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Renewable energy: Rise in global wind speed to boost green power

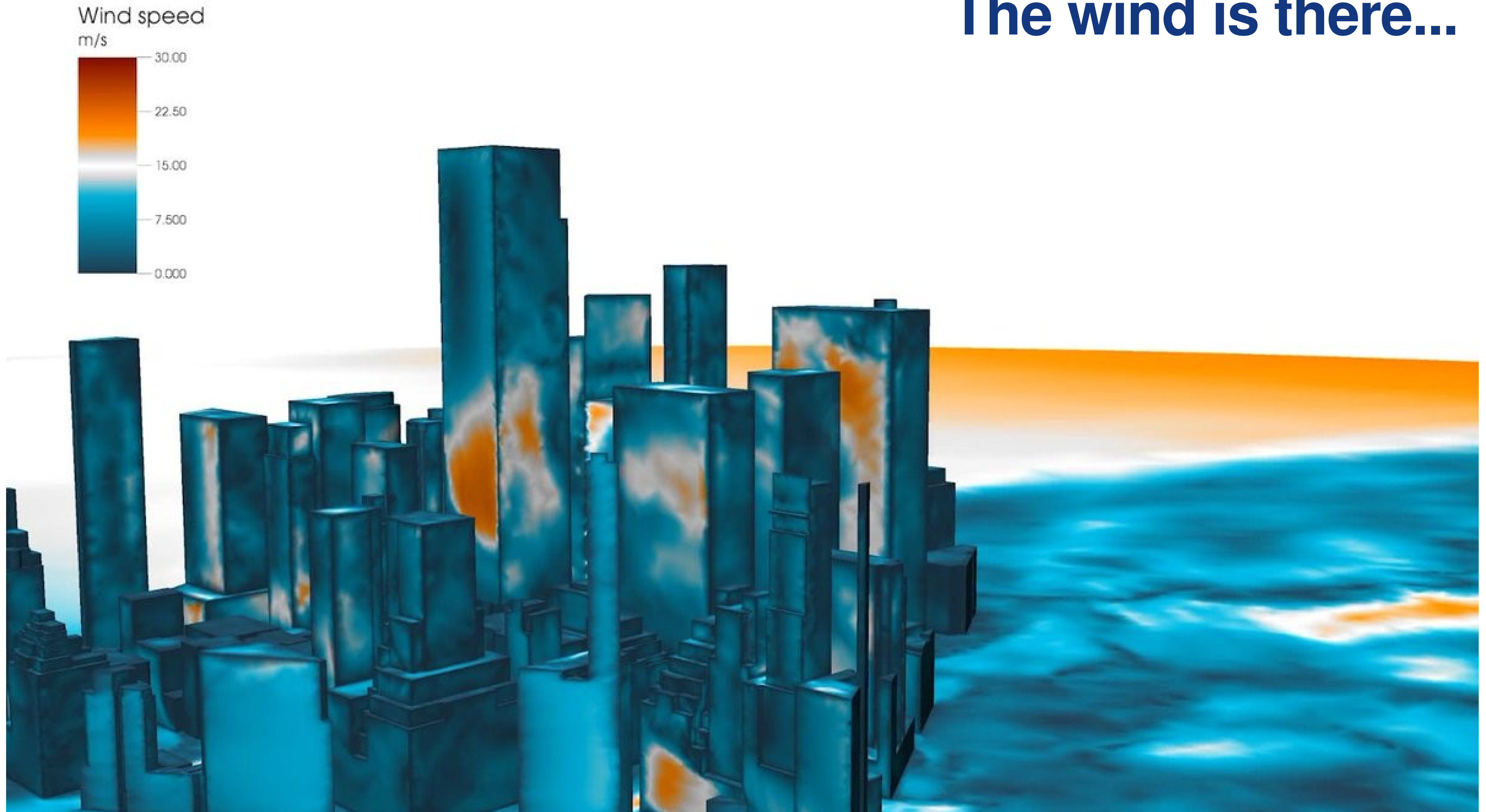
By **Matt McGrath**
Environment correspondent

🕒 18 November 2019



Climate change

The wind is there...



