BVGassociates

Growing Medium Wind in the UK

50 to 500kW rated turbines

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RenewableUK 2011 Conference, 26 October 2011

www.bvgassociates.co.uk

Why medium wind?

- Helps UK meet its legal and moral obligations to address climate change.

- Helps keep the lights on through security and diversity of supply. Contributes to decarbonising energy and to 15% energy from renewables 2020 target.

- Creates skilled jobs in the UK.

  “Creating jobs and growth is our number one priority for Britain right now”. At October 2011 announcement that David Brown will be creating a wind turbine research and development innovation centre.

Why medium wind?

- Part of route to least increase in bills. Ofgem set out 4 scenarios in October 2009 for the UK energy market. The 'Green stimulus' scenario which included "government policies support investment in renewables" lead to the least increase in customer bills by 2020
- Is less grid constrained. Careful though as cost of upgrading (11 kV) grid to carry more power can kill projects – investigate as soon as able
- Is more affordable for high worth individuals and some bank finance available – greater diversity
- Usually smaller dwelling separation than required for larger wind
- More acceptable scale for some locations e.g. AONB
- Is less constrained by aviation e.g. Medium wind turbines at East Midlands Airport. We are working with another airport. Careful though aviation can kill projects

MINISTRY OF DEFENCE

ONSHORE RADAR COVERAGE

UK

BVGassociates

An aviation constraint – MOD radar

Radar Coverage Data produced by ADATS. © Crown Copyright 2009

TURBINE TIP HEIGHT

100m

Radar Coverage Data produced by ADATS. © Crown Copyright 2009

TURBINE TIP HEIGHT

60m

Radar Coverage Data produced by ADATS. © Crown Copyright 2009

TURBINE TIP HEIGHT

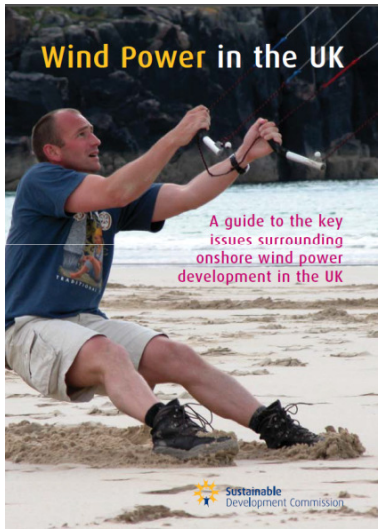
40m

Why medium wind?

