WICO – Wind of the coast

WP3 Exchange of experiences and best practices

Workshop 3 – Technical

Huelva, 28th October2010

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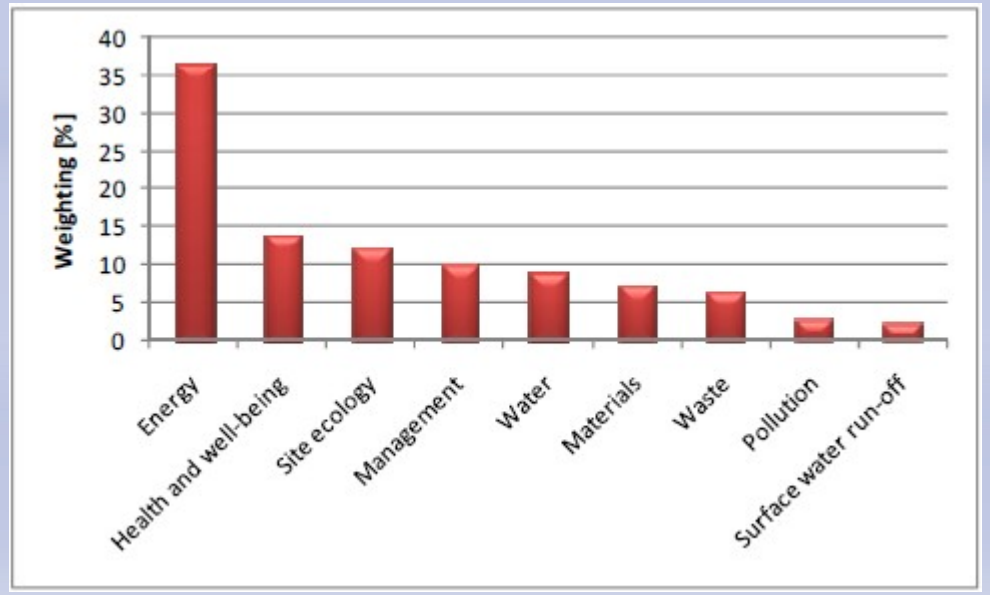
Buildings Technical Drivers

9 weighted factors for assessment in UK Code for Sustainable Homes – 1 year's renewable production will be counted in claiming zero carbon



Zero carbon is scheduled for 2016 for new homes and *proposed* for new non-domestic buildings from 2019