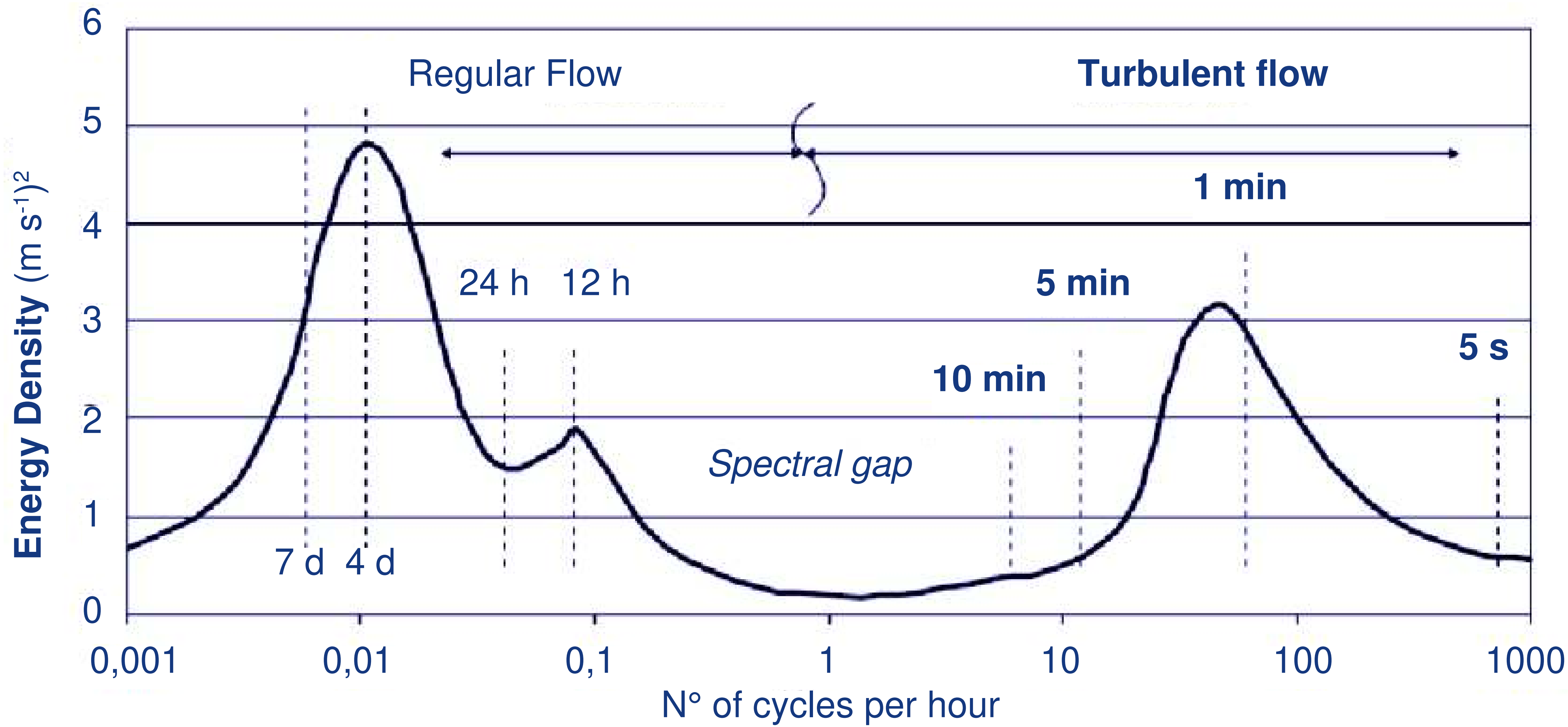




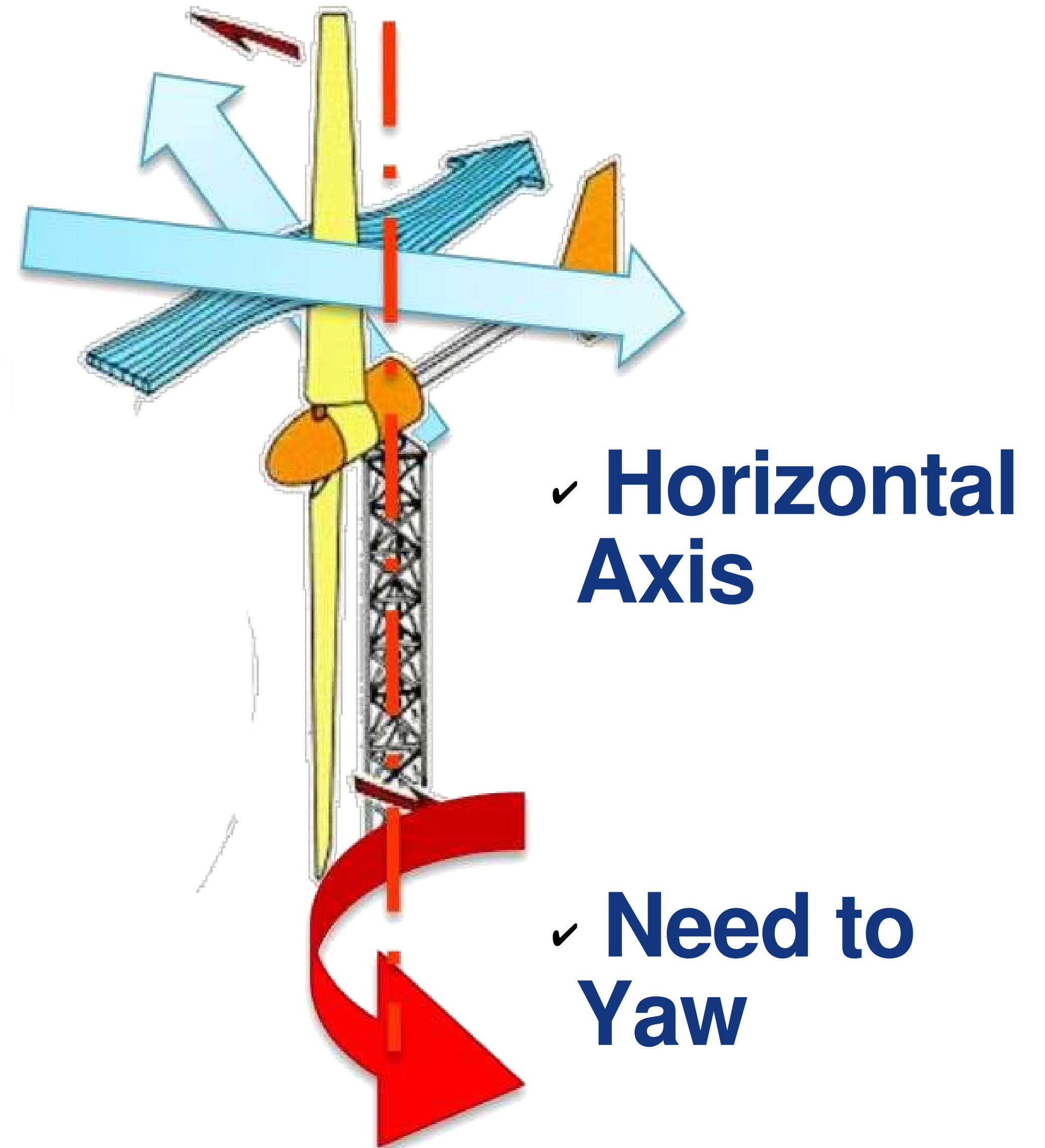
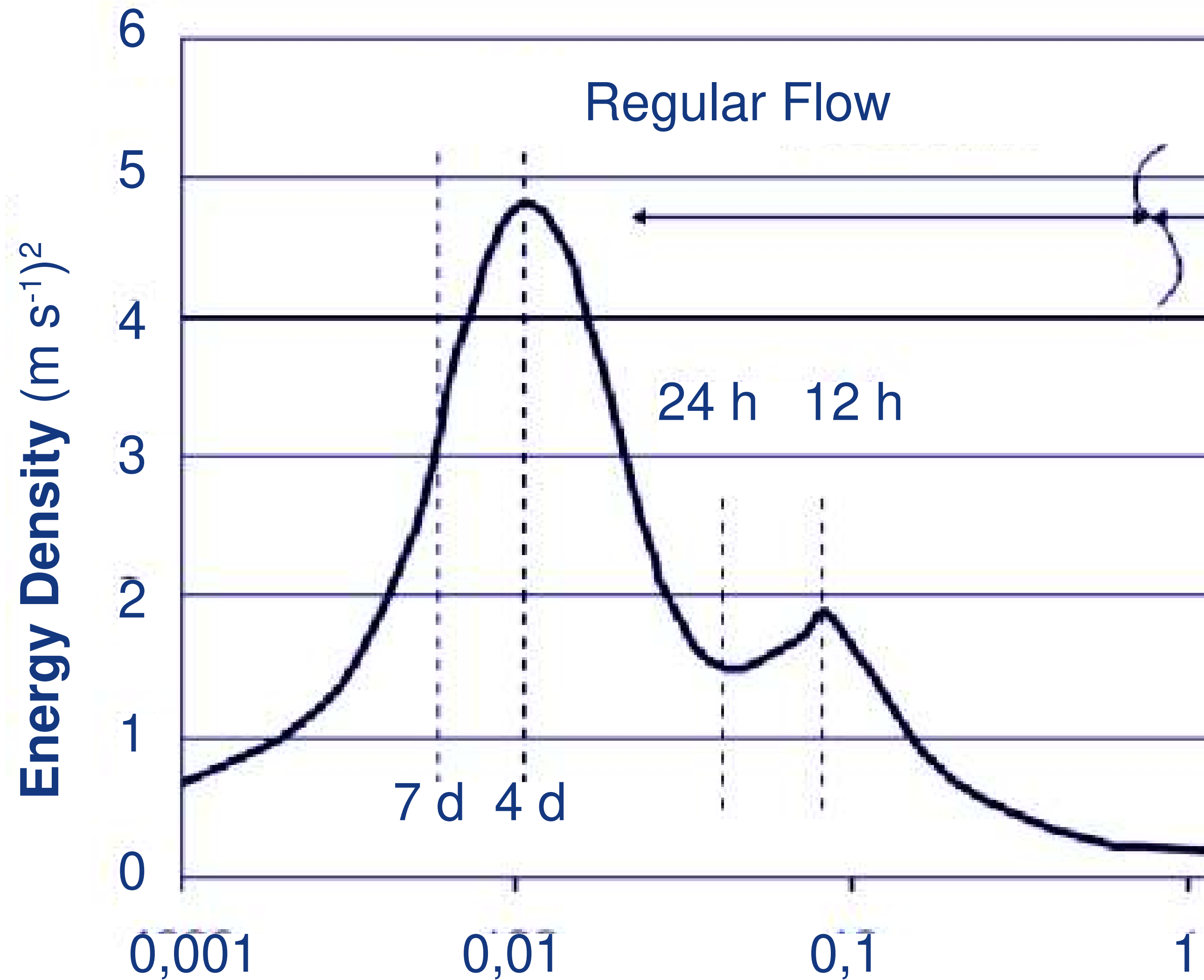
A Circular Chance!



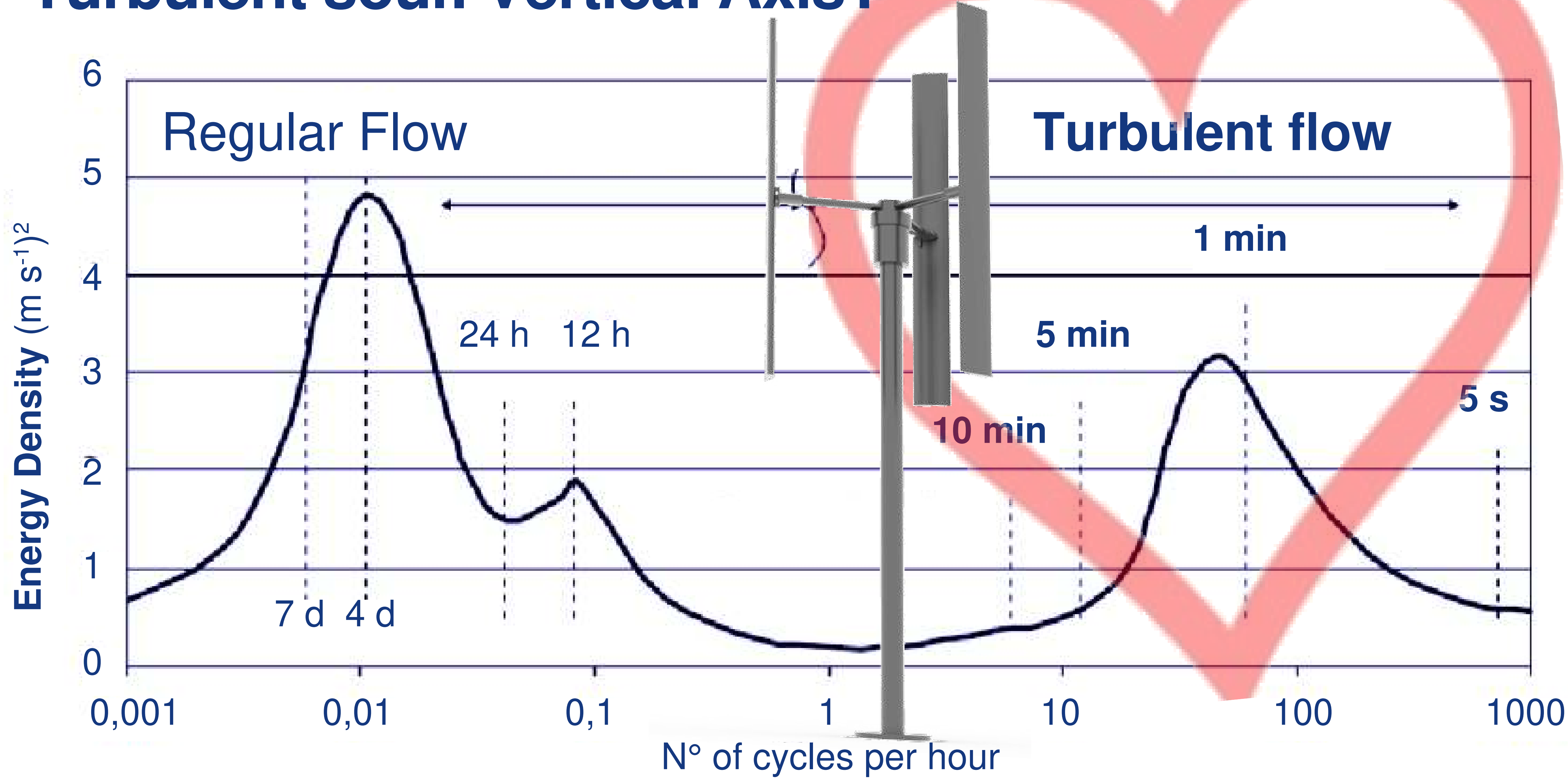
The Wind has two souls!