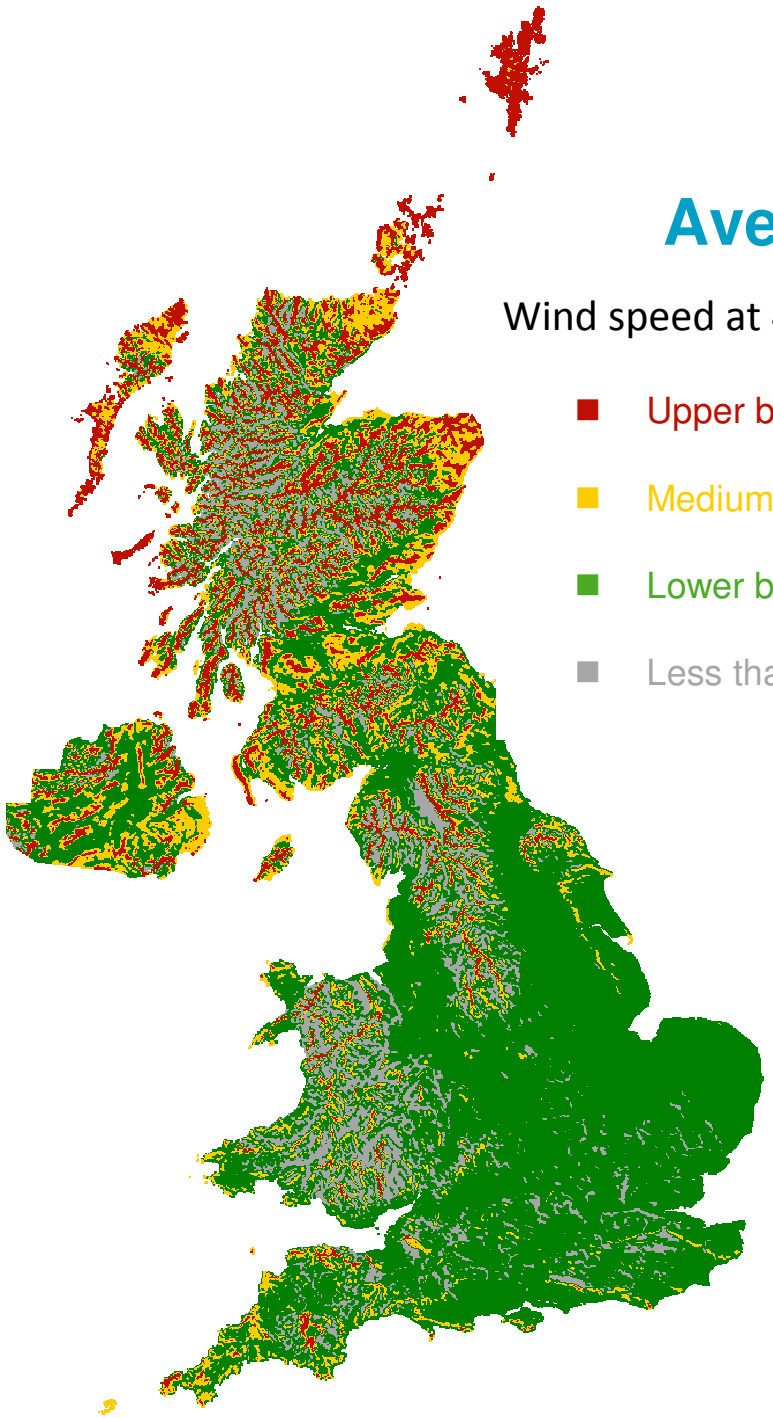
- Energy generated of a scale that matches that generated in a year by SMEs
- Many suppliers entering market
- Abundant resource

  "The UK has the best and most geographically diverse wind resources in Europe, more than enough to meet current renewable energy targets"

- And local ....



Average mean wind speeds



Wind speed at 45m above ground level

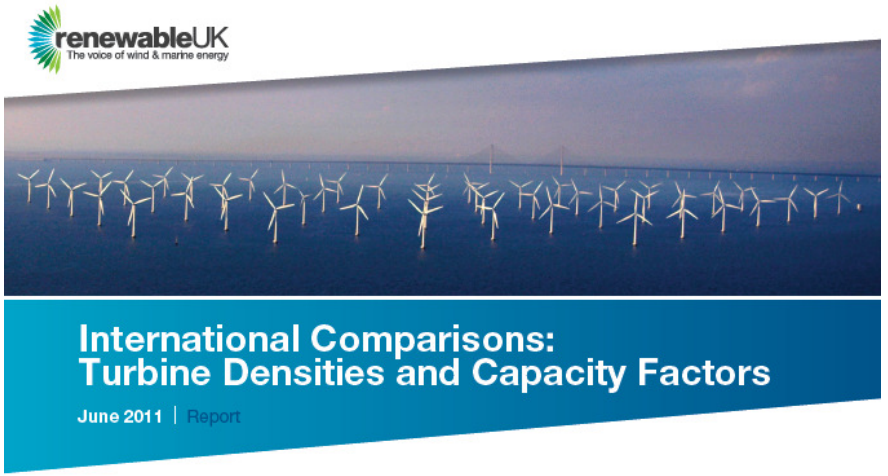
- Upper band (greater than 8.2m/s)
- Medium band (7.3m/s to 8.2m/s)
- Lower band (6m/s to 7.3m/s)
- Less than 6m/s

- Most of UK near area with wind speed > 6 m/s at 45 m above ground.
- Data from DECC Wind speed Database
- Colours nominally reflect different wind turbine IEC Classes