Code Level	1	2	3	4	5	6
Carbon Reduction/Level	-10%	-18%	-25%	-44%	-100%	Zero C

% Reductions relative to compliance with Part L 2006 Building Regulations

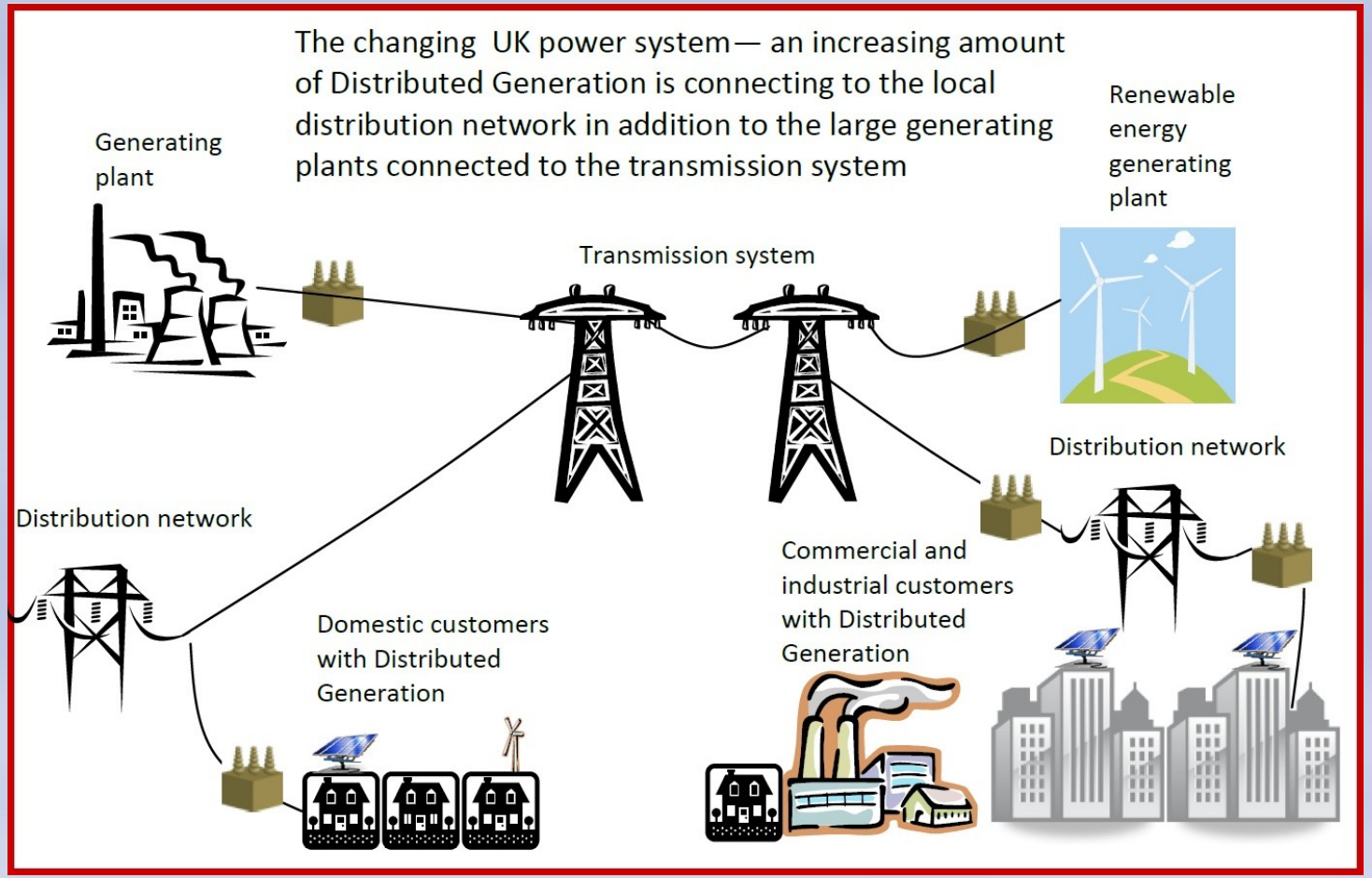
Getting to Code Level 6

- Low and zero carbon energy technology would find a place and as the reduction from the 2006 regulation level becomes great (-70%) so renewable heat and community heat export would be required to achieve Code 6.
- Code 6 implies a gross reduction from the regulated level of ~150%. This is because all non regulated sources of carbon emission must be included (e.g. cooking, appliance use etc.)
- The detail of allowable techniques, on-site or off-site, is still subject to debate and consultation

Establishing Best Practice

- Building Research Establishment Environmental Assessment Method (BREEAM)
- World's longest established and most widely used environmental assessment method for buildings - regarded in UK as **best practice** in environmental design and management.
  - Management: overall management policy, commissioning site management and
  - procedural issues
  - Energy use: **operational energy** and carbon dioxide (CO2) issues
  - Health and well-being: indoor and external issues affecting health and well being
  - Pollution: air and water pollution issues
  - Transport: transport-related CO2 and location-related factors
  - Land use: green and brownfield sites
  - Ecology: ecological value conservation and enhancement of the site
  - Materials: environmental implication of building materials, including life-cycle impacts
  - Water: consumption and water efficiency

Distributed Connection



Taken from ENA's Guidelines to ER G59/2

Beyond Metering for FITs

FIT payments require a **generation meter**.

Exports may be "deemed" in some cases or will require measurement meters.

Domestic SMART meters will be rolled out by 2020. Smart distribution and supply networks are also needed to move from deterministic planned supplies to flexible and resilient distributed supplies. International, National, Community, Domestic "smart grids" strategy is in development & debate

SSEG Connection

- **Small Scale Embedded Generation (<16 amps per phase may be connected without prior consultation** (i.e. 3.6 kW single phase, or 11 kW 3-phase)
- Simply comply with Engineering Recommendation G83/1-1 (ENA) and use approved types and certified equipment & competent installer (MCS) AND notify the DNO within 28 days and provide “installation commissioning confirmation” within 30 days of commissioning respectively. Essentially all that is required is “fit and inform”.
- For households, single phase would be usual but for 3 phases there would be additional work and cost but…

Wind is Different!