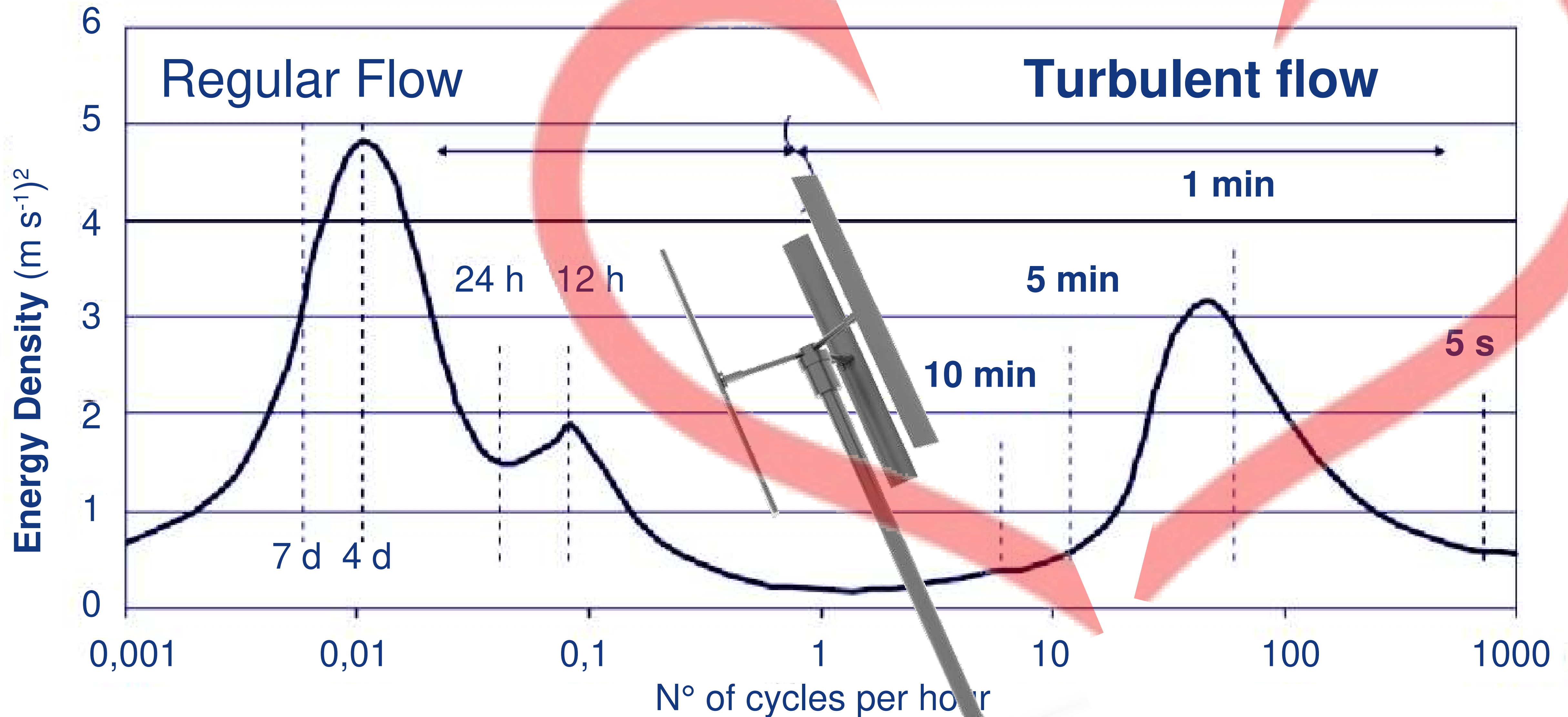
Conventional wind turbines:



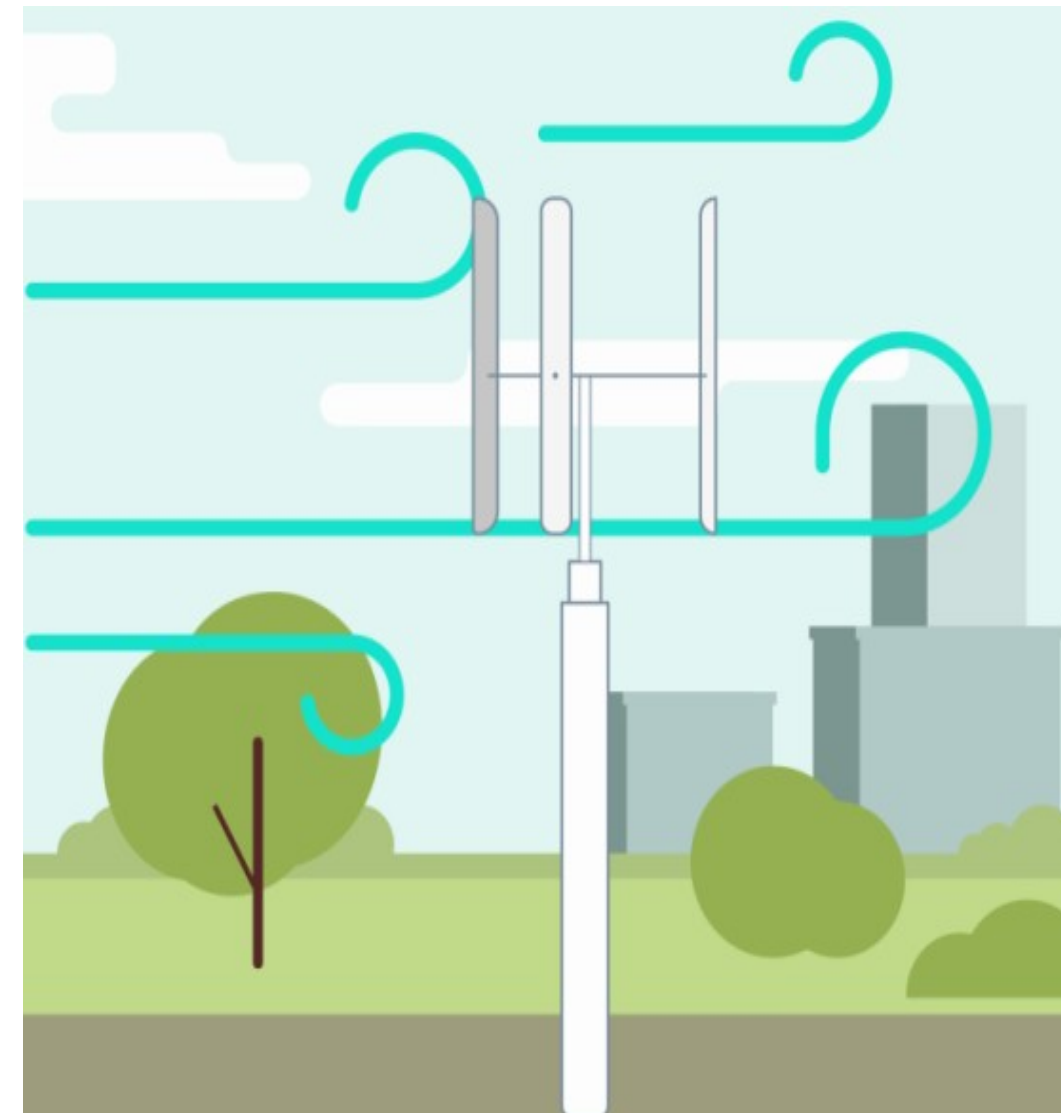
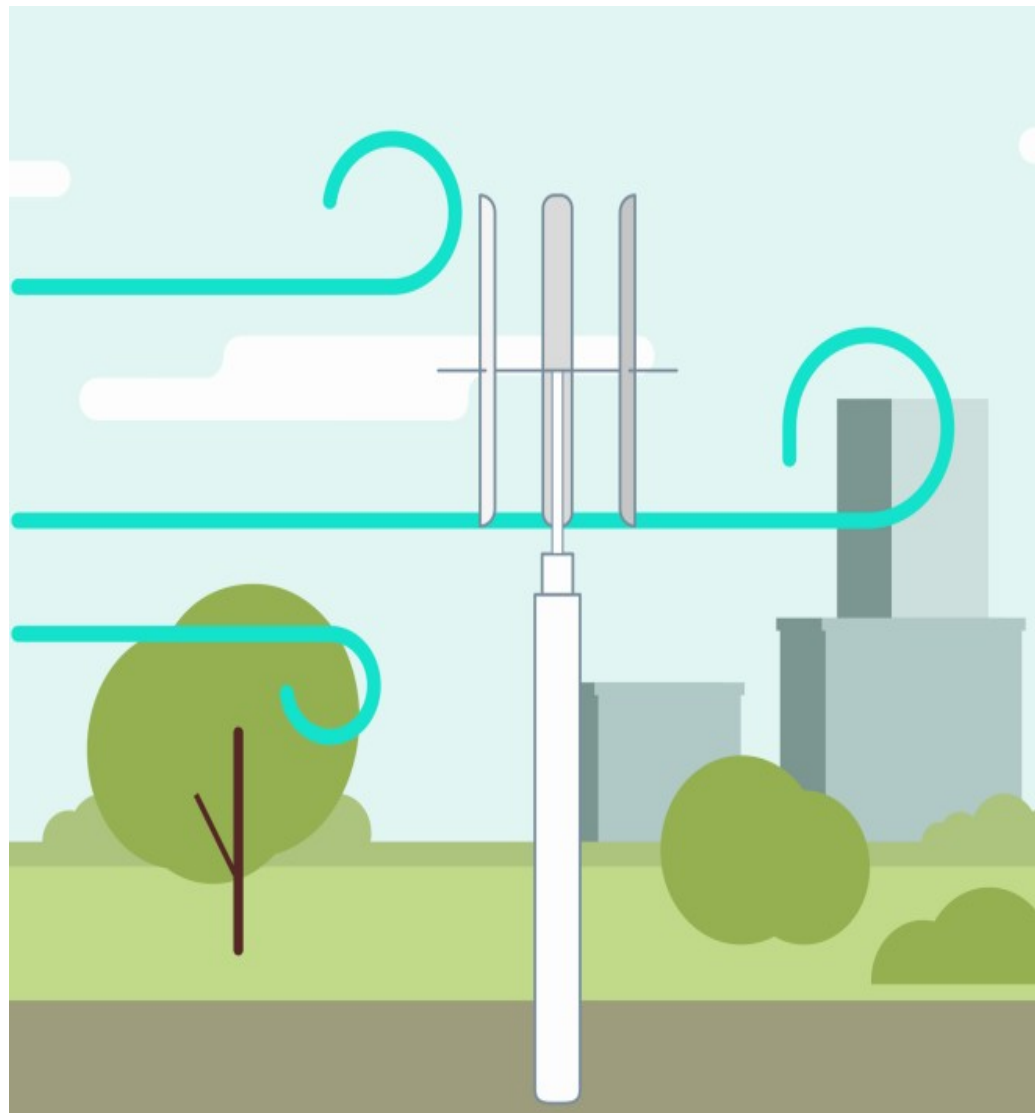
Turbulent soul: Vertical Axis?



