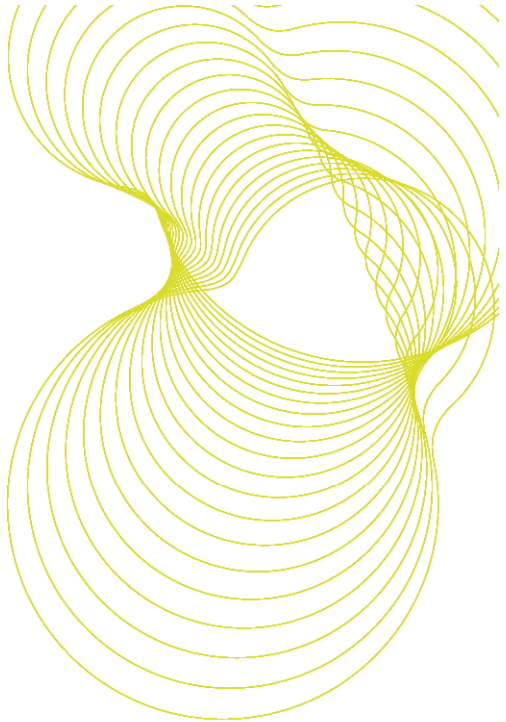


Making the case for small wind

Location & Siting are key !

Richard Phillips

BRE Global Limited.

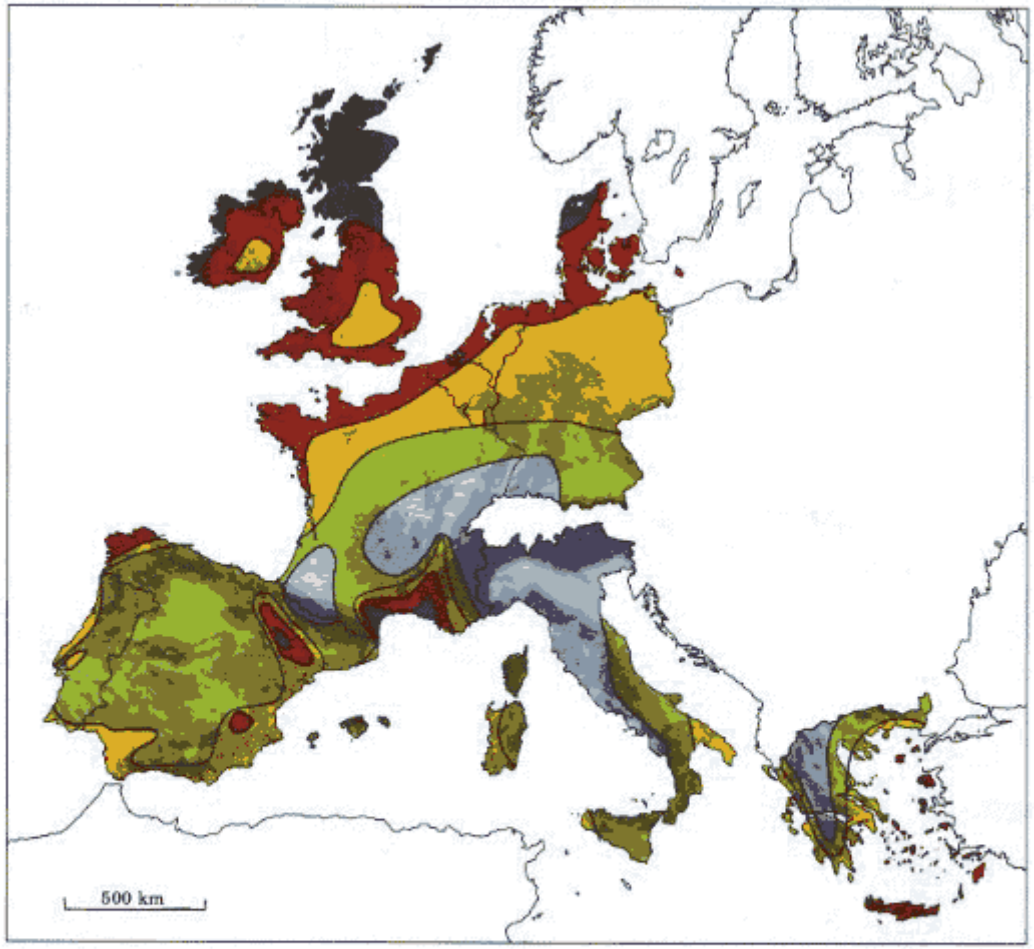
Ecobuild 5 March 2009

Drivers for Microgeneration Technologies such as Micro-wind turbines

- Energy Performance of Buildings Directive
- Government's 2016 zero carbon homes target
- Code for Sustainable Homes
- Merton Rule et al
- Low Carbon Building Programme grants

But will micro-wind deliver the carbon savings ?