- SSEGs are listed as approved types:
  - Domestic Combined Heat and Power
  - Photovoltaic
  - Fuel Cells
  - Micro Hydro
- Wind generators are not type approved but the installer can ask the DNO who may permit the G83/1-1 process for specific micro wind plant.
- Else G59/2 process is required.

MCS approved suppliers and equipment

Product Type	Manufacturer	Product Name	Product Model(s)	Certification Number
Wind Turbine	Silken Renewable Energy	Silken Small Wind Turbine SW 3.4	SW 3.4	Transition Product 470
Wind Turbine	Silken Renewable Energy	Silken Small Wind Turbine SW 4.1	SW 4.1	Transition Product 471
Wind Turbine	Skywing Hong Kong	Skywing	20k	Transition Product 385
Wind Turbine	Skywing Hong Kong	Skywing	30k	Transition Product 386
Wind Turbine	Skywing Hong Kong	Skywing	50k	Transition Product 387
Wind Turbine	Skywing Hong Kong	Skywing	10k	Transition Product 384
Wind Turbine	Southwest Windpower Inc	Skystream 4.7	Skystream 4.7	Transition Product 568
Wind Turbine	Southwest Windpower Inc	Skystream 3.7	1.SSL.*.1.230.02	Transition Product 426
Small Wind Turbine	Southwest Windpower, Inc	Skystream 3.7	Skystream 3.7	MCS WT0043/01
Small Wind Turbine	Southwest Windpower, Inc	Skystream Marine 3.7	Skystream Marine 3.7	MCS WT0043/02
Wind Turbine	The Power Collective Ltd	RidgeBlade	RB01	Transition Product 619
Wind Turbine	UK Maglev Wind Turbines Limited	Practical 350	350W	Transition Product 282
Wind Turbine	UK Maglev Wind Turbines Limited	Marine 400	400W	Transition Product 283
Wind Turbine	UK Maglev Wind Turbines Limited	Maglev HAWT 600	600W	Transition Product 284
Wind Turbine	UK Maglev Wind Turbines Limited	Practical 1000	1kW	Transition Product 285
Wind Turbine	UK Maglev Wind Turbines Limited	Maglev Vertical Turbine	250W - 50kW	Transition Product 280
Wind Turbine	UK Maglev Wind Turbines Limited	Maglev HAWT 300	300W	Transition Product 281
Wind Turbine	Urban Green Energy	UGE -4K	UGE -4K	Transition Product 595
Wind Turbine	Urban Green Energy	UGE 1K	UGE 1K	Transition Product 596
Wind Turbine	Urban Green Energy	UGE-eddy	UGE-eddy	Transition Product 597

Product Type	Manufacturer	Product Name	Product Model(s)	Certification Number
Wind Turbine	Vertical Wind Energy	VWE Field2(3kw)	Available with Masts 10m-15m	Transition Product 225
Wind Turbine	Vertical Wind Energy	VWE Field3(6KW)	Available with Masts 12m-15m	Transition Product 226
Wind Turbine	Westwind	Westwind - HAWT	WESTWIND 3Kw	Transition Product 268
Wind Turbine	Westwind	Westwind - HAWT	WESTWIND 5.5Kw	Transition Product 269
Wind Turbine	Westwind	Westwind - HAWT	WESTWIND 10Kw	Transition Product 270
Wind Turbine	Westwind	Westwind - HAW	WESTWIND 20Kw	Transition Product 271
Wind Turbine	Windspire Energy	Windspire	810040	Transition Product 557
Wind Turbine	Xzeres Wind Corp.	Xzeres ARE442	Xzeres ARE442	Transition Product 600
Wind Turbine	Zephyr Corporation	Airdolphin	GTO	Transition Product 623

List is growing - many turbines are "transition products" See www.microgenerationcertification.org