4 minutes to start... the wind is gone :(



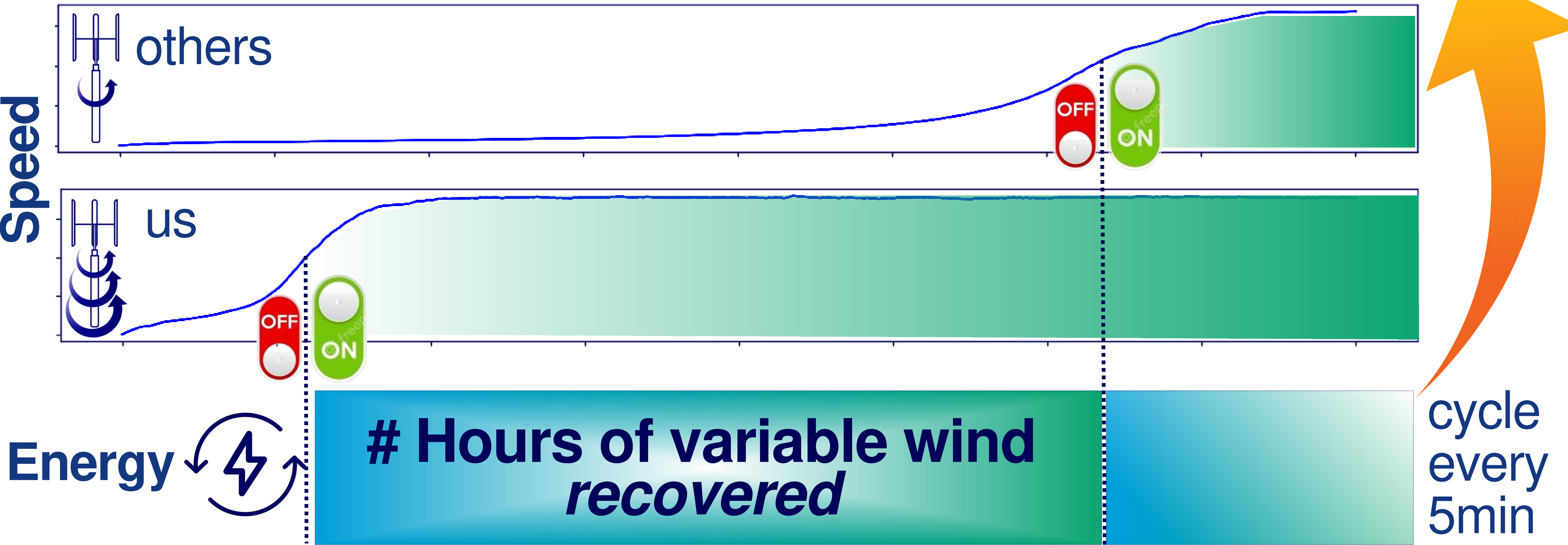
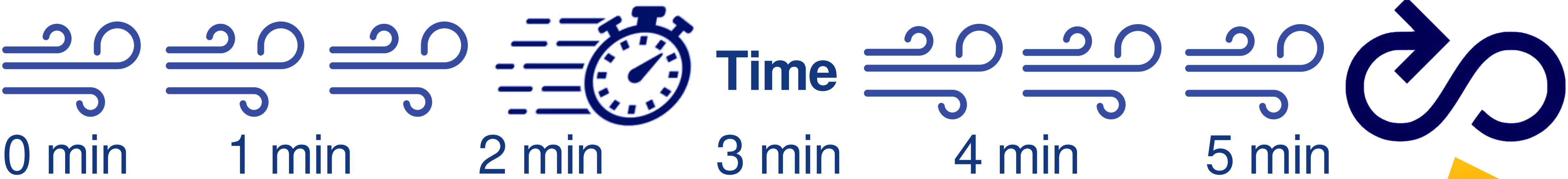
Passive Variable Geometry (PVG): Passion for the Turbulent soul of Wind



- ✓ **Self adapting** to the changes in the natural resource
- ✓ Adjusting **Pitch & Diameter** to boost **Rotation**

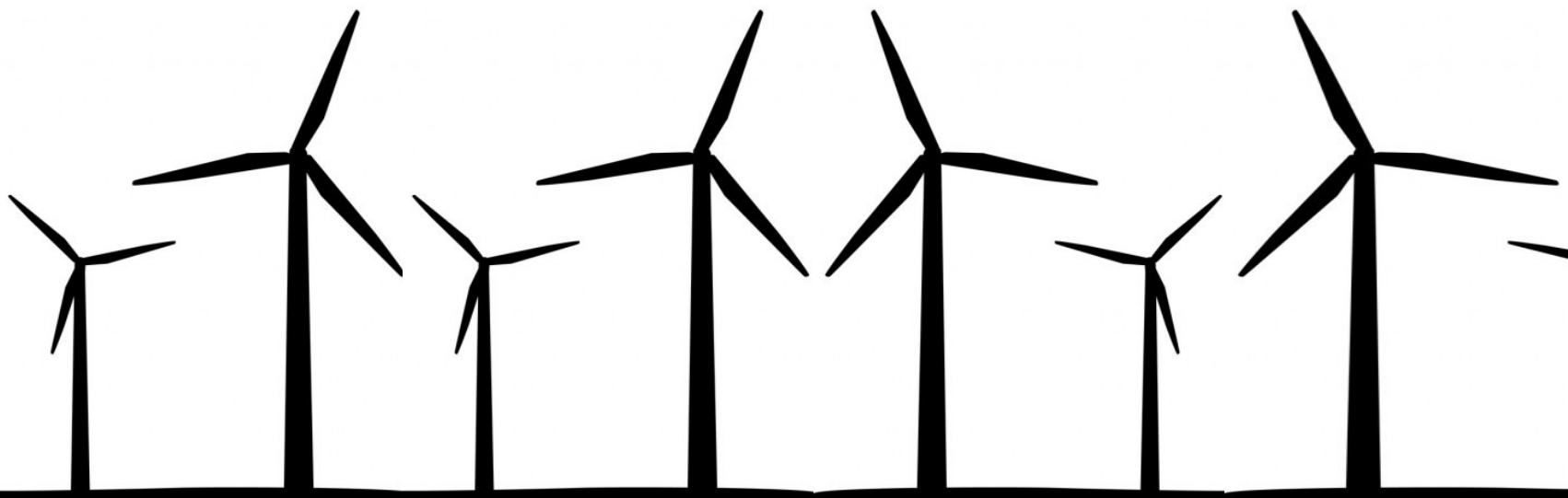
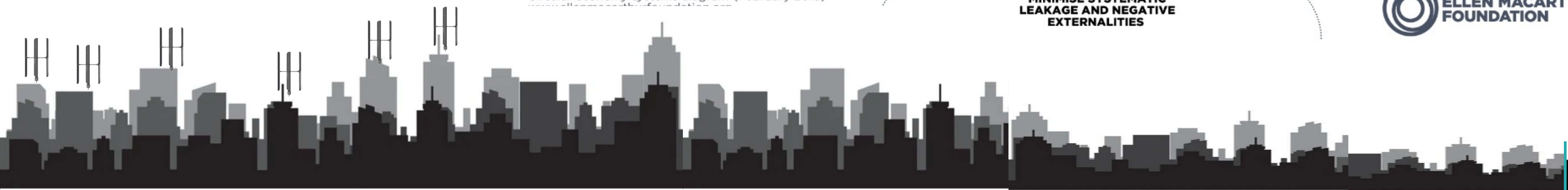
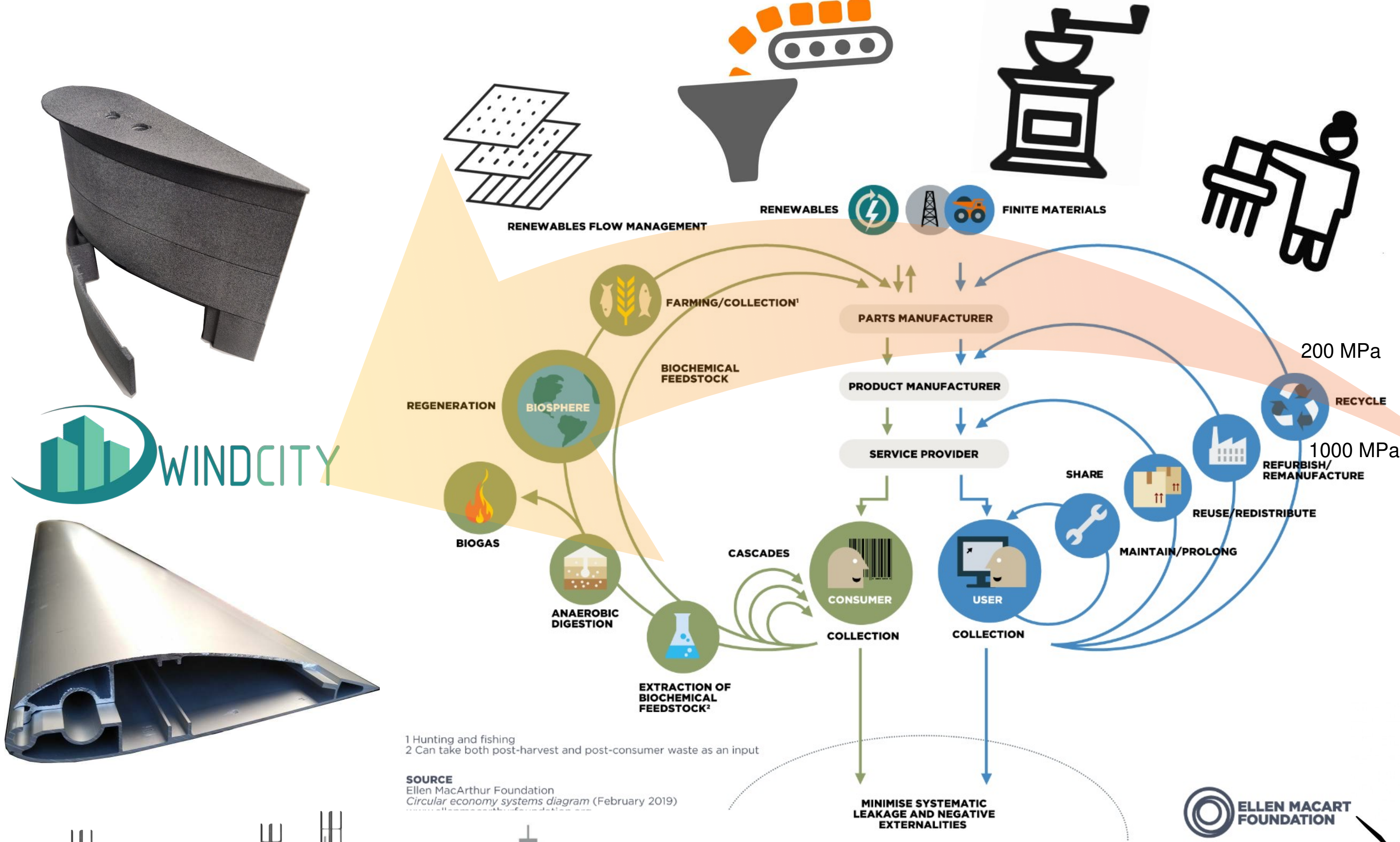