UK Wind Resource



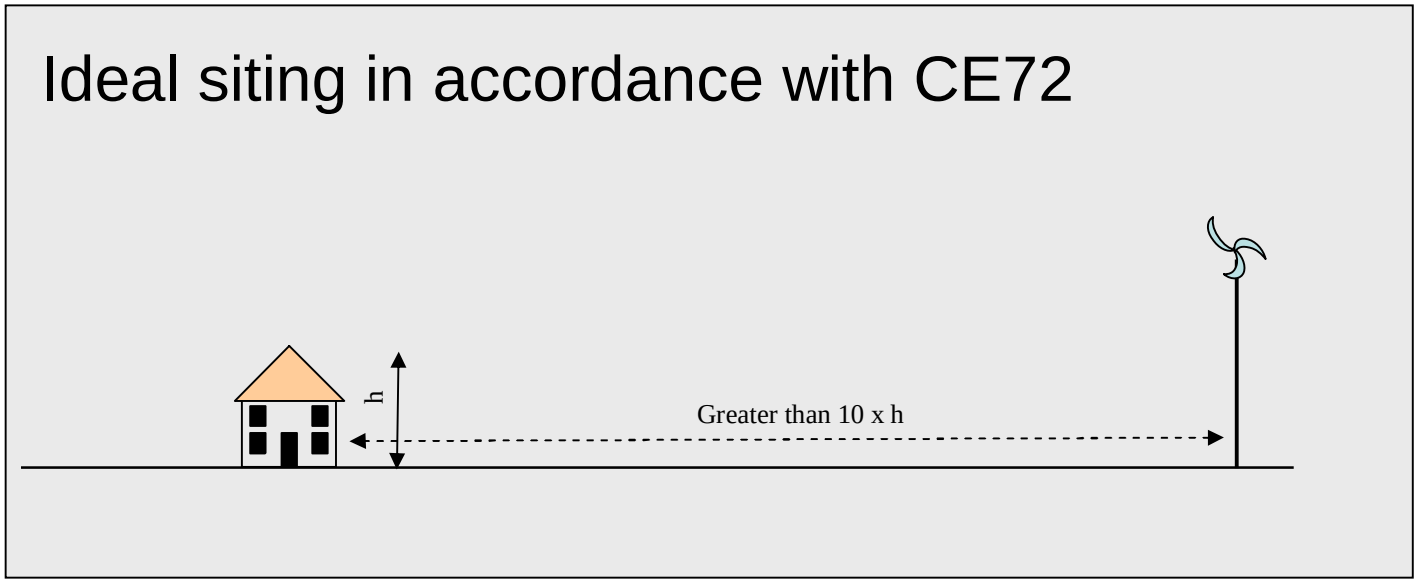
Wind resources[1] at 50 metres above ground level for five different topographic conditions

	Sheltered terrain[2]		Open plain[3]		At a sea coast[4]		Open sea[5]		Hills and ridges[6]	
	$m\,s^{-1}$	Wm^{-2}	$m\,s^{-1}$	Wm^{-2}	$m\,s^{-1}$	Wm^{-2}	$m\,s^{-1}$	Wm^{-2}	$m\,s^{-1}$	Wm^{-2}
	> 6.0	> 250	> 7.5	> 500	> 8.5	> 700	> 9.0	> 800	> 11.5	> 1800
	5.0-6.0	150-250	6.5-7.5	300-500	7.0-8.5	400-700	8.0-9.0	600-800	10.0-11.5	1200-1800
	4.5-5.0	100-150	5.5-6.5	200-300	6.0-7.0	250-400	7.0-8.0	400-600	8.5-10.0	700-1200
	3.5-4.5	50-100	4.5-5.5	100-200	5.0-6.0	150-250	5.5-7.0	200-400	7.0- 8.5	400- 700
	< 3.5	< 50	< 4.5	< 100	< 5.0	< 150	< 5.5	< 200	< 7.0	< 400