Multiple SSEG Connection

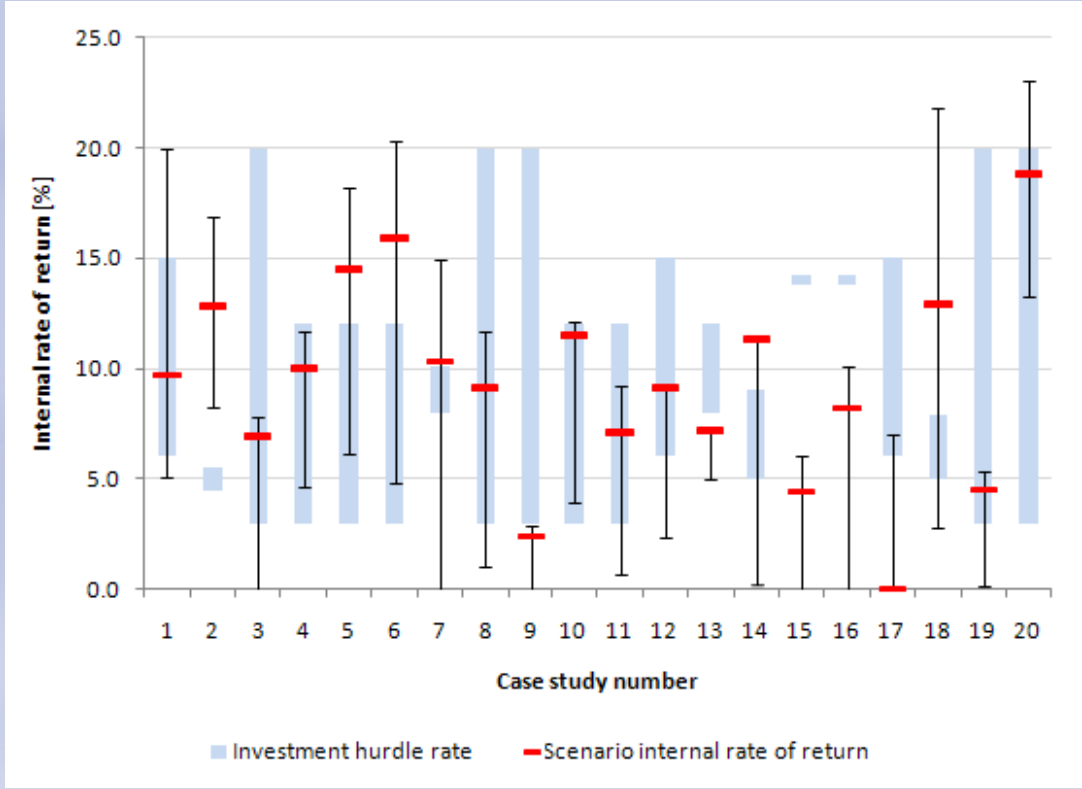
E.g. several SSEGs for connection for a development of several houses

- The applicable Engineering Requirement is G83/1-1 Stage 2
- Where several connections are required, Installer applies to DNO (who may allow specific SWTs as SSEG)
- DNO assesses impact on network and prepares a connection design if needed.
- DNO informs Installer if network reinforcement is needed prior to commissioning
- Installer instals and commissions
- Installer notifies DNO within 28 days and submits supporting information within 30 days

General Connection

- Where generators greater than 16A per phase are deployed or generators not on approved list, DNO consultation and written agreement required
- Onus on applicant to demonstrate ER G59/1 compliance of each installation
- Can take a long time and applicant may struggle to provide necessary technical details
- Each system has to be individually designed and evaluated prior to installation
- An on-site acceptance test may be required but type testing may be acceptable

Renewable Technology Relativities



1 Micro hydro mill conversion, 5kW
2 Medium new hydro, 100kW
3 Micro domestic wind, 1.5kW
4 School wind scheme, 15kW
5 Public sector office wind scheme, 330kW
6 Community wind scheme, 1,500kW
7 Private company wind scheme, 2,000kW
8 Domestic retrofit PV, 2kW
9 Domestic retrofit PV tiles, 2kW
10 Community centre PV, 8kW
11 Social housing PV, 20kWe
12 Commercial PV scheme, 200kW
13 Commercial office GSHP, 150kW
14 Home retrofit ASHP, 6kW
15 Biomass gasification CHP, 1,000kW
16 Biomass steam turbine CHP, 5,000kW
17 Small AD, 100kW
18 Municipal AD, 5000kW
19 Domestic solar thermal, 2kW
20 Domestic biomass boiler, 250kW

From "FIT for the Future", Friends of the Earth/Arup 12 Oct 2010

A Wind Turbine Solution?