Also plenty of space

- 20 times more large turbines per km^2 in Denmark than England

Country	Watts/ capita	Wind Turbines per 100 sqkm	2009 Capacity factor
England	16	0.49	
Wales	127	2.43	
Northern Ireland	172	1.54	
Scotland	454	1.72	
UK	58	1.09	28.7
Ireland	310	1.6	29
Germany	320	5.95	17.4
Spain	425	3.39	23
Denmark	518	10.85	23



renewableUK
The voice of wind & marine energy

International Comparisons: Turbine Densities and Capacity Factors

June 2011 | Report

Studies on the UK's wind resource are conclusive: "The UK has the best and most geographically diverse wind resources in Europe, more than enough to meet current renewable energy targets".[1]

By examining deployment densities per unit of landmass across the European Union this paper shows, however, that the UK's wind resource is massively underutilised in comparison to many of our EU neighbours, with countries with greater population densities or smaller land areas (or both) hosting many times more turbines per 100 km/sq than the UK.

Introduction

There are no objective criteria of how many onshore wind turbines in the UK would be "too many". What this briefing paper shows however, is that many European countries currently have a much higher density of large wind turbines per 100 km² than the UK (or its constituent parts).[2] Consequently, these countries reap a higher yield of electricity from wind, despite the UK having 40% of Europe's wind resource.

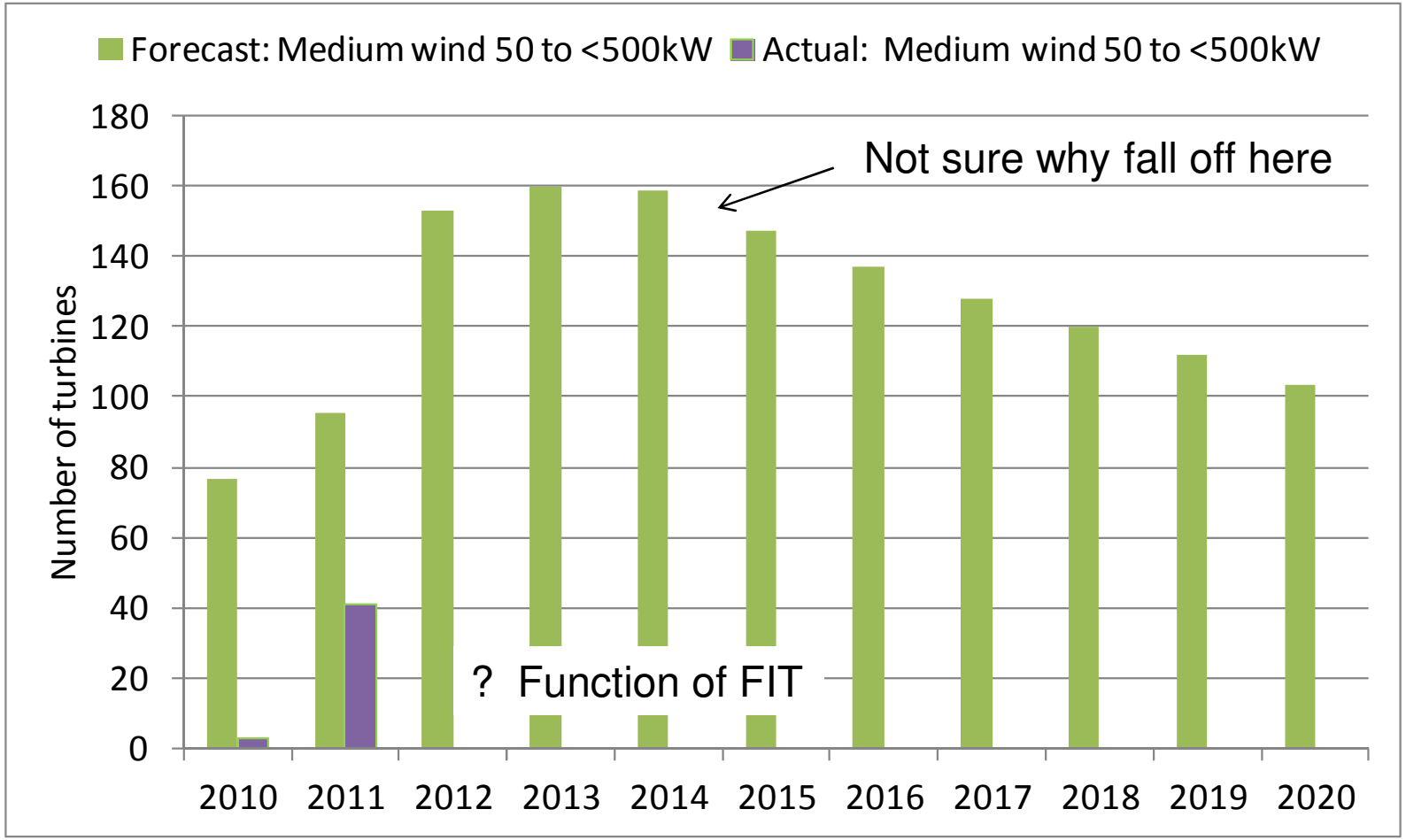
For example, Denmark has 20 times more large wind turbines per 100 km² than England, which has on average 0.49 large wind turbines per 100 km². It is a similar case with the Netherlands, which has 5.54 turbines per 100 km², over 10 times more than England, while also being more densely populated (see Table 2).