PVG in Turbulent Wind. Explained.

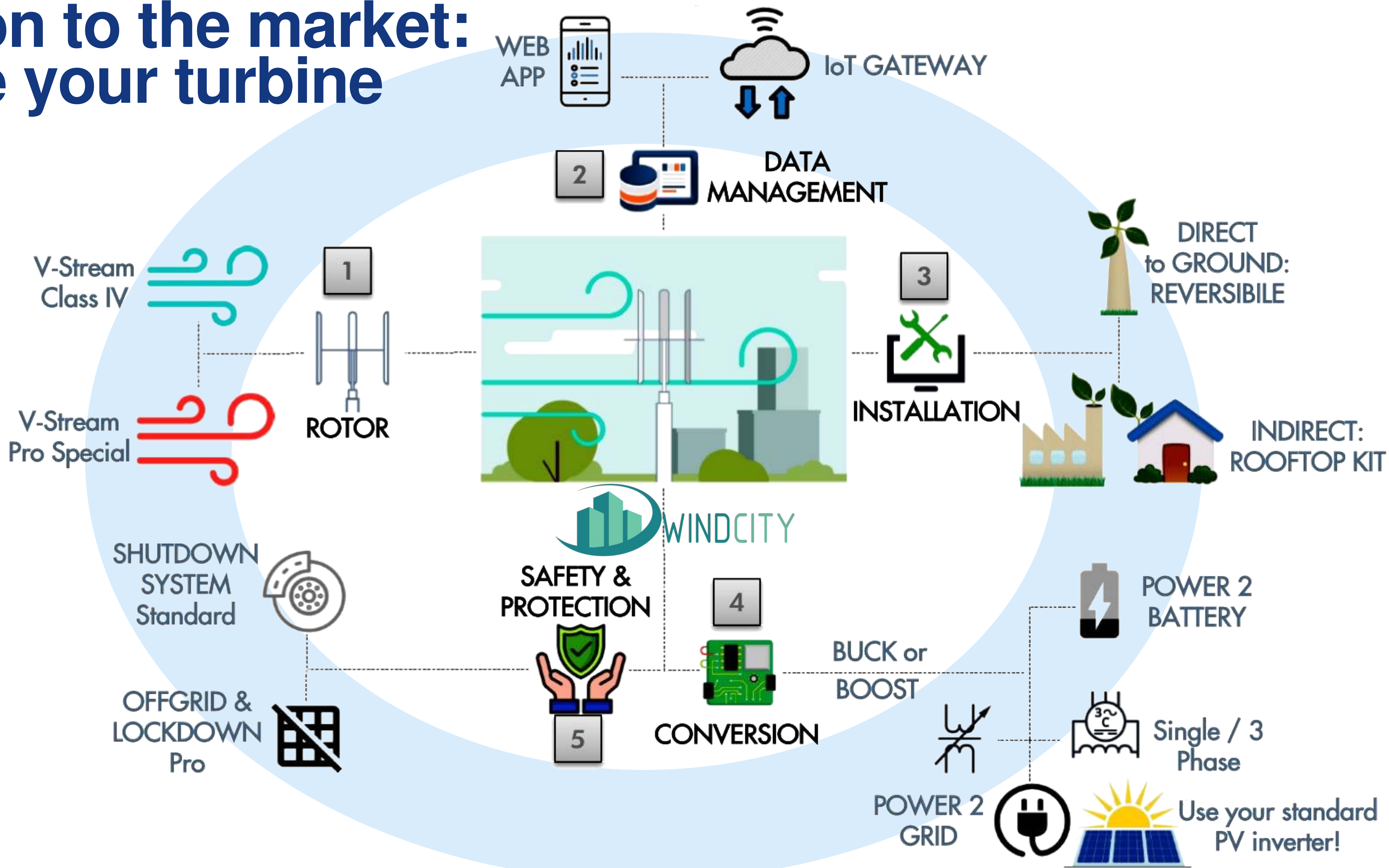


Hours of variable wind
recovered

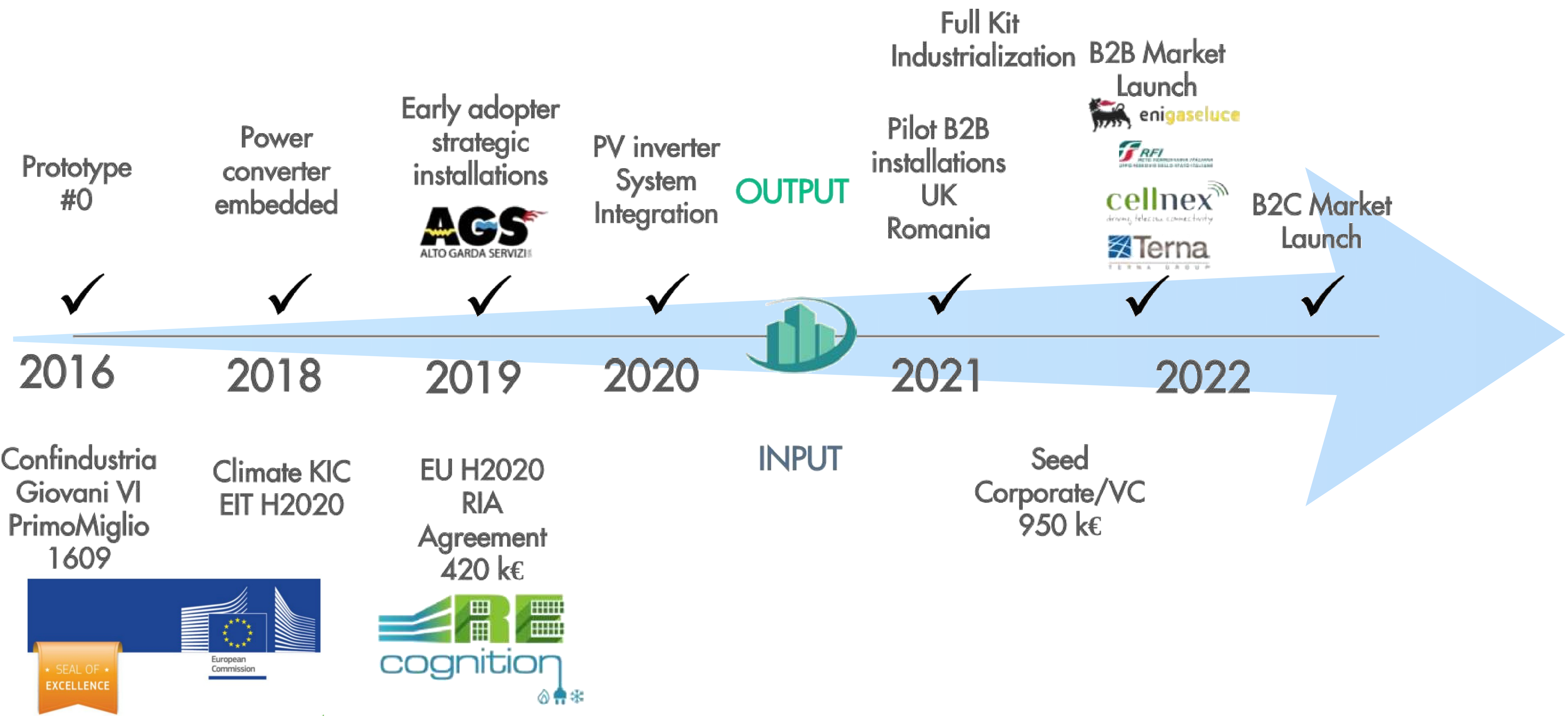
Our light-weight material secret: we re-use old wind turbine blades



