Lessons from a Small Wind Trial in Ireland

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Small Wind Conference, Stevens Point. June 17th 2015.

Thanks to SEAI - the Sustainable Energy Authority of Ireland. The work discussed was completed with Eddie Reynolds and Andrew Cowley, among others including DkIT and GMIT. Analysis is continuing in other institutes at present.

Background

- Until recently, not much data, especially about complex sites.
- Warwick Wind Trials (2006 – 2008)
- Delta/Zeeland Wind Trial (- 2009)
- ..?

More Data Needed!

For lots of reasons:

- Improving models (validation)
- Good (cheaper) information
- To to settle the matter (rigorously!) of the viability or otherwise of urban wind
- To ensure that wind turbines work when deployed - to make an evidence based case (or otherwise) for small wind.

Publicly Available Data ..!

Published data is what we need. Recently more online, e.g.

- Southwark's roof mounted Proven
- The Irish Small Wind Trial.

The Irish Small Wind Trials

A little over five years ago, SEAI decided to conduct a field trial of small wind turbines (and solar) ...

... it was designed to test the state of the art locally.

The Irish Small Wind Trials

- At the time approx. a 0.19 euro FIT managed by state utility - since lapsed and not reinstated.
- Longer term data collection was initially an afterthought!

Trial Summary

- 2010 – 2012
- 10 manufacturers + 1 that we added later
- Irish (2.5), French (1), Dutch (1), German (1), Canadian (1), UK (2.5), American ...
- ... + 1 Danish ...
- 16 useable sites ... + 1 added later.

Trial Summary

Breakdown by Rating ...

- ~ 2.5 kW (3)
- ~ 5 kW (9)
- ~ 10 kW (1)
- ~ 15 kW (2)
- ~ 50 kW (1)

- And, unofficially, 850 kW (1)

Trial Summary

Breakdown by Tower Height:

- 10 m (4, including the 3 smaller machines)
- 12 m (3)
- 15 m (7)
- 16 m (1)
- 30 m (1)

- And, unofficially, 60 m (1).

Trial Summary

- 2 years of data collection - 1 second and 1 minute averaged.
- Wind turbines + met. mast
- 16 original met and data installs removed in 2013 (end of trial, legal advice)
- Data currently available to academic researchers for analysis
- Hope is that it will be widely shared.

It wasn't an IEC test ...

- Cup anemometer x 1
- Wind vane
- Solar power (pv) panel for backup power
- Air temperature sensor
- Relative humidity sensor
- Barometric pressure sensor

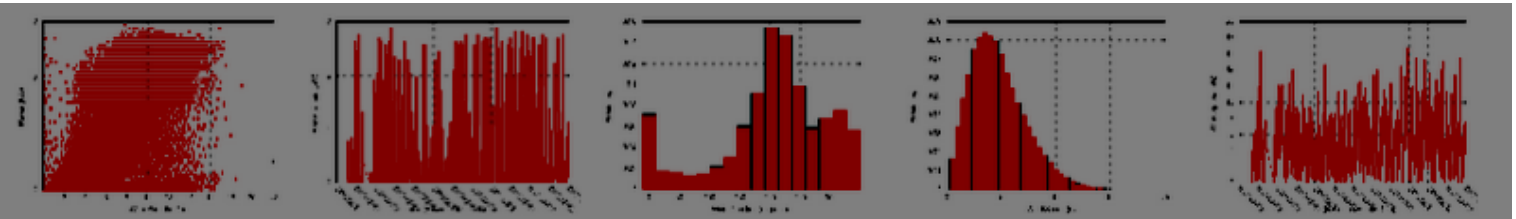
... but pretty good!

Analysis Work (1)

- Autumn 2012 ... assembled a crack team ...
- ... I hired two researchers immediately and set them to work ... we had three months ...
- The aim of the work was not only to complete an initial analysis; also to develop some code and skills.
- One explicit longer term aim was to produce a siting protocol by taking lessons from the data together with models.