- Good Wind Resource?
  - Carry out survey
- Favourable Site?
- Economic comparison with other technology €£

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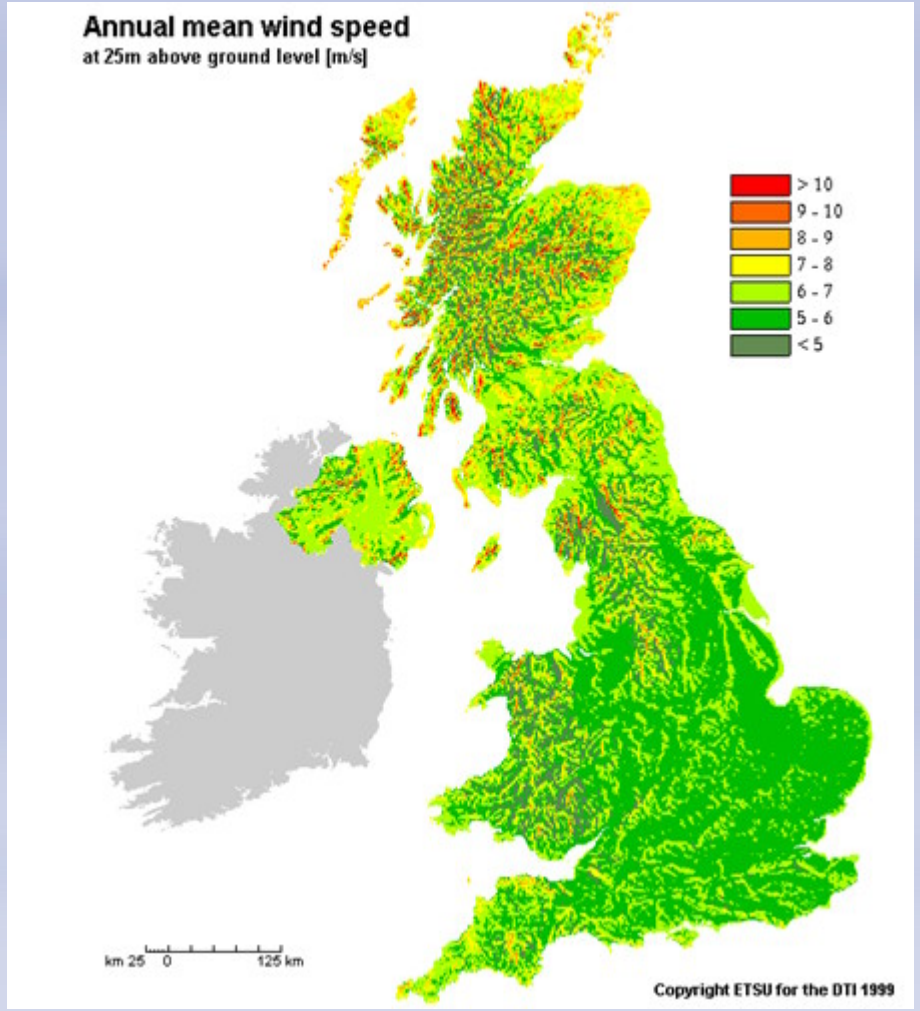
UK Wind Resource



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Official DECC Wind Database

- DECC (formerly DTI) wind speed database contains estimates of the annual mean wind speed throughout the UK.
- Uses an air flow model that estimates the effect of topography on wind speed.
- No allowance for the effect of local thermally driven winds such as sea breezes or mountain/valley breezes
- The model has a 1km resolution and makes no allowance for topography on a small scale or local surface roughness (such as tall crops, stone walls, or trees)
- Values given at either 10m, 25m or 45m above ground level
- The data can only be used as a guide Ordnance Survey grid references used describe the bottom left corner of each 1km square.