These lower turbine density rates, as a rule, translate into a lower contribution of wind to the electricity supply. For instance, Denmark consistently sources around 20% of its total consumption annually, while in the UK as a whole that percentage is around 3%.

If the alternative criterion of watts per capita rates for wind power are taken into account, as opposed to turbine density rates, the UK performs even worse, and is placed towards the bottom of the EU 27 league (see Table 2).

RenewableUK | Facts on Wind

What progress against predictions 50 to 500MW Installation per year – estimate from data on slide 15



Forecast: Results for the final FITs from a model produced by Element Energy and Poyry Consulting as part of Qualitative issues in the design of the GB feed-in tariffs, URN: 09D/698

What progress against predictions?

- Lead times longer partly because new market, new planning considerations
- Grid connection costs – line upgrades make some projects uneconomic
- Time to obtain planning permission 2 to 18 months
- Planning success rates
- Some grid connection offers being made for a future time e.g. 2014
- FIT uncertainty – has been relatively ok till now as turbine supply lead times short so installation possible before end of March
- Future is positive if FIT is at a stable level compared to costs

Feed-in Tariff's and ROCs

- Two support mechanisms for wind projects; FIT (≤5 MW) and RO (any)
- The Renewables Obligation Order 2009 (the ROO 2009) introduced a number of changes to the operation of the Renewables Obligation (RO). The most significant of these was the introduction of banding, which established differentiated levels of support for different technologies according to a number of factors including their level of development
- The RO is made up of three complementary obligations, one for England and Wales, one for Scotland and one for Northern Ireland
- Review originally brought forward so new banding proposals intended summer 2011 but published October 2011
- New banding to commence for schemes accredited (i.e. operational) from 01 April 2013

Consultation on the Renewables Obligation Banding Review

- Close Date: 12/01/2012
- Table 2 includes the following

Renewable electricity technologies	Current support, ROCs/MWh	Proposed ROC support/MWh[1]
Onshore wind	1	0.9
Offshore wind	2 in 2013/14; 1.5 from 2014/15 onwards	2 in 2013/14 and 2014/15; 1.9 in 2015/16 and 1.8 in 2016/17
Tidal impoundment (range) – tidal barrage (<1GW)	2	2 in 2013/14 and 2014/15; 1.9 in 2015/16 and 1.8 in 2016/17
Tidal impoundment (range) – tidal lagoon (<1GW)	2	2 in 2013/14 and 2014/15; 1.9 in 2015/16 and 1.8 in 2016/17
Tidal stream	2	5 up to a 30MW project cap. 2 above the cap.
Wave	2	5 up to a 30MW project cap. 2 above the cap.

1. Years refer to obligation periods under the RO. For example, 2013/14 refers to the period 1 April 2013 to 31 March 2014.