European Wind Speed Map (extracted from www.windatlas.dk/Europe/About.html

breglobal

Micro-wind turbines in urban environments

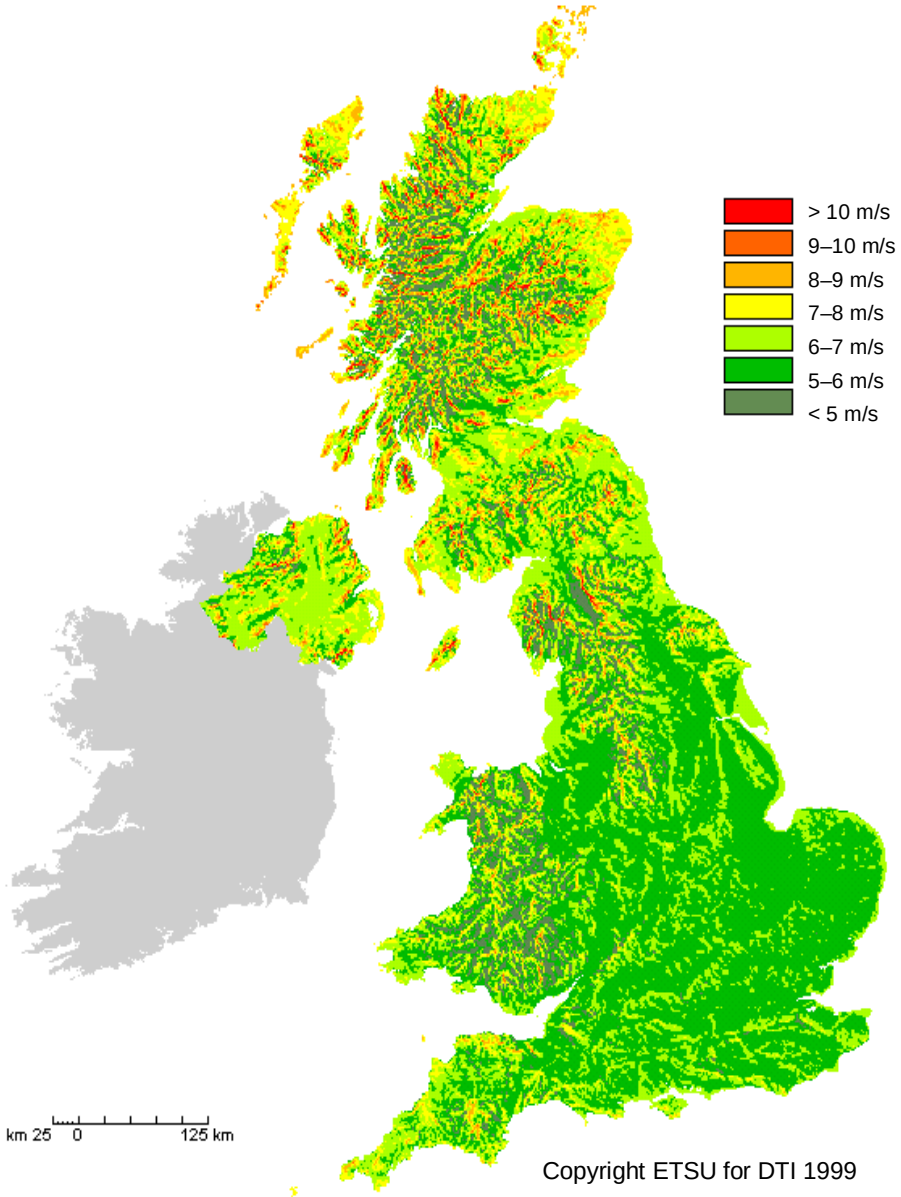


However, most of us live in urban environments and in these cases turbines may be mounted close to or on buildings.

What performance can we expect in these non-ideal situations ?

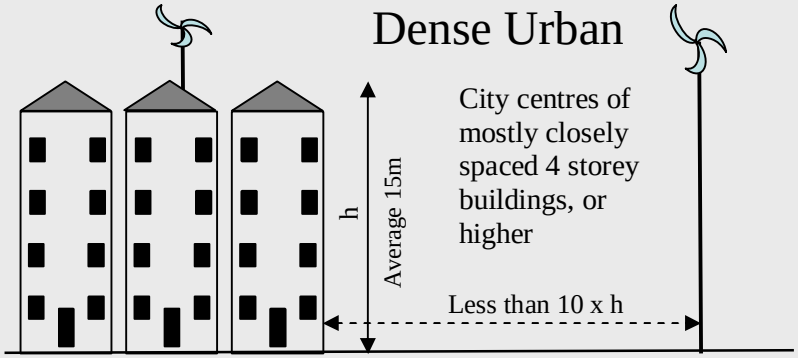
NOABL database

- Full monitoring of wind resource unlikely for micro-wind installations
- Predictions often based on NOABL database
- NOABL provides average annual wind speed for UK on a 1 km grid
- NOABL model accounts for gross topography but not surface roughness due to buildings etc
- Hence tends to overestimate resource for urban environments
- Account must also be taken for local obstructions and effect of the turbine siting