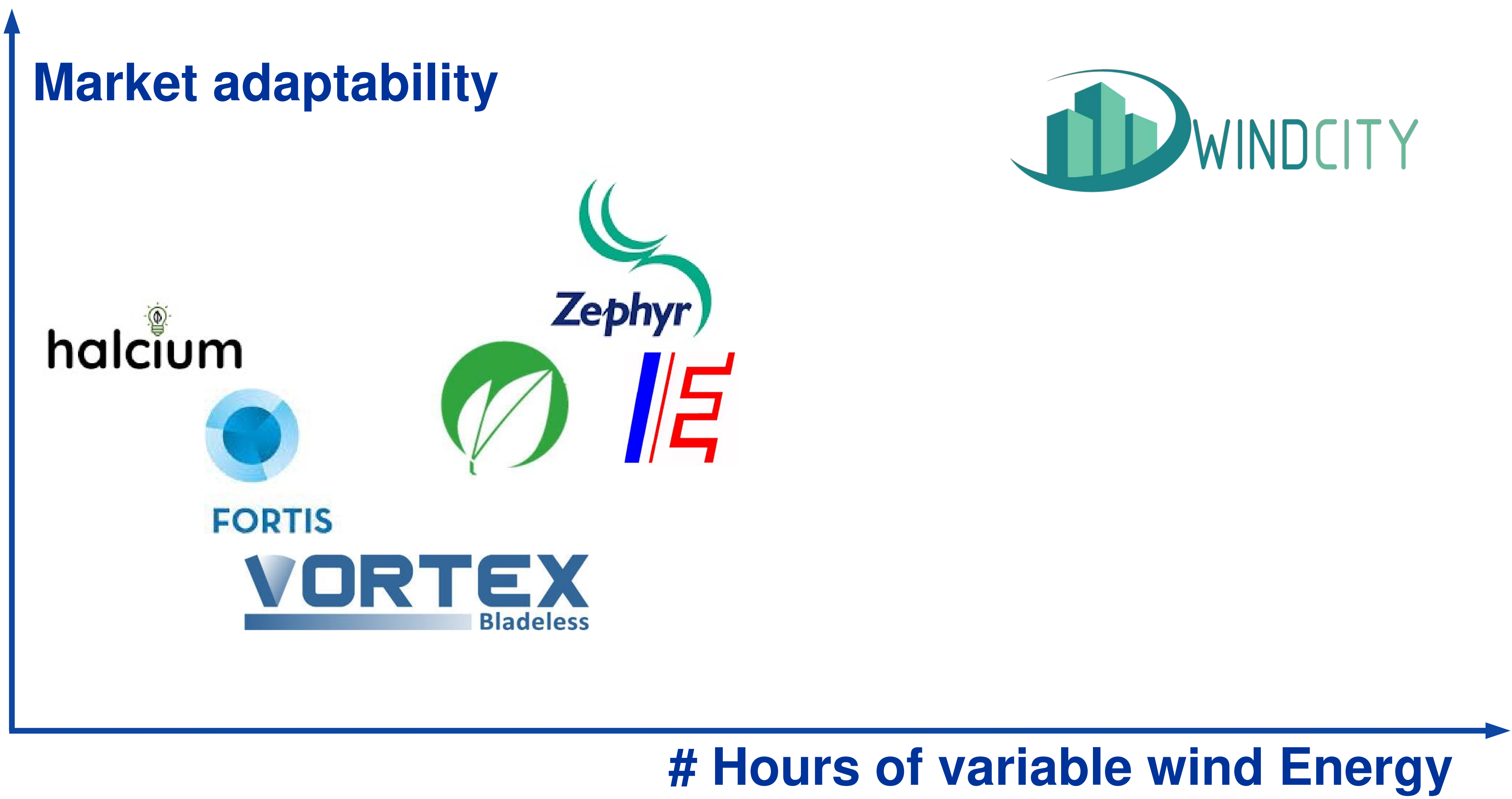
Adaptation to the market: Compose your turbine



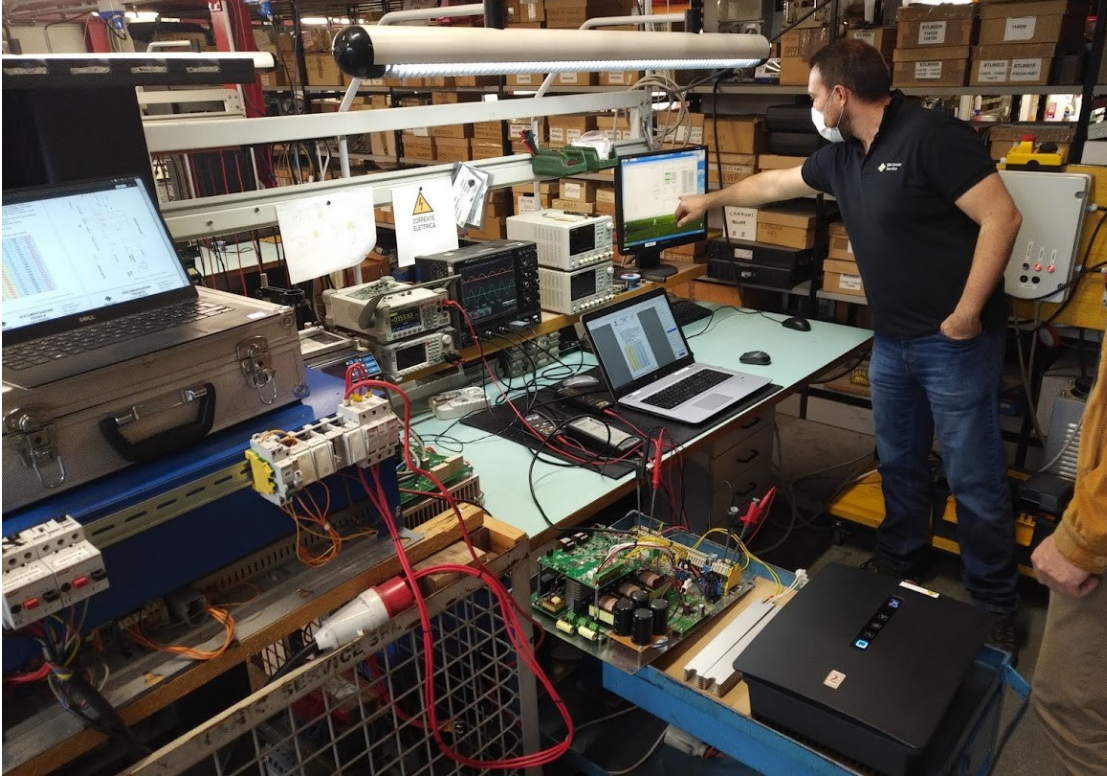
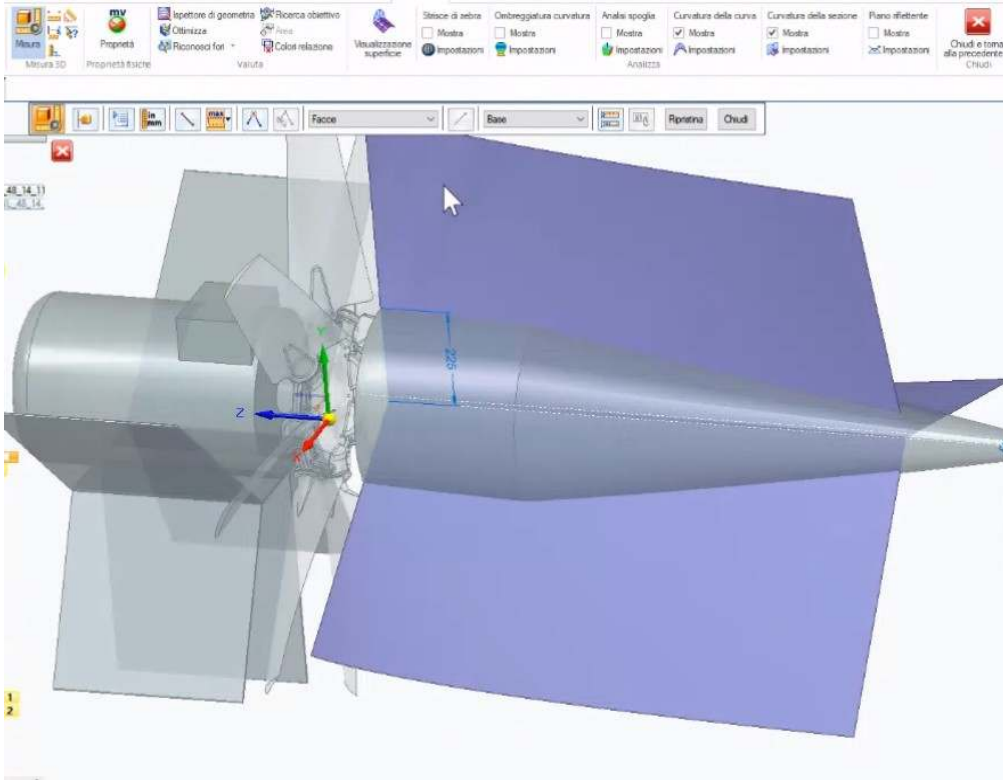
Roadmap: Pilot & Demonstrators



Competition Map



Our team: *Know-how & know-why* behind the scenes



```
class PVG:
    def __init__(self):
        #-----
        # Constants
        #-----
        with open('constants.yml') as f:
            self.constants = yaml.load(f)

        #-----
        # Mechanical properties
        #-----
        with open('mechanical.yml') as f:
            self.mech_prop = yaml.load(f)

        #-----
        # Geometrical properties
        #-----
        with open('geometrical.yml') as f:
            self.geom_prop = yaml.load(f)

        #-----
        # Aerodynamic moment coefficients
        # as a function of angle of attack
        #-----
```