Analysis Work (2)

- Python and VB ... using Python since 2002 ...
- Partly as a verification check, the two researchers worked together and coded similar routines in two different implementations.
- Two phases of work:
  - First a (relatively) simple first pass to examine and clean all the data
  - Then a second pass to look at a couple 0f interesting sites in more detail.



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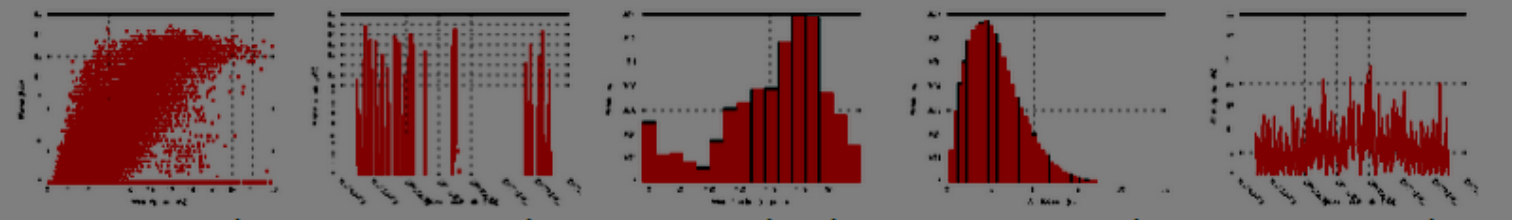

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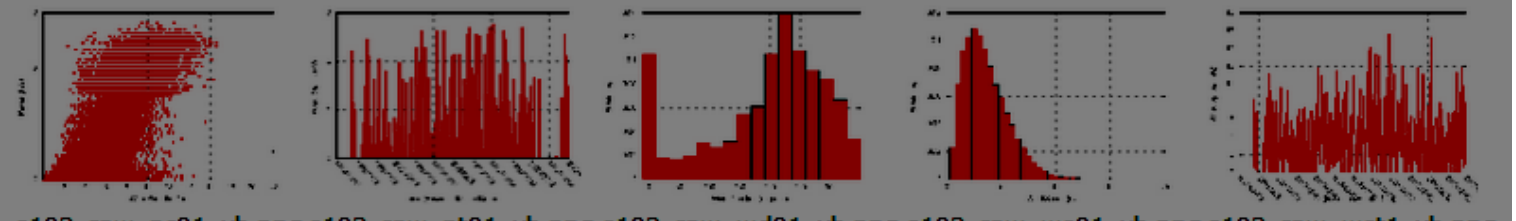

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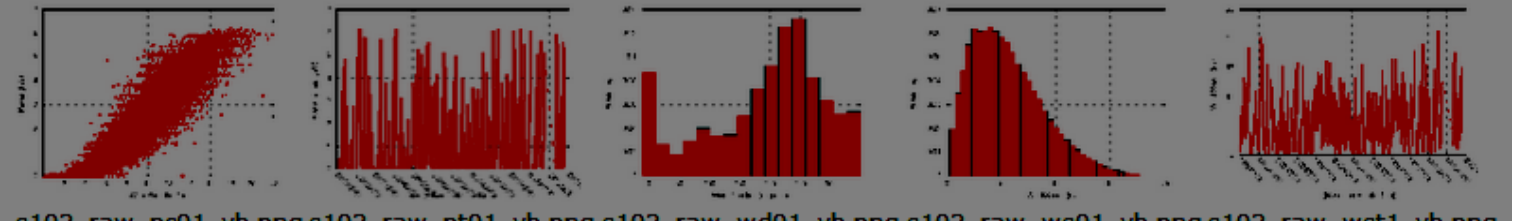