MCS corrections for NOABL wind speeds

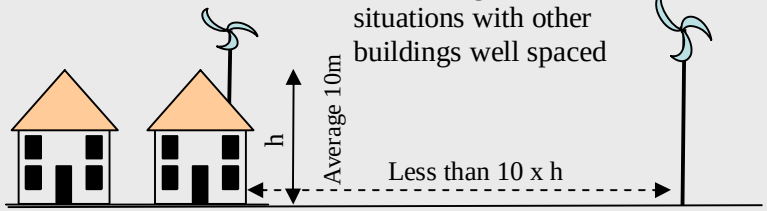
Dense Urban



City centres of mostly closely spaced 4 storey buildings, or higher

Distance from ridge to lowest point of turbine blades (m)	Mean Wind Speed Scaling Factor
10	56%
5	51%
3	44%
1	35%

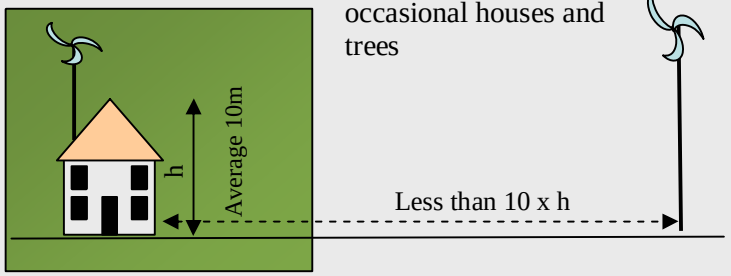
Low rise urban / suburban



Typically town/village situations with other buildings well spaced

Distance from ridge to lowest point of turbine blades (m)	Mean Wind Speed Scaling Factor
6	67%
4	61%
2	53%
0	39%

Rural



Open country with occasional houses and trees

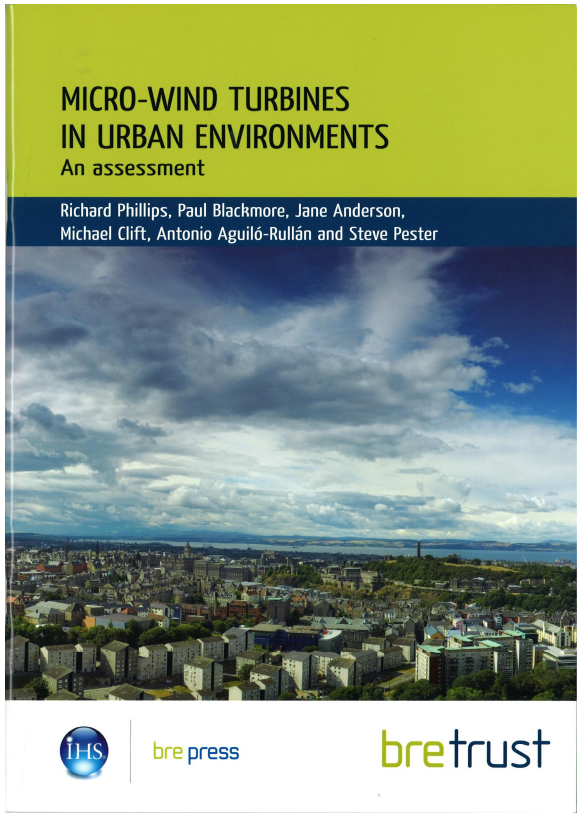
Distance from ridge to lowest point of turbine blades (m)	Mean Wind Speed Scaling Factor
12	100%
7	94%
2	86%
0	82%