ANNUAL ENERGY PRODUCTIBILITY FROM GWA 3.0 POWER DENSITY AND WIND SPEED DATA											
Wind Power (W/m2)	v (m/s)	Weibull dist.	Power	Full Energy	Power Coeff.	Cp*power	PMG lim it	Energy LIM.			
0.00	0	0.00%									
0.21	1	10.23%	2,731.25	24	0.375	1,024.22	1,024.22	1			
1.15	2	11.99%	21.85	191	0.375	8,193.75	8,193.75	9			
3.17	3	12.07%	73,743.8	645	0.375	27,853.9	27,853.9	29			
6.31	4	11.30%	174.8	1531	0.375	65.55	65.55	65			
10.28	5	10.08%	341,406	2991	0.375	128,027	128,027	113			
14.61	6	8.69%	589.95	5168	0.375	221,231	221,231	168			
18.81	7	7.28%	936,819	8207	0.375	351,307	351,307	224			
22.40	8	5.96%	1398.4	12250	0.375	524.4	524.4	274			
25.08	9	4.78%	1991.08	17442	0.375	746.655	746.655	312			
26.67	10	3.76%	2731.25	23926	0.375	1024.22	1024.22	338			
27.16	11	2.92%	3635.29	31845	0.375	1363.24	1363.24	348			
26.63	12	2.23%	4719.6	41344	0.375	1769.85	1769.85	345			
25.26	13	1.68%	6000.56	52565	0.375	2250.21	2250.21	330			
23.27	14	1.25%	7494.55	65652	0.375	2810.46	2810.46	307			
20.88	15	0.92%	9217.97	80749	0.375	3456.74	3456.74	277			
18.29	16	0.66%	11187.2	98000	0.375	4195.2	3600	210			
15.68	17	0.48%	13418.6	117547	0.375	5031.99	3600	151			
13.17	18	0.34%	15928.7	139535	0.375	5973.24	3600	107			
10.85	19	0.24%	18739.6	164107	0.375	7025.12	3600	75			
8.80	20	0.17%	21850	191406	0.375	8193.75	3600	53			
7.02	21	0.12%	25294.1	221576	0.375	9485.29	3600	36			
5.51	22	0.08%	29082.4	254761	0.375	10905.9	3600	25			
4.27	23	0.05%	33231.1	291105	0.375	12461.7	3600	17			
3.26	24	0.04%	37756.8	330750	0.375	14158.8	3600	11			
2.46	25	0.02%	42675.8	373840	0.375	16003.4	3600	8			

Wind Power density from Data Archives= 340.00 W/m2
Weibull shape factor k = 1.417
Wind Power density from Distribution = 341.21 W/m2
Total frequencies from Weibull distribution 97.31%

$V_w = 6.65$ m/s
 $A = 6.05$ m/s

Radius of VAWT, Passive Variable Geometry 20° max = 1.15 m
Blade length @ chord 250 mm = 1.9 m

density of air at mean Temperature °C = 1.25 kg/m3
PMG limit = P_{peak} = 3600 W

Max Annual Energy Yield from site: 3832.9 kWh/y



Tommaso Morbiato
R&D Head,
CEO



Matteo Pasti
R&D System
Integration

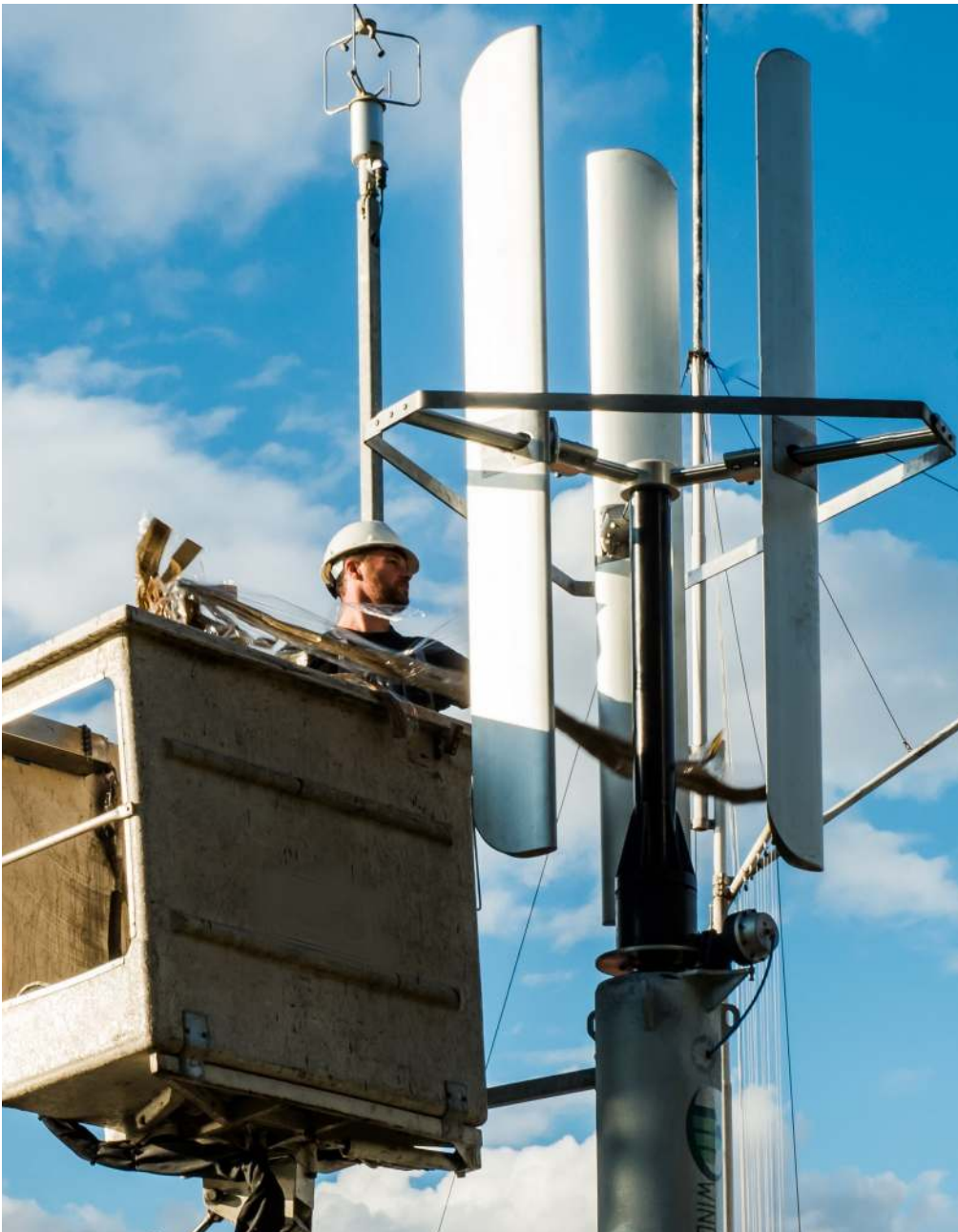
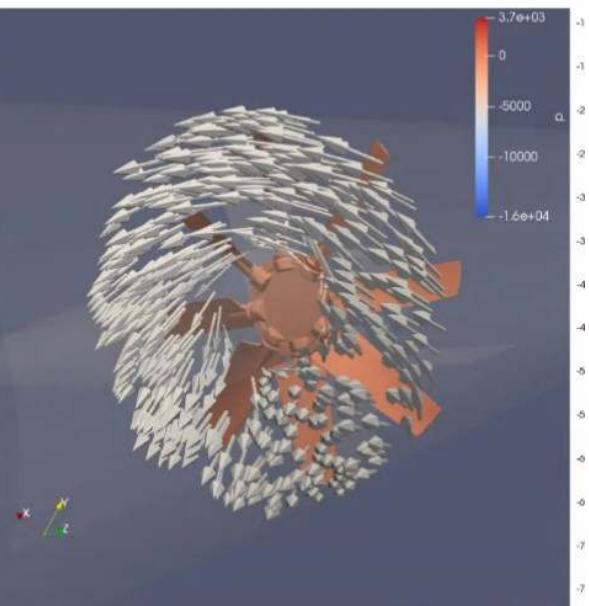