Feed-in Tariffs - current

- Comprehensive FIT Review; awaited since July but what will it propose?
- No FIT in NI rather 4 ROCs for <250 kW turbines

Original April 2010

Technology	Scale of project (nameplate)	Tariff level for new installations in period (p/kWh) [NB tariffs will be inflated annually]			Tariff lifetime (years)
		Year 1: 1.04.10-31.03.11	Year 2: 1.04.11-31.03.12	Year 3: 1.04.12-31.03.13	
Wind	≤1.5kW	34.5	34.5	32.6	20
Wind	>1.5 - 15kW	26.7	26.7	25.5	20
Wind	>15 - 100kW	24.1	24.1	23.0	20
Wind	>100 - 500kW	18.8	18.8	18.8	20
Wind	>500kW - 1.5MW	9.4	9.4	9.4	20
Wind	>1.5MW - 5MW	4.5	4.5	4.5	20

Current April 2011

Installations registered in FIT Year 2 (01 April 2011 - 31 March 2012)
36.2
28
25.3
19.7
9.9
4.7

Note these are generation tariffs, with the total income comprising three tariffs: generation (as above), exported power (i.e. power sold back to the grid at ~ 3.5 p/kWh) and avoided consumption (this is a saving on the import of power per kWh but the current supply tariff may be increased if the quantity of import is significantly reduced giving a reduced saving).

Example Financials from BVG Associates model

- Assumes FIT tariffs as off April 2011 and 10% losses
- Wind speed makes a lot of difference
- FIT makes 500 kW (at sweet spot) give good return but ...
- 10 MW project with large turbines generates about just under 20 times more energy than the 500kW project
- 2 No. 500kW turbine will give worse return as lower FIT tariff

		Wind speed at 45m (m/s)			
Wind project		5.5	6.0	6.5	7.0
1 x 500kW (FIT) 40m hub height	SPBP (yrs)	4.5	3.7	3.2	2.8
	IRR (10 yrs)	18%	24%	29%	34%
5 x 2MW (RO) 80m hub height	SPBP (yrs)	9.0	7.2	6.0	5.2
	IRR (10 yrs)	2%	6.4%	10%	14%

Medium Sized Wind Turbines in the Market

Turbine Comparisons in Market

Manufacturer	Model	Rotor diameter (m)	Rated power (kW)	Number of blade	Rotor orientation	Drive train	Tower type
ACSA	A27	27	225	3	Upwind	Geared - 1 or 2 stage	Standard + Tilt-up tower
ACSA	A29	29	225	3	Upwind	Geared - 1 or 2 stage	Standard + Tilt-up tower
Enercon	E33	33.4	330	3	Upwind	Gearless - king pin	Standard
Enercon	E48	48	800	3	Upwind	Gearless - king pin	Standard
EWT	DW52-500kW	52	500	3	Upwind	Gearless - 1 bearing	Standard
EWT	DW54-500kW	54	500	3	Upwind	Gearless - 1 bearing	Standard
Gamesa	G58-850	58	850	3	Upwind	Geared - Multi stage	Standard
Northern Power Systems	Northwind 100	21	100	3	Upwind	Gearless - 1 bearing	Standard
Norwin	29-STALL-220 kW	29.1	200	3	Upwind	Geared - Multi stage	Standard
Norwin	29-STALL-225 kW	29.1	225	3	Upwind	Geared - Multi stage	Standard
Norwin	47-ASR-500 kW	47	500	3	Upwind	Geared - Multi stage	Standard
Norwin	54-ASR-750 kW	54	750	3	Upwind	Geared - Multi stage	Standard
Polaris	P19-100	19.1	100	3	Upwind	Gearless	Standard
Powerwind	500	56	500	3	Upwind	Geared - 1 or 2 stage	Standard
RRB Energy	PS500	47	500	3	Upwind	Geared - Multi stage	Standard
Turbowinds	T400-34	34	400	3	Upwind	Geared - Multi stage	Standard
Turbowinds	T500-48	48	500	3	Upwind	Geared - 1 or 2 stage	Standard
Vergnet	GEV MP200 kW 30	30	200	2	Downwind	Geared - 1 or 2 stage	Gyn-pole lift
Vergnet	GEV MP250 kW 30	30	250	2	Downwind	Geared - 1 or 2 stage	Gyn-pole lift
Vergnet	GEV MP275 kW 30	30	275	2	Downwind	Geared - 1 or 2 stage	Gyn-pole lift
Vergnet	GEV MP275 kW 32	32	275	2	Downwind	Geared - 1 or 2 stage	Gyn-pole lift
Vestas	V52-850	52	850	3	Upwind	Geared - Multi stage	Standard
Wind Energy Solutions	WES30	30	250	2	Upwind	Geared - 1 or 2 stage	Standard
Wind Technik Nord	WTN250	30	250	3	Upwind	Geared - 1 or 2 stage	Standard
Wind Technik Nord	WTN500	48	500	3	Upwind	Geared - 1 or 2 stage	Standard
Windflow	250	33.2	250	2	Upwind	Geared - Multi stage	Standard
Windflow	330	33.2	330	2	Upwind	Geared - Multi stage	Standard
Windflow	500	33.2	500	2	Upwind	Geared - Multi stage	Standard