From: MIS 3003

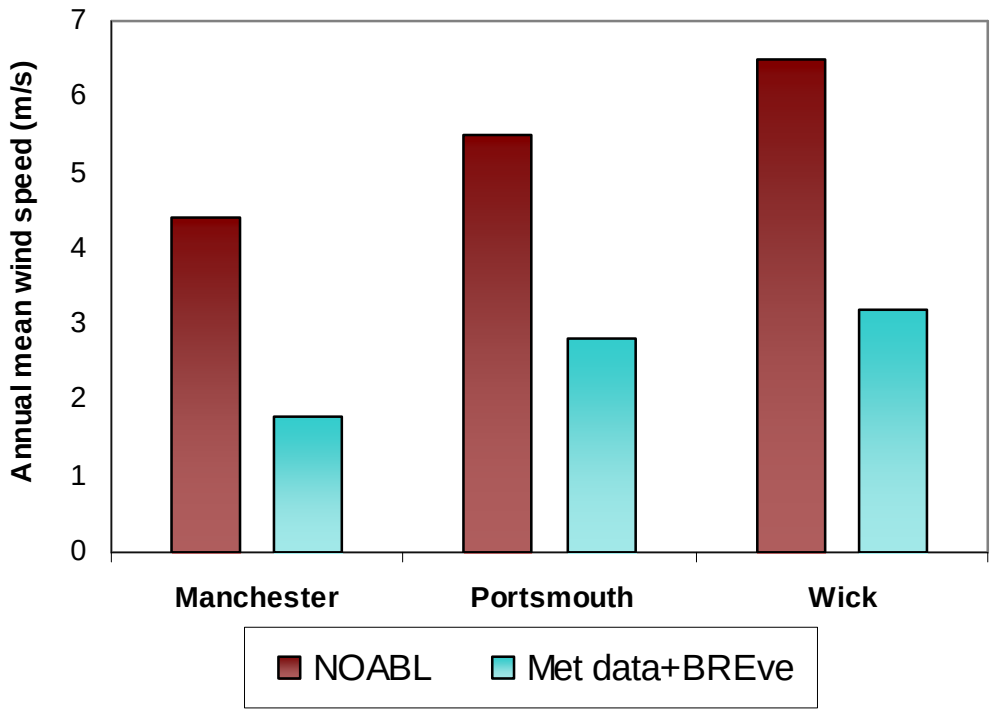
breglobal

BRE Trust Report FB17
Micro-wind turbines in urban environments – An Assessment

- Investigates the wind resource in typical urban locations in Manchester, Portsmouth and Wick
- Uses BREVe software (based on BS 6399-2) to adjust local Met wind data to account for the local roughness and topology
- Confirms that NOABL over estimates the wind resource for urban environments
- Within large urban areas the wind resource may be too low for any practical installations to be viable but in optimum locations CO_2 payback could be less than a year

