantly near the top of the hill and the air flow should be free from excessive turbulence.
- Existing nearby obstacles such as trees, houses or buildings can significantly affect wind speed
- Locate as far away from obstacles as possible
- Alternatively, the turbine height can be increased to compensate the lack of distance.

2. Location



Site clear of obstacles by at least 10 times the height of the obstruction (BWEA)

3. Point of connection to grid

- It is recommended that the wind turbine is located reasonably close to the point of energy use, or to an electricity connection.
- Otherwise the cost of underground cabling could prove prohibitive to carrying out the installation.
- This is an advantage of domestic installations

4. Noise and visual impact

- Particularly sensitive issues in a residential area
- Both these issues can be subjective and therefore are often difficult to judge
- Guidelines are still being worked out

4. Noise and visual impact

- Noise:
  - Try to minimise contribution to noise levels above the normal noise level for a site
  - ETSU R97: turbine noise level should be kept to within 5dB(A) of the average existing evening or night-time background noise level
  - A fixed lower value for these limits of between 35 and 40db (A) is also specified when background noise level is very low
  - This means that it is advisable to maximize the distance from housing as far as is possible

4. Noise and visual impact

- Visual impact:
  - Highly subjective issue. However, the visual aspects as perceived (either positively or negatively) by the community should ideally be assessed at an early stage in the project
  - Consider early community consultation and awareness raising
  - In some cases a study on shadow-flicker from the turbines should be carried out

5. Monitoring

- Consider carrying out wind resource assessment prior to installation
  - this can be costly and cause time delays
- Consider monitoring the power and energy production of an urban installation
  - could cost as little as £800 extra
  - reliable data improves educational value of installation
  - Provides information for future installations
- There is not enough monitoring of small wind!

Wind Energy Integration in the Urban Environment

The WINEUR project

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WINEUR Partners

- Intelligent Energy Europe – ALTENER project
- European partners:
  - Axenne and ADEME (France)
  - IT Power (UK)
  - Horisun and City of Amsterdam (The Netherlands)
- Windy cities network
  - Government Office
  - EST
  - Yorkshire Forward
  - Sunrise

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WINEUR project

- Start: January 2005
- Finish February 2007

- What?
  - Technical and economic information on small wind turbines
  - Investigation of planning and social issues
  - Workshops for local authorities
  - Creation of a national Windy Cities network
  - Creation of a European Windy Cities network

WINEUR results so far

- Wind Energy brief profiles: Europe and worldwide
- Catalogue of European Urban Wind Turbine Manufacturers
- Catalogue Guide
- Techno-Economic report
- Grid connection report
- Report on planning and legal aspects

Website: www.urbanwind.org

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UK vs Europe

- Many problems the same but...the UK has some advantages:

- More manufacturers
- More installations
- Favourable micro-generation policies (even if not wind specific)
- Local authorities taking the lead

Thank you for your attention!

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