Purchasers of some turbines > 500 kW are to apply to Ofgem for 500 kW accreditation

Sales

Manufacturer		UK installations/sales	Global installations
ACSA	A27 & A29	First installations 2012Q1, A27 and A29, over 100 in planning	~2,000 V27 & V29 turbines, <1,000 A27 & A29
Enercon	E33 & E48 & E44	1 in UK, 6 on Falkland Islands & 5 on Ascension Isle (E33), 84 (E48), 18 (E44)	84 (E33) 1,789 (E48)
EWT	DW52-500kW & DW54-500kW	3 x 900kW turbines in South West Wales at the Castle Pill site. 1 x 500kW turbine in Cornwall. 9 x 500 kW turbines sold in the UK that all will be installed by the end of this year / beginning of next year.	307 (500 kW to 900 kW)
Gamesa	G58-850	Approx. 35 installed	
Northern Power Systems	Northwind 100	10	
Norwin	29-STALL-225 kW, 47-ASR-500 kW & 47-ASR-750 kW	1 x 750kW machine erected approx 12 months ago at the Hydrogen Office Project in Scotland. Many 500kW and 225kW machine projects reaching order stage (first turbine erection approx mid of 2012)	>400 (225 kW) >118 (500 kW and 750 kW)
Powerwind	500	1 under constuction, Ebbw Vale (Wales)	Installed 45 turbines since 2008 and sold over 100 in rest of Europe
RRB Energy	PS500	0 installed to date	~600 PS500 turbines (not including V47)
Turbowinds	T400-34 & T500-48	0 installed to date, 1 sold - due to be installed in January	~45
Vergnet	GEV MP200 kW, GEV MP250 kW GEV MP275 kW 32 & 30	2 turbines constructed and due for commissioning in next few weeks. 5 further turbines now in construction phase for build out pre 31 March 2012.	500 (for all rotor diameter versions of 275kW models)
Vestas	V52-850	Approx. 190 installed	3,851
Wind Energy Solutions	WES30	Before FIT: 2x WES30 Under FIT: 2x WES30 Turbines to be installed before April 2012: 1x WES30	400+ (including Lagerway installations)
Wind Technik Nord	WTN250 & WTN500	2 WTN 250 (30m) installed, East Midlands International Airport Over 25 x 250kW/500kW turbines in planning and expecting the first ones to come out of planning in November and then followed by a steady stream.	~50 on the continent
Windflow	250, 330 & 500	1 sale, a further 5 with grid and planning, that they are working to close and a further 20 that are in the consenting process.	100 (Windflow 500)

Turbines – 50kW (some examples)

Manufacturer	Model	Rotor diameter (m)	Rated power (kW)	Number of blades	Rotor orientation	Drive train	Tower type
Coemi	55/15	15	50	3	Upwind	Geared - 1 or 2 stage	Standard
Endurance	E-3120 50kW	19.2	50	3	Downwind	Geared - Multi stage (separate main bearing)	Standard
GHREPOWER	50kW	14.2	50	3			Standard
Polaris	50kW	15	50	3	Upwind	Gearless	Standard (hydraulic tilt up design)
Aria (re engineered Lagerwey 18/80	Libellula 55 kW	18	55	2	Upwind	Geared	Standard
WES	WES 18	18	80	2	Upwind	Geared	Standard