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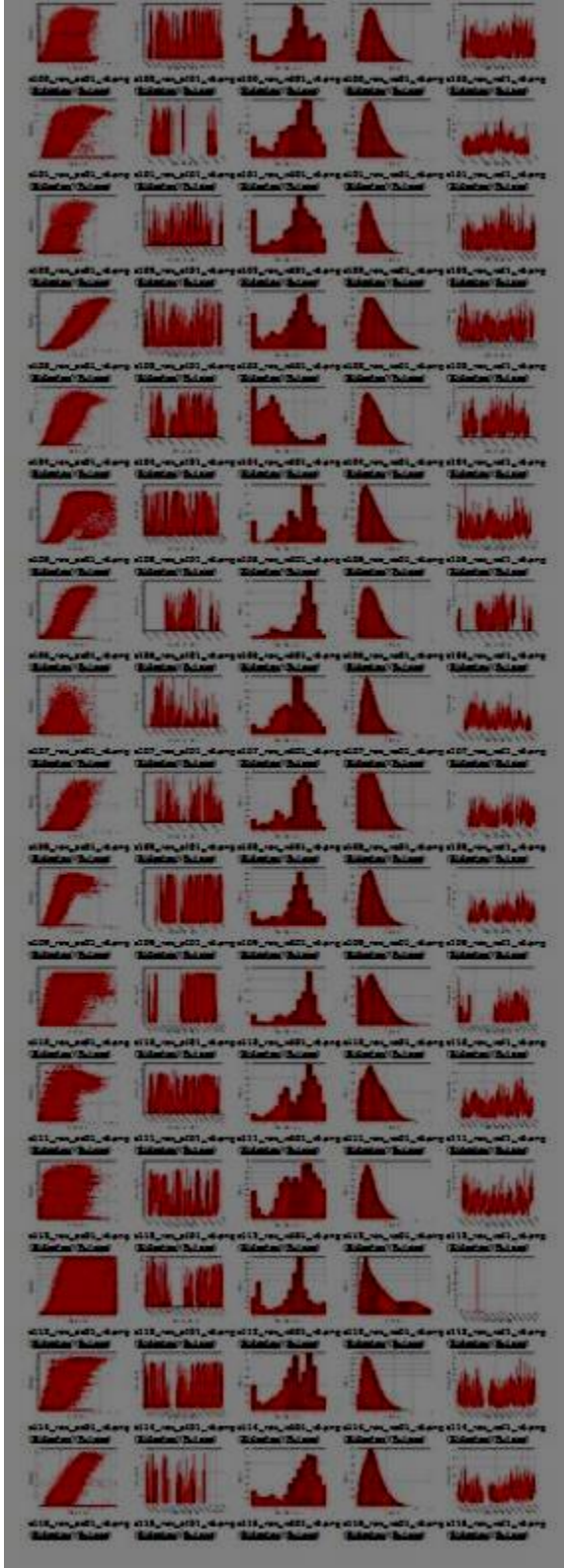


It wasn't easy ...