- On-site measurements needed for a proper assessment

Best Practice Example

Children participating in data collection aimed at finding a site for a second turbine. The school is noted for gaining grants, eco-education and has a diverse successful range of renewable energy sources

Proven 6 KW turbine at St Columb Minor Primary School, Cornwall, UK Excellent exposed location with no obstruction to the turbine. Outcome: Since installation, the turbine has provided over 10,000kWh per year towards the school's energy usage.

Information and picture from Ashden Awards publication May 2010, Friends of the Earth Case Study from Proven, Oct 2010

Wind Measurements 1

UK Meteorological Office Weather Stations measure among many other items:

- Mean wind speed, mean wind direction and maximum gust at 10m above the ground
- Visibility, cloud (cover type height), duration of sunshine

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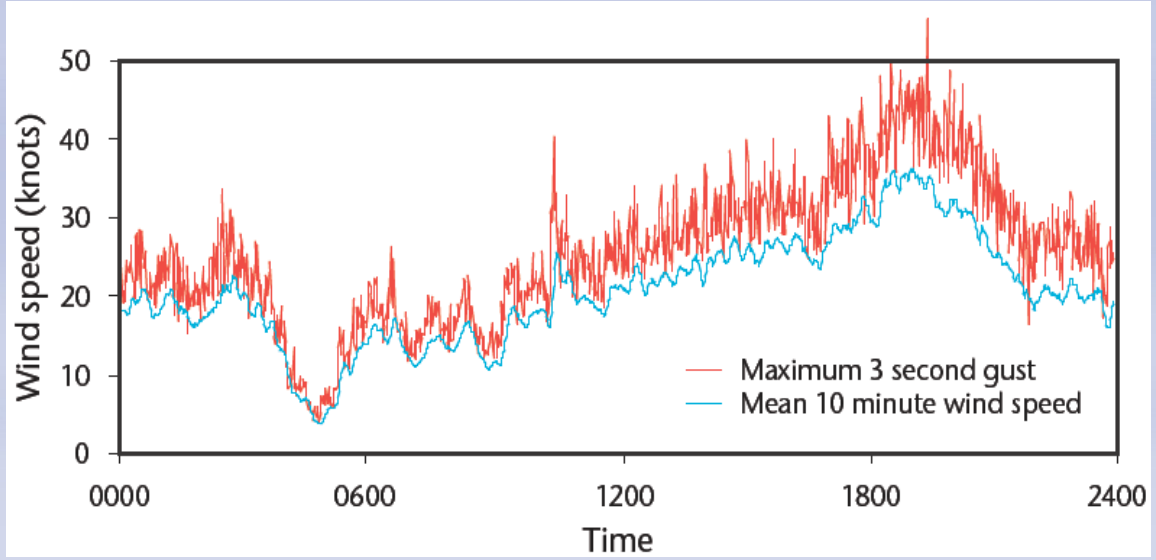
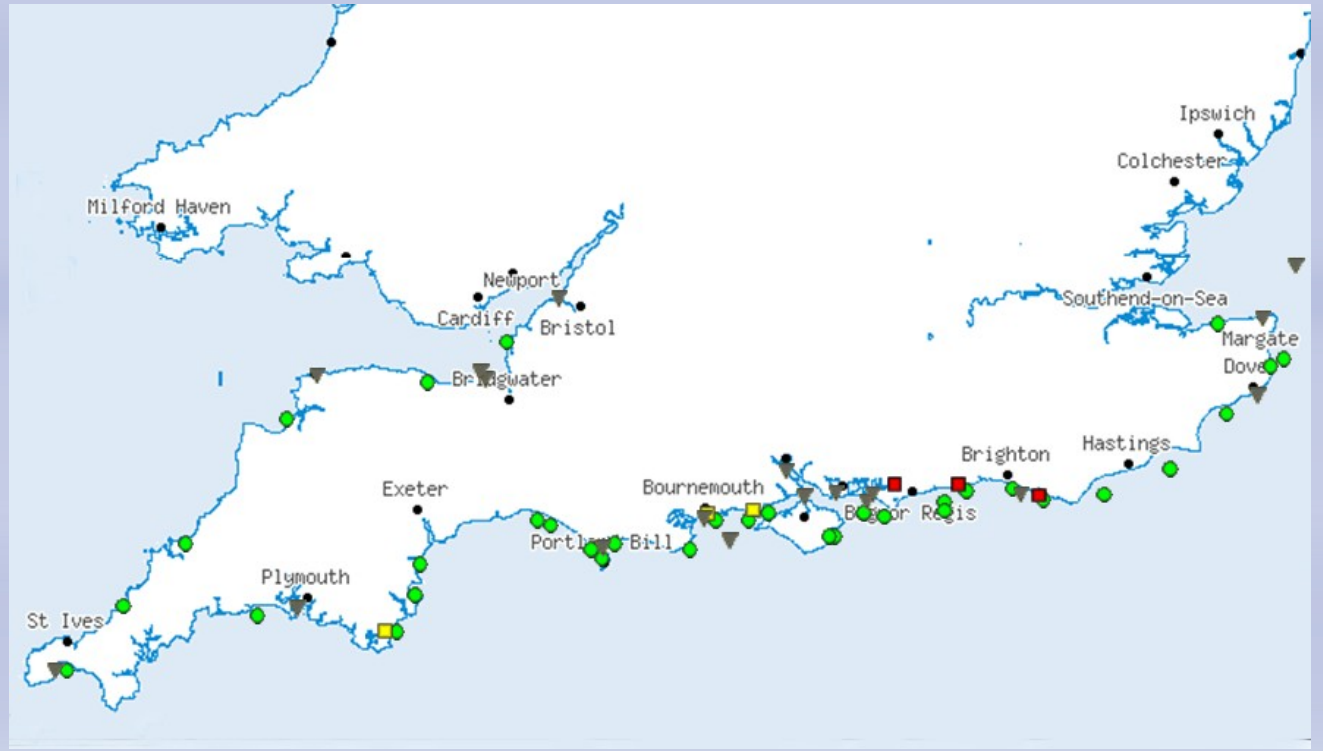
Wind Measurements 2