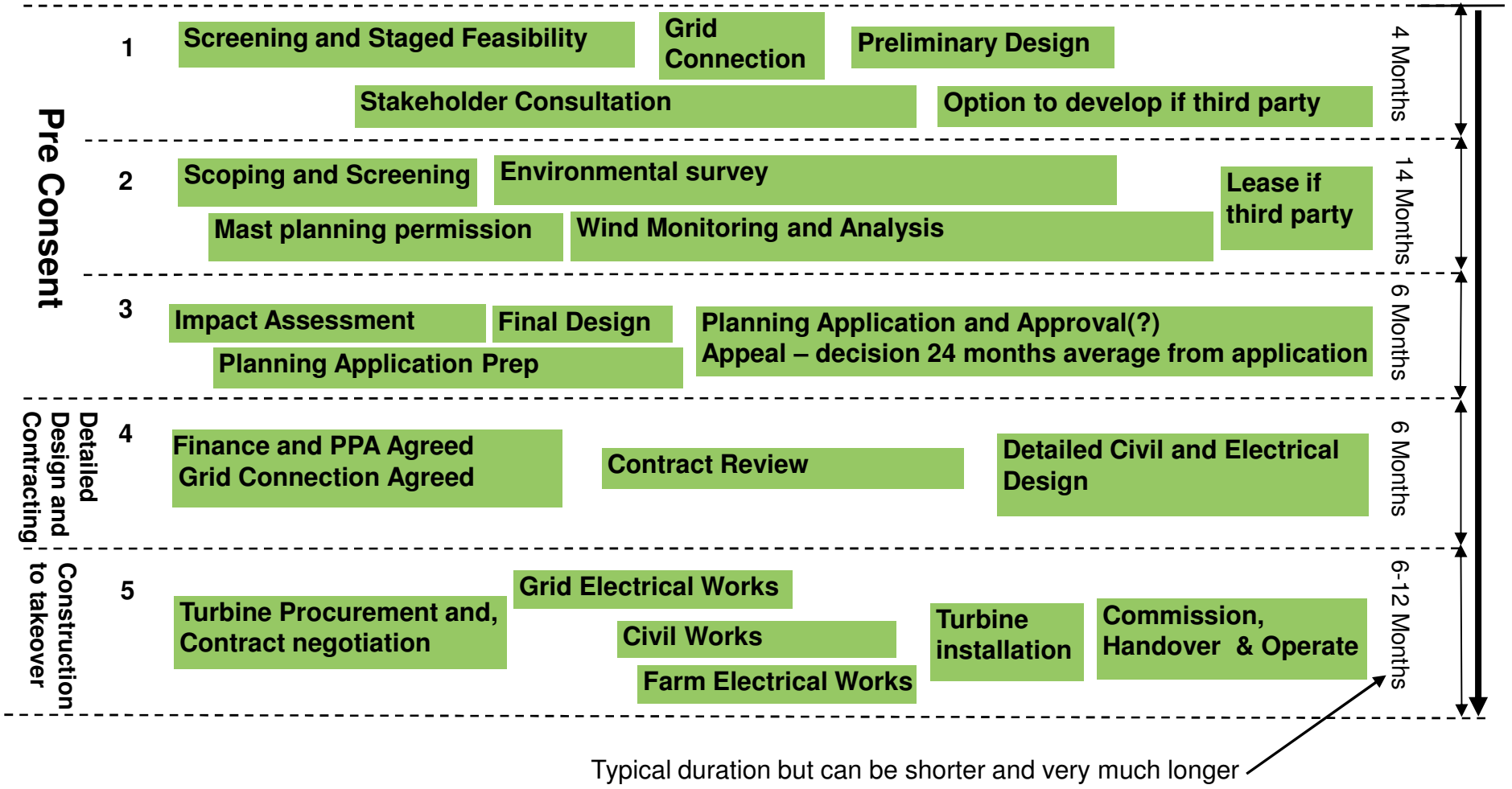
Coemi 55/15

E-3120 50kW

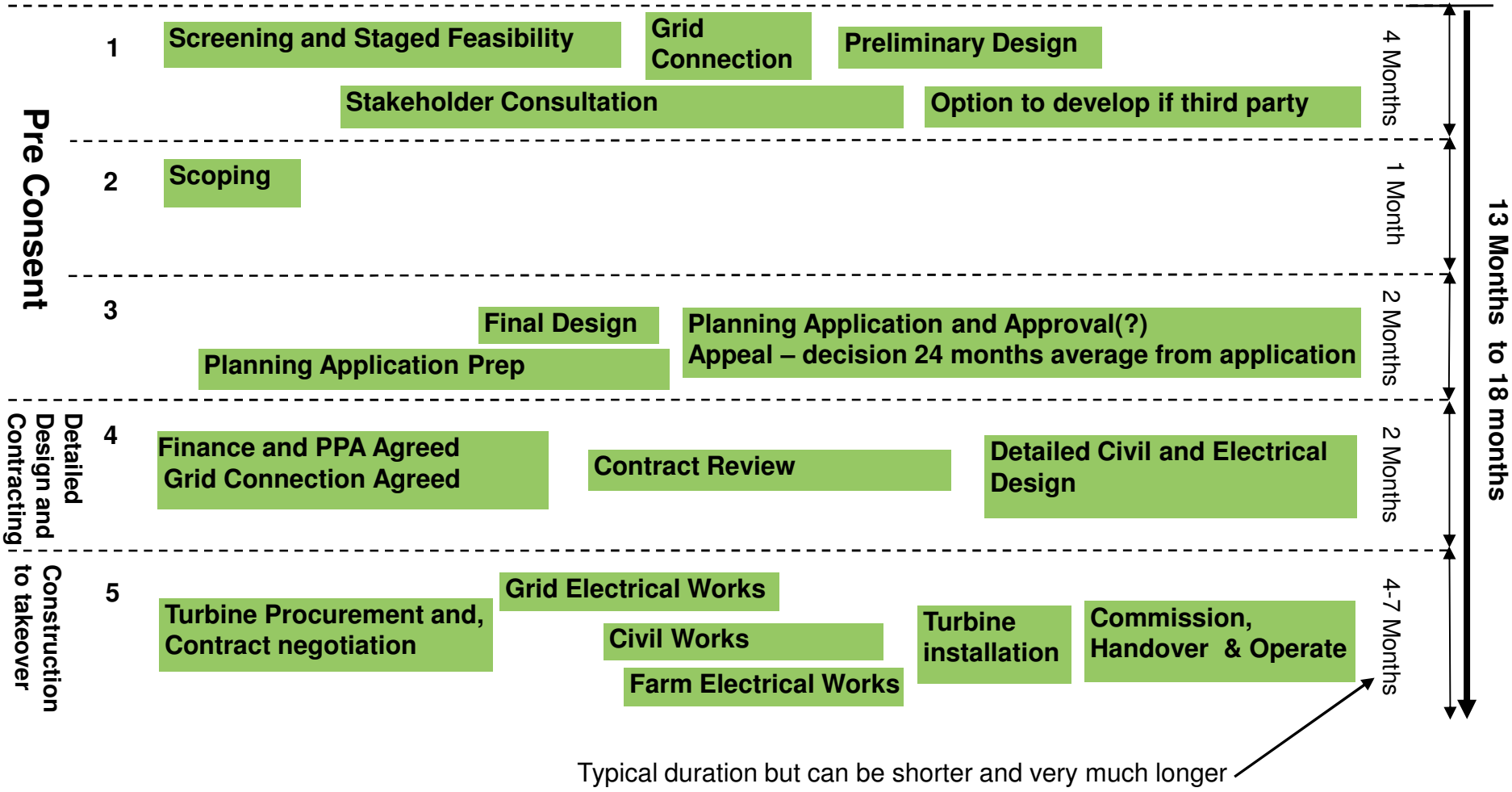
GHREPOWER 50kW

Polaris 50kW

Large Wind Project Development Stages ~> 5 MW



Medium Wind Project Development Stages 500kW



To sustain growth medium wind needs

- Adequate tariff – level and forward visibility
- Any tariff adjustment mechanism accounts for development lead times
- Minimum standards – functionality
- Desirable to avoid current perversion where possible
  - e.g. Need to down rate turbine to 500 kW turbines
  - Sterilising sites suitable for much greater wind energy generation (difficult to gauge this though)

Thank you for listening

Any questions?

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Keen to help you make medium wind a success.