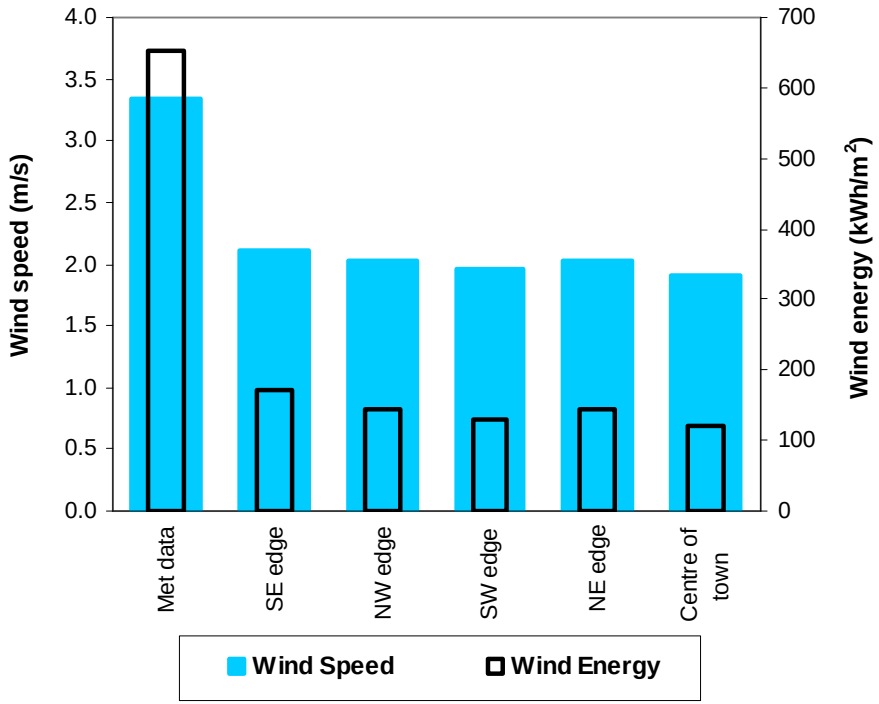


Corrected Met data compared with NOABL data



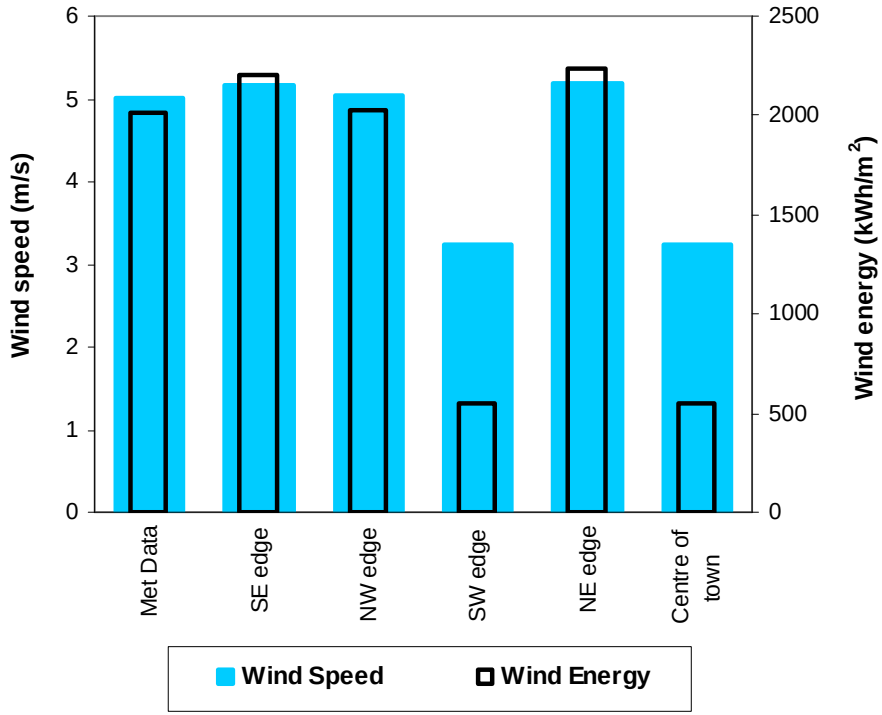
From: BRE Trust Report FB17

BRE Trust Report FB17
Large inland city: Manchester



Average annual wind speed and wind energy

BRE Trust Report FB17
Coastal town: Wick



Average annual wind speed and wind energy

CO_2 Payback periods in Manchester

Table 14: **CO_2 payback periods (years) for micro-wind turbines in Manchester (south west edge).**

Micro turbine	3 m above ridge (pos. 15)			1.5 m above ridge (pos. 13)			1.5 m above mid pitch (pos. 7)			1.5 m above eaves (pos. 1)		
	1	2	3	1	2	3	1	2	3	1	2	3
Met data	0.5–0.7	1.4–1.7	3.4–3.6	0.5–0.7	1.4–1.7	3.4–3.6	0.5–0.7	1.4–1.7	3.4–3.6	0.5–0.7	1.4–1.7	3.4–3.6
Scaled for terrain	3.7–6.2	36–n/p	32–46	3.7–6.2	36–n/p	32–46	3.7–6.2	36–n/p	32–46	3.7–6.2	36–n/p	32–46
Det DP 25	2.7–4.1	17–65	22–28	2.8–4.3	18–87	23–30	3.6–5.9	26–n/p	29–41	4.4–7.8	26–n/p	37–56
Det DP 25 (10 m)	6.7–15	n/p	60–n/p	19–n/p	n/p	n/p	22–n/p	n/p	n/p	n/p	n/p	n/p
Det DP 25 (20 m)	6.3–14	87–n/p	54–n/p	19–n/p	n/p	n/p	25–n/p	n/p	n/p	48–n/p	n/p	n/p
Det DP 25 (50 m)	8.8–26	n/p	78–n/p	13–97	n/p	n/p	15–n/p	n/p	n/p	17–n/p	n/p	n/p
Det DP 50	2.9–4.1	13–32	18–23	2.2–3.3	13–30	18–22	5.0–9.4	43–n/p	41–67	5.5–11	43–n/p	45–78
Det DP 50 (10 m)	4.1–6.3	25–n/p	27–37	5.6–11	92–n/p	49–92	16–n/p	n/p	n/p	66–n/p	n/p	n/p
Det DP 50 (20 m)	4.5–6.9	25–n/p	28–39	4.1–7.0	27–n/p	33–48	20–n/p	n/p	n/p	66–n/p	n/p	n/p
Det DP 50 (50 m)	4.1–6.2	19–n/p	26–35	5.2–10	65–n/p	44–76	16–n/p	n/p	n/p	31–n/p	n/p	n/p

CO_2 Payback periods for Wick (NE Edge)

Table 17: **CO_2 payback periods (years) for micro-wind turbines in Wick (north east edge).**

