CONFERENCE about opportunities for small wind turbines in urban areas: Recommendations for the SWIP Project
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IEA Task 27: Responding to challenges for small wind uptake

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OA IEAWIND Task 27

Content

Reasons to use small wind

Small Wind Challenges

Low rise buildings?

Medium size wind turbines in urban environment?

High rise buildings?

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Reasons to use small wind

- The demand for electricity in urban areas will grow rapidly. (urbanization movement, electrical heating and cooling, electrical vehicles, etc.).
- Buildings consume approximately 40% of the total energy consumption.
- Trends are going to low carbon/carbon neutral buildings.
- Interest in renewable energy generation in urban areas is growing and small wind power could one possible solution.
- ……but there are still large uncertainties in expected output of wind energy in urban areas.

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Small Wind Challenges

- Small wind requires cost reduction.
- Safe and liable design. Guaranties.
- Cost competitive wind resource assessment procedures.
- Simplicity and reduced O&M cost.
- Silent operation is mandatory .
- Energy efficiency.
- Feasibility.
- New applications: High turbulent sites -> Urban and peri-urban sites. Difficulty in accurately predicting small wind turbine production due to the impact of the site turbulence.
- Current policies, in special regarding permitting, are in general obstructional.
- Social aspects: building owner, tenants, neighbors, visual effects

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Small wind cost reduction

- Turbines design simplification.
  - HAWT vs VAWT.
  - HAWT Upwind vs downwind turbines.
  - Pitch vs stall regulated
  - Self-erected or fix towers.
- Mass production (strongly dependent on the development markets and/or support schemes).
- Increase of the accuracy of wind assessment procedures.
- Standarisation of components (generator, power converter)
- Refinement of the already existing standards for small wind.

HAWT

Upwind **or** Downwind

VAWT

Giromill **or** Helical

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Small wind safe and liable design

- Design must be adapted to site conditions. (Classes adaptation)
- Design must be verified by modelling and testing. Customer label based on test could be useful
- Need for small wind turbine power curves tested according to adequate standard procedures.
- Improvement of existing standards. Measurements at low turbulence sites so no guarantees for urban performance.
- Installation site may be need to be a compromise.

Cost competitive wind resource assessment

- Wind resource is absolutely site specific.
- Development of cost competitive procedures for wind resource assessment.
- At least 3 months measurements wind speed & wind direction are required but measurement is difficult. Cup anemometers don't respond well to high turbulence, non-horizontal winds. Other options costly or experimental.
- Development of new tools including effect of turbulence produced by different shape obstacles.

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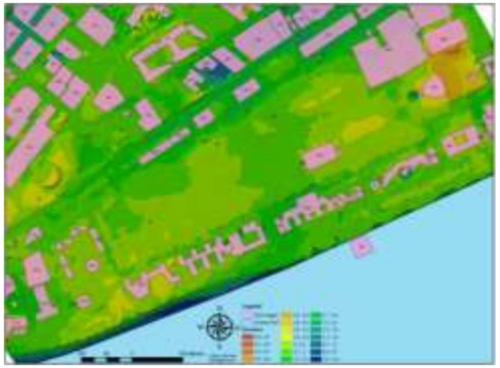
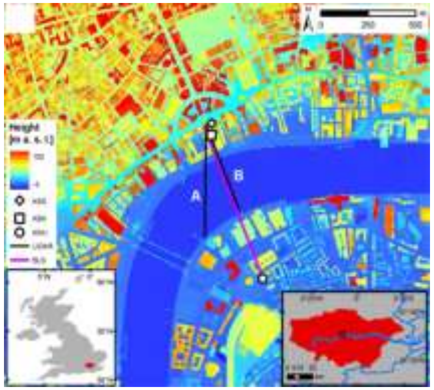
Wind resource assessment in built environment

- The built environment has big effect on performance.
- Great care should be taken in selecting suitable sites for building-mounted turbines.
- Wind atlas available not ideal for urban wind resource assessment.
- There are still developed few "Wind City maps"
- Identification of the flat roofs with favorable environment
- Definition of a 'sensitive perimeter' depending on the environment
- Checking the local planning rules/standards
- CDF calculations to locate the speed-up/down zones and obstacle correction coefficients
- Procedure to downscale accurately the local wind atlas. Commercial tools generally overestimate wind resource in high turbulent areas.
- Predict power production for different locations on the building before to select site and height.
- **Identifying the proper location on the roof is critical**

Barcelona Wind City map



MIT Boston (US)



London (UK)

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Simplicity and reduced O&M cost

- User does not want complex solutions.
- O&M costs must be reasonable. One visit/year should be enough.
- Turbulence has to be taken into account for reliable designs (Fatigue, life time).
- Existing standards uses I_{15} = 0.18 for design.
- I_{15} or I_5 or TKI ?

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Silent operation

- Acoustic noise emissions and vibrations must be reduced.
- New low noise blade designs.
- Direct drive designs or gear?
- Furling regulation must be avoided.

Energy efficiency

- Adequate turbine siting procedure.
  - Yields in urban areas likely to be low –careful site selection required
- Reasonable wind turbine yield with moderate wind resources.
  - Small wind turbine power performance
- Energy yield measurements as a “kind of certification”
- Energy balance: electricity generation versus demand (energy saving strategy -> self consumption).

New applications: High turbulent sites

- Wind speed-up effect seen above isolated house reduced when house in an urban area
- Flatter roof buildings tend to give greater wind speed-up than pitched roof
- Siting on house critical –must be above roofline.
- Onsite measurement campaigns urgently needed to validate predictions
- Analyze impact of turbulence levels on turbines
- Building integration: load, force, vibrations, contact sound,
- Regulations, permitting, accessibility, …

Conclusions

- Sufficient wind resources exist in many urban areas for wind energy generation but each building had its own specific set of wind characteristics.
- Wind around buildings difficult to generalize: very sensitive to geometry and wind direction
- Adequate measurement is difficult.
- Power performance of standards wind turbines in high turbulent sites is lower than open sites.
- Some wind turbine designs can improve the performance
- "Users must look for good wind resources and good wind turbines". Best practices, case studies and RP are required

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Adequate wind resource assessment → Adequate Wind Turbine characterization → Optimal Wind turbine sitting

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Thank You for your attention

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