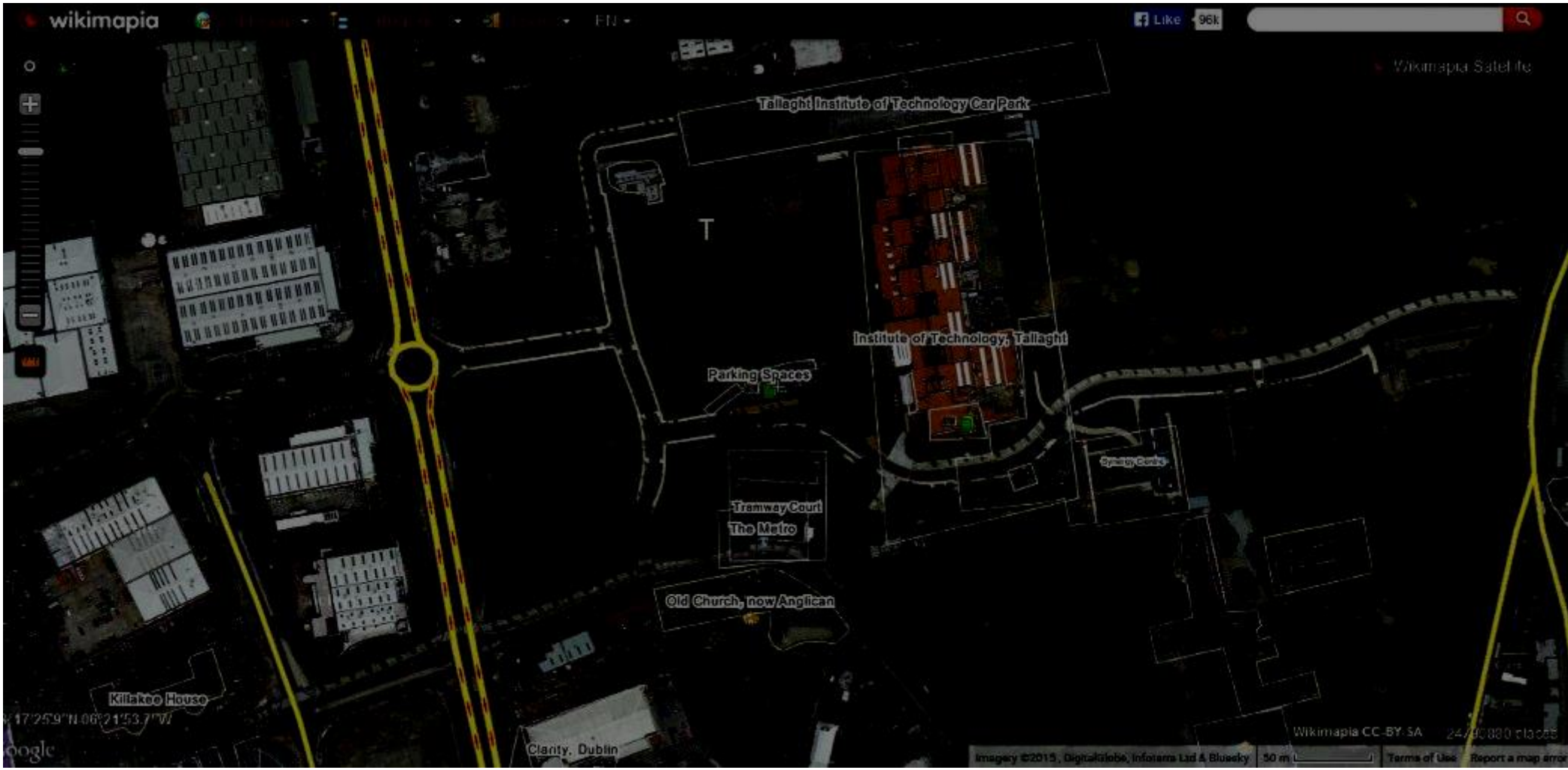
- There were some data quality issues – missing data values and occasionally inconsistent readings ...

- We were coding most of the routines for cleaning the data – some of this involved educated guesswork ...

Phase 2 ..!

- A (complex) rural site and an urban site
- Two 5 kW machines – urban in 15 m tower, rural on 10 m tower ...


Rural Site
Urban Site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Report a map error

Results ...

- We produced wind speed and wind direction tables (after NREL)
- Wind roses (local effects evident)
- Turbine power curves by sector (more or less as per wind maps with local effects)
- Turbulence intensity by wind direction and wind speed (urban 20% + in every direction, complex rural about 15%)
- Urban average wind speed pretty low, as you'd expect, rural complex better but not as good as

The Future ...

- We're still looking at the data and more researchers from around Ireland have taken an interest.
- Other analyses exist, including SEAI's own final report, and it'd be nice to pull these together into a coherent form.
- Producing siting protocols to validate models is a near-termaim, depending on resources over the coming months ...

The Future ...

- Wind Task 27 is an obvious home for some of the data and this work is already underway.
- We're attempting to pull together a distributed wind effort in Ireland – data is at the centre of this.

Lessons

It's not easy to run a small wind trial.

- Technical challenges: communications (easier now, only five years on), reliability and maintenance, data quality assurance, data analytics. You need a dedicated team.
- Other challenges: regulatory, planning, grid connect permission, legal considerations and so on.

If it was to be done again ...

- Temper ambitions with the possible practicality.