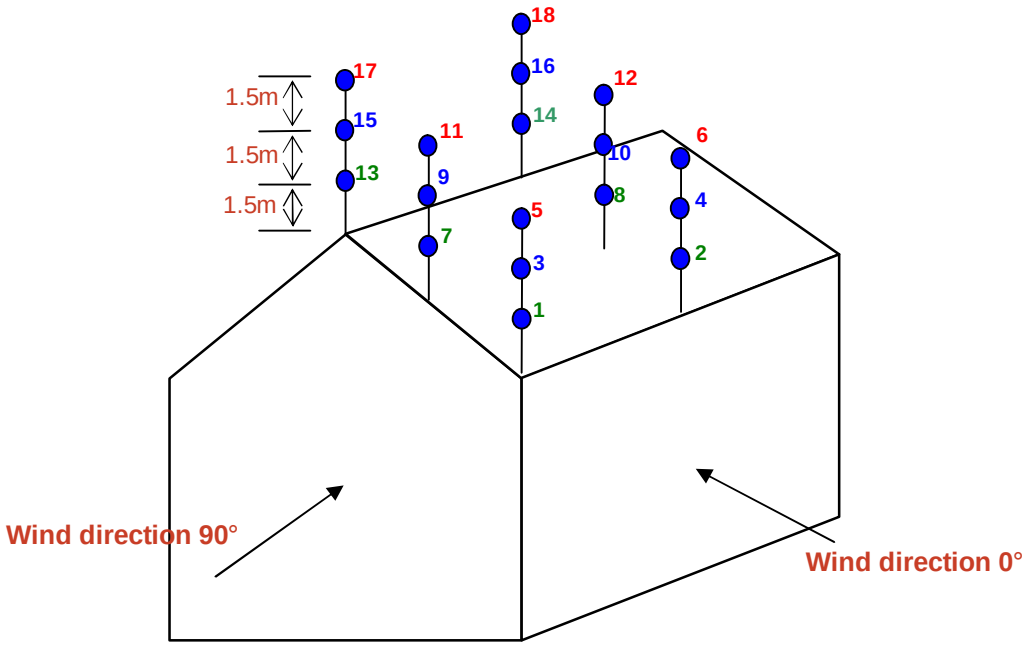
Micro turbine	3 m above ridge (pos. 15)			1.5 m above ridge (pos. 13)			1.5 m above mid pitch (pos. 7)			1.5 m above eaves (pos. 1)		
	1	2	3	1	2	3	1	2	3	1	2	3
Met data	0.2–0.3	0.4–0.5	1.1–1.1	0.2–0.3	0.4–0.5	1.1–1.1	0.2–0.3	0.4–0.5	1.1–1.1	0.2–0.3	0.4–0.5	1.1–1.1
Scaled for terrain	0.2–0.2	0.4–0.4	1.0–1.0	0.2–0.2	0.4–0.4	1.0–1.0	0.2–0.2	0.4–0.4	1.0–1.0	0.2–0.2	0.4–0.4	1.0–1.0
Det DP 25	0.2–0.2	0.3–0.4	0.8–0.9	0.2–0.2	0.3–0.4	0.9–0.9	0.2–0.3	0.4–0.5	1.1–1.1	0.3–0.4	0.6–0.7	1.4–1.5
Det DP 25 (10 m)	0.3–0.3	0.6–0.7	1.4–1.5	0.5–0.6	1.2–1.5	3.0–3.2	0.6–0.8	1.6–2.0	3.8–4.1	1.1–1.5	3.2–4.3	7.3–8.1
Det DP 25 (20 m)	0.3–0.4	0.6–0.7	1.6–1.7	0.5–0.6	1.2–1.5	3.0–3.2	0.6–0.7	1.4–1.7	3.4–3.7	0.7–1.0	1.8–2.3	4.5–4.8
Det DP 25 (50 m)	0.3–0.4	0.7–0.9	1.9–2.0	0.4–0.5	0.8–1.0	2.1–2.2	0.4–0.5	1.0–1.2	2.4–2.6	0.5–0.6	1.1–1.3	2.6–2.8
Det DP 50	0.2–0.2	0.3–0.3	0.7–0.8	0.2–0.2	0.3–0.3	0.8–0.8	0.3–0.4	0.7–0.8	1.6–1.7	0.4–0.5	0.7–0.9	1.8–1.9
Det DP 50 (10 m)	0.2–0.2	0.3–0.4	0.9–0.9	0.3–0.3	0.5–0.6	1.3–1.4	0.4–0.6	1.0–1.3	2.6–2.8	0.8–1.1	2.2–2.9	5.2–5.7
Det DP 50 (20 m)	0.2–0.3	0.4–0.5	1.0–1.0	0.2–0.3	0.5–0.5	1.2–1.2	0.5–0.6	1.1–1.3	2.7–2.8	0.7–1.0	1.9–2.3	4.5–4.8
Det DP 50 (50 m)	0.2–0.3	0.4–0.5	1.0–1.1	0.2–0.3	0.5–0.6	1.3–1.3	0.4–0.6	1.0–1.2	2.5–2.6	0.6–0.7	1.3–1.6	3.1–3.4

CO_2 Payback periods for Wick (Town Centre)

Table 18: **CO_2 payback periods (years) for micro-wind turbines in Wick (town centre).**