Anemometers used by Met Office. The sonic one is used in adverse situations (mountains, say)



A Day at Prestwick showing gusts

Coastal Measurements



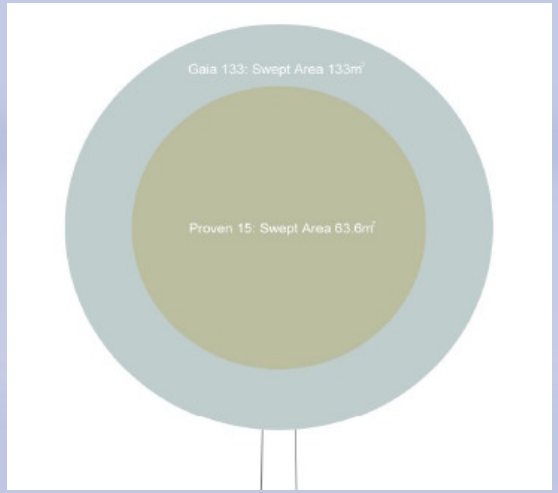
Some monitoring equipment include anemometers. Owned and operated by various Local Authorities and Agencies. Geo Data Institute, University of Southampton, Manages data www.channelcoast.org/data_management/real_time_data/charts/

Technical Review 1

- Often wind turbines are compared using their maximum power output or ‘rated power’ in kilowatts (kW).
- But some manufacturers rate their products at very high wind speeds and others at lower speeds.
- To a first level it is best to compare turbines with a particular wind speed distribution in view.
- In South East England a predominant range of 4 - 9m/s and may not favour a turbine that performs better in the 10 - 15m/s range than another, say
- But this is only part of the story. Is the wind direction steady? Is the flow laminar?
- Small quick directional response turbines might be better than larger low speed optimised designs in difficult areas