Interesting EU Projects

SWIP Project

NEW INNOVATIVE SOLUTIONS, COMPONENTS AND TOOLS
FOR THE INTEGRATION OF WIND ENERGY
IN URBAN AND PERI-URBAN AREAS

SWIP challenges and goals

The goal of the project is o develop and validate innovative solutions for small and medium size wind turbines to improve their competitiveness, enabling and facilitating the integration and deployment into urban and peri-urban areas. These solutions will address the current main barriers that delay the market uptake of this technology:

WIND PREDICTION

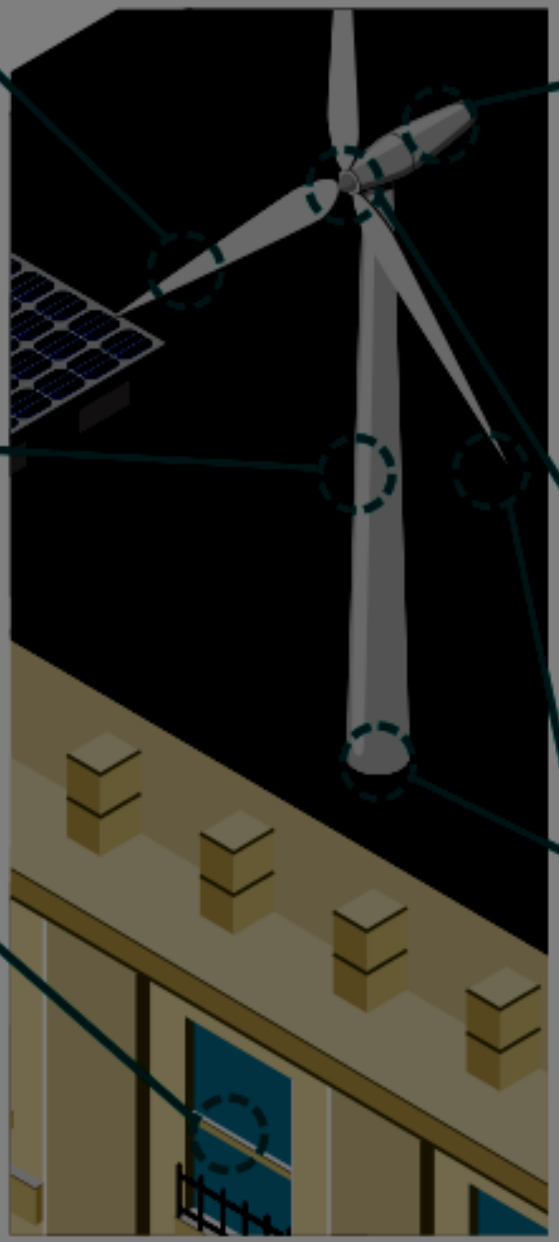
New methodology for wind resource assessment in urban and peri-urban areas, able to predict wind speed in urban location with a maximum 8% standard RMS error, without the need of performing a measuring campaign.

OPERATION

Implementation of a Supervisory Control And Data Acquisition (SCADA) system that will allow a better performance of the wind generator, through improved operation and maintenance. This system will be used for the control of the turbine, safety issues, operation mode selection and reliability improvement.

AESTHETIC ASPECT & SOCIAL ACCEPTANCE

Improved structure and anchorage elements of small and medium size wind turbines for their installation into districts and buildings. Development of best practices guidelines for the aesthetic integration of these systems into urban and peri-urban settings.



COST OF TECHNOLOGY & WIND MARKET

Design of an innovative and low cost wind generator (between 1 and 100 kW) which could be adapted to different types of wind turbines deployments depending on its final emplacement.

Two configurations of permanent magnet generator will be developed, one for direct drive connection and a second one for a gearbox connection.

POWER PERFORMANCE

Cutting-edge technology wind blades, which maximize the wind energy conversion in each type of final model, addressing small and medium size wind turbines and considering both vertical and horizontal axis.

NOISE & VIBRATIONS

New solutions to mitigate and absorb the noise and vibration produced by the wind turbine, according to the existing safety regulations regarding small wind turbine operation.

The new blades will also contribute to the objectives of reducing vibration and noise coming from those elements.

Coordinator

CIRCE
www.fcirce.es

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Solearth
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PROJECT BUDGET
6,5 m€

EU CONTRIBUTION
4,9 m€

DURATION
Oct 2013 – Jan. 2017

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This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement N.°: 608554

SWIP

www.swipproject.eu