	3 m above ridge (pos. 15)			1.5 m above (pos. 13)			1.5 m above mid pitch (pos. 7)			1.5 m above eaves (pos. 1)		
Micro turbine	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**
Met data	0.2–0.3	0.4–0.5	1.1–1.1	0.2–0.3	0.4–0.5	1.1–1.1	0.2–0.3	0.4–0.5	1.1–1.1	0.2–0.3	0.4–0.5	1.1–1.1
Scaled for terrain	0.7–0.9	2.0–2.5	4.4–4.8	0.7–0.9	2.0–2.5	4.4–4.8	0.7–0.9	2.0–2.5	4.4–4.8	0.7–0.9	2.0–2.5	4.4–4.8
Det DP 25	0.5–0.7	1.5–1.8	3.4–3.7	0.5–0.7	1.5–1.9	3.5–3.8	0.7–0.9	2.1–2.6	4.7–5.0	0.9–1.3	2.9–3.9	6.4–7.0
Det DP 25 (10 m)	1.0–1.4	3.7–5.0	7.4–8.1	2.4–3.6	14–41	19–24	3.1–5.0	19–n/p	25–33	6.5–15	n/p	57–n/p
Det DP 25 (20 m)	1.1–1.5	4.0–5.5	8.1–9.0	2.5–3.7	13–32	19–24	2.8–4.3	14–41	22–28	3.8–6.4	26–n/p	31–45
Det DP 25 (50 m)	1.4–1.9	5.5–8.3	10–12	1.6–2.2	6.8–11	12–14	1.8–2.6	8.1–14	14–16	1.9–2.8	7.4–12	14–17
Det DP 50	0.4–0.6	1.2–1.4	2.8–3.0	0.5–0.6	1.2–1.5	3.0–3.1	1.0–1.4	3.1–4.2	7.0–7.7	1.2–1.6	3.4–4.6	7.6–8.5
Det DP 50 (10 m)	0.6–0.8	1.7–2.1	3.9–4.1	0.9–1.2	3.1–4.1	6.5–7.1	2.0–2.8	8.8–16	15–18	4.4–7.9	39–n/p	37–58
Det DP 50 (20 m)	0.6–0.8	1.9–2.3	4.3–4.6	0.8–1.0	2.3–3.0	5.2–5.6	2.0–2.9	8.3–15	15–18	3.6–6.0	22–n/p	29–41
Det DP 50 (50 m)	0.7–0.9	1.9–2.3	4.3–4.6	0.9–1.1	2.8–3.6	5.9–6.5	1.8–2.6	7.3–12	13–16	2.3–3.4	9.2–17	17–20

BRE Trust Report FB17
Investigation of wind flow over house roofs



Warwick Wind Trials

- Measured wind speeds were lower than predicted by NOABL at all sites
- Corrections from MIS 3003 give better predictions but do not account for turbines on high rise buildings
- Proposes scaling factors which account better for these installations
- Also found wide variation in yield and found non viable sites (in some energy consumption exceeded the yield)
- Identifies the need for better prediction tools and standardised measures of turbine power curves
- Identified noise problems with some turbines

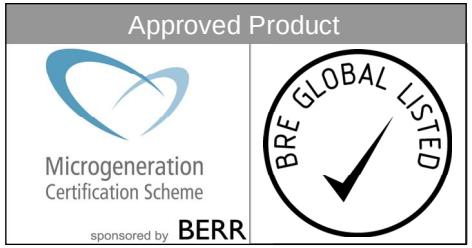
Carbon Trust Small-scale wind energy report

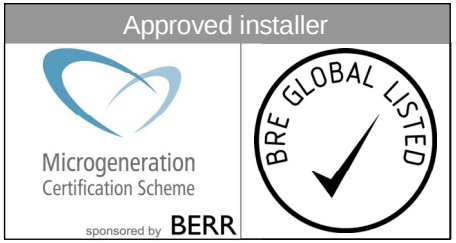
- Uses National Climate Information Centre (NCIC) wind speed data and allows for local surface roughness
- Have developed a tool for estimating turbine yield by entering the post code, installation site details, and power curve details
- It is hoped that this tool will become a freely available web tool. (I believe that it is due to be launched today)

Conclusions

- Siting is Key ! Especially in urban environments
- Within large urban areas the wind resource may be too low for any practical installations to be viable
- NOABL data appears to give very optimistic estimates of the wind resource in urban environments
- Other wind data or corrections to NOABL data are required to get sensible wind resource estimates for urban environments and building mounted turbines
- Various studies are in hand which should provide the basis for improved data. These include both theoretical methods and practical measurements
- In optimum locations CO_2 payback can be a few months but in less suitable locations turbines may never pay back

Conclusions





- The factors in MIS 3003 give better predictions than using un corrected NOABL data but the factors could be improved especially for turbines on high rise buildings.
- Certification under the MCS scheme will provide a standardised measure of turbine power curves via the BWEA and IEC 61400 standards
- Certification under the MCS Scheme will also provide a standardised measure of the noise produced by the turbines

Thank you

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