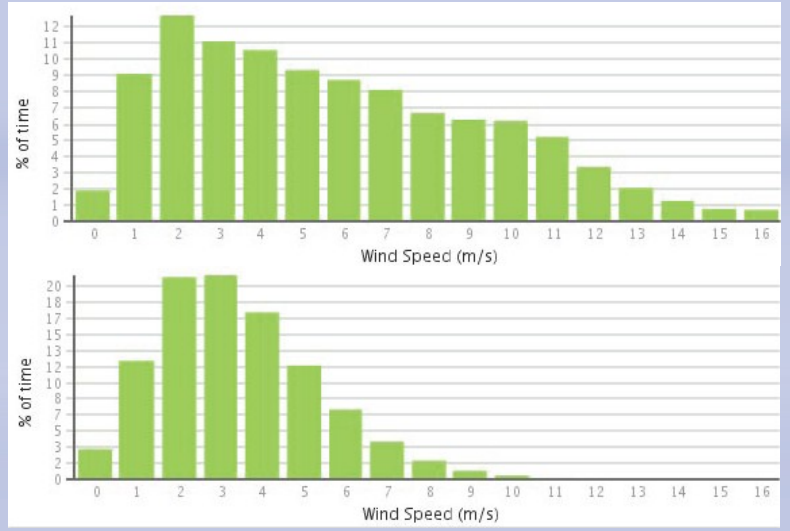
Technical Review 2

Hypothetical Simplistic Choice Proven 15 vs Gaia 133



Open Sea
Open Rural ?

Cluttered or
Urban?



	3	4	5	6	7	8	9	10	11	12
Gaia 133	0	1,100	2,800	5,000	7,300	8,900	10,400	11,400	11,300	11,000
Proven 15	0	570	1,940	3,850	5,790	8,080	10,330	11,730	12,460	12,680

Simplistic choice = Gaia in B perhaps Proven in A
But what about directional stability and turbulence?
Maybe VAWT versus HAWT will be important

Technical Review 3

VAWT or HAWT or WHAT?

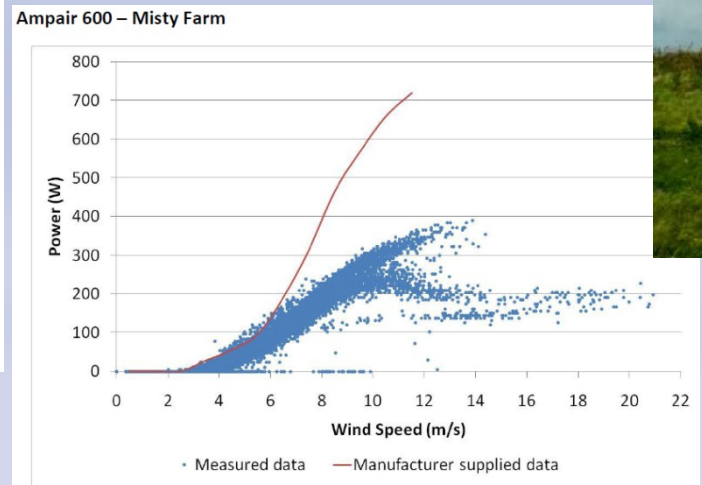
- VAWT and HAWT designs are common
- For clean steady wind HAWT offers a wider range of mature designs and are probably cheaper
- Rapidly changing and swirling flows are claimed to show an advantage to VAWT or so is the popular belief
- Wind speed response is design sensitive – low average speed, high survival speed, etc. MCS and Manufacturer data indicate choice based on wind speed survey
- The “Warwick Report” indicates shortfall from expected output (manufacturers power curve) and achieved output in many practical sites (all HAWT design)?
- Response inclined and unsteady wind is not clearly described by manufacturers data however, nor is that wind information generally available
- WHAT? Exotic designs & variations exist but none appears to be economically and convincingly engineered – perhaps reduced bird strike etc.

Technical Shortcomings

Warwick Wind Trials Project, Encraft 2009

Case Study: Misty Farm was the Encraft test reference site for the urban wind trial. It was selected for its good rural location, close to the sea on top of a hill with very little obstructions to air flow.

NOABL wind speed estimate:	6.3ms^{-1} at 10m
Hours of data collected:	7623
Mounting type:	Freestanding pole – reference site
Turbine:	Ampair 600 230
Inverter:	Windy Boy WB700
Anemometer:	NRG #40 calibrated
Data logger:	Pace Scientific XR5
Wattmeter:	Iskraemeco ME162



Output fell below expectation on most case studies

Technical Risk – Reliability And Safety

These pictures of failures were obtained from Encraft published information