Samuele, Luana, Roby, Vanni
Casonato
Prototyping & Production Team



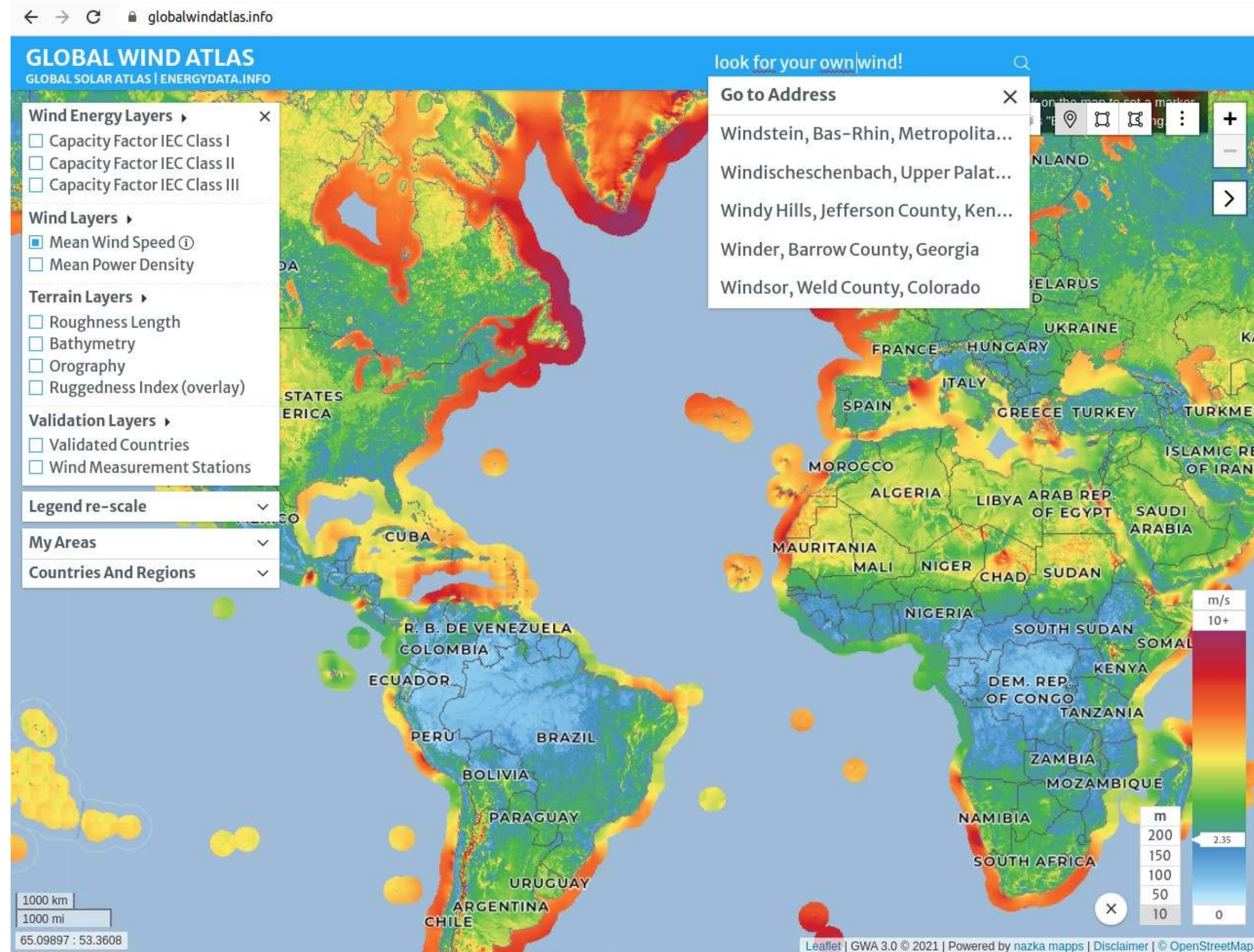
Eleonora Lisato
Administration,
Financial
Planning &
Market Dev.

Thank you to all the **R&D Team** collaborators: S. Colladet, G. Altimari, T. Pascon, D. Cosenza, I. Achilli, S. Ambroso, B. Dommergues, F. Ponchio, G. Pastore, L. D’Oriano, R. Poletto, Y. Guclu, A. Valentini, E. Mier



The Big rise of the small Wind market: time to harvest your wind is now!

- ✓ TAM 1,7 B€ in 2026
- ✓ 15% CAGR according to NewsCorp (DowJones)
- ✓ SAM 0,5 to 1,5%
- ✓ SOM (break-even) 0,07%



KEEP IN TOUCH
BUON VENTO!

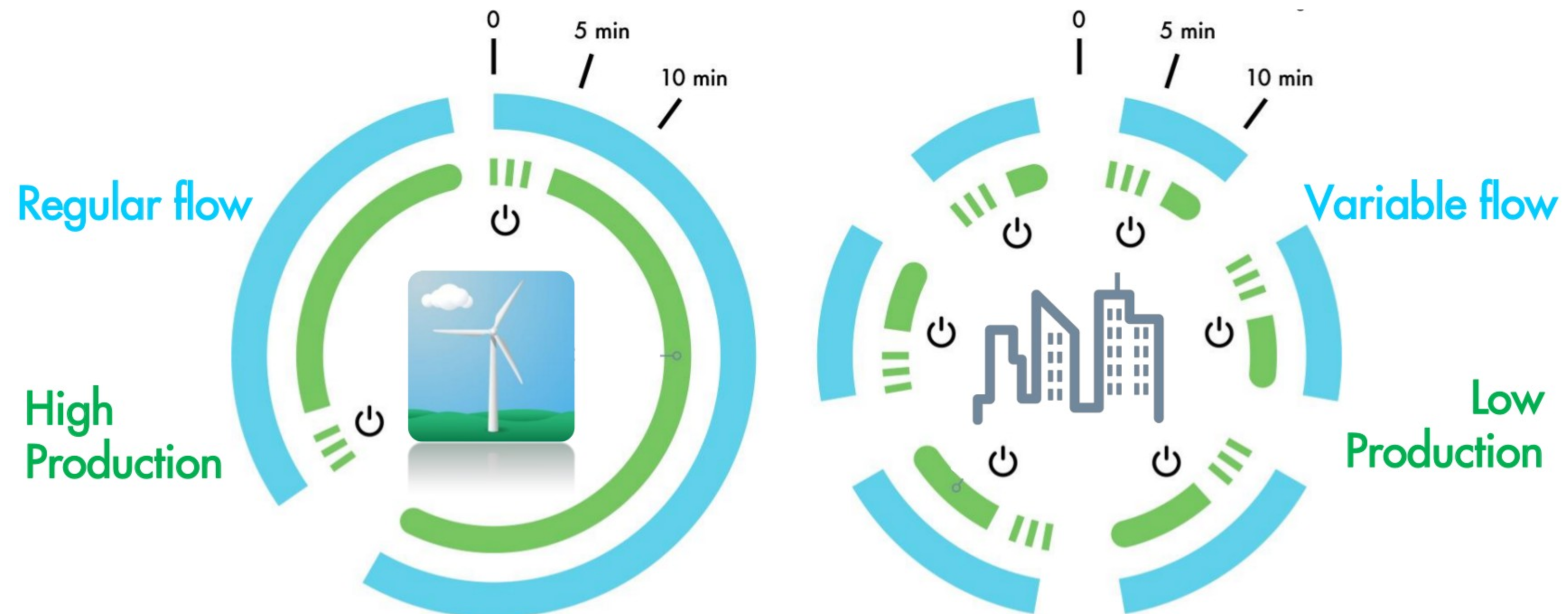
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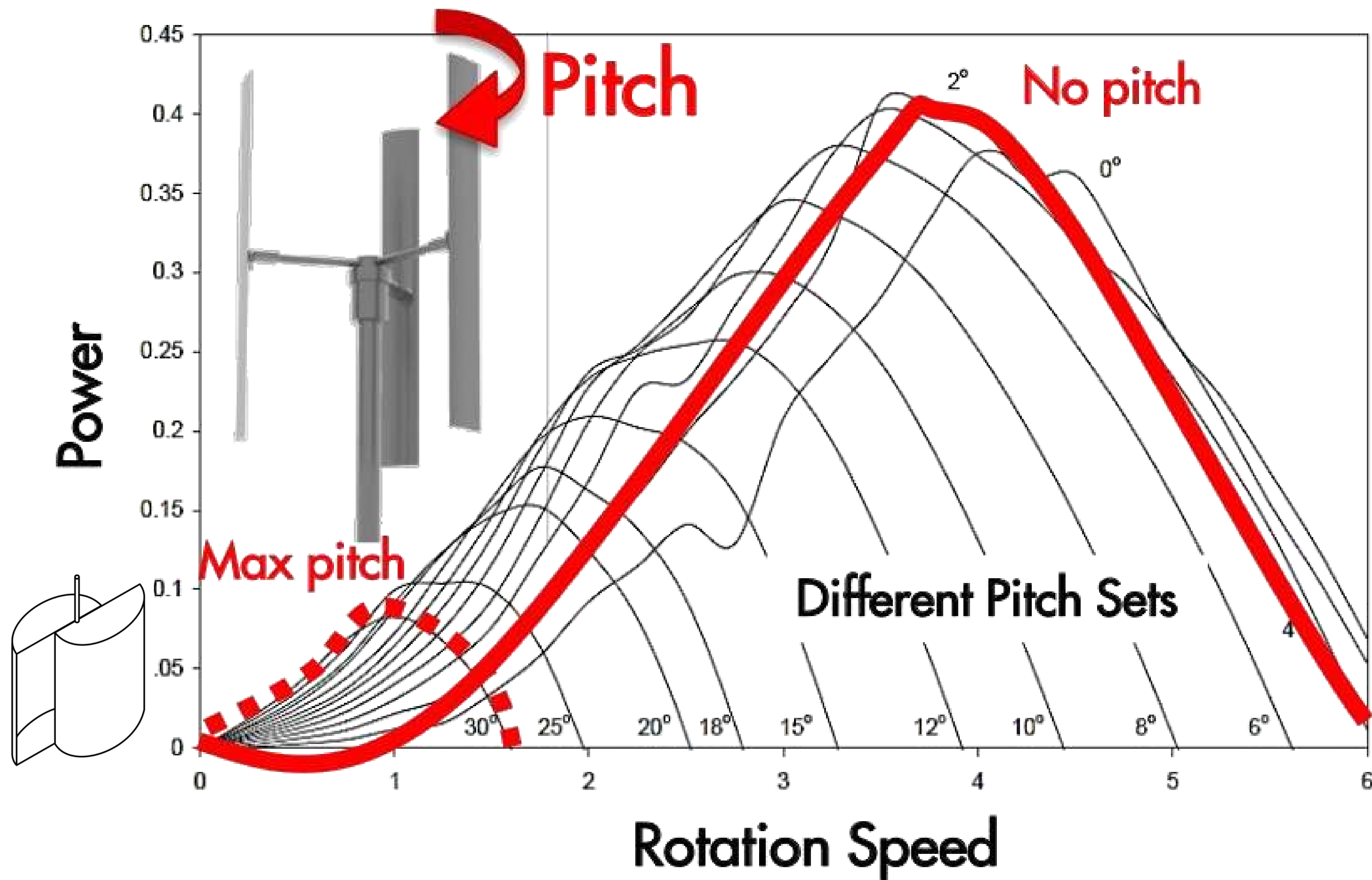
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A New Wind in the City: our Circular chance

There is a particular wind blowing **below** conventional wind turbines: Urban Boundary Layer nowadays is wasted

The cities could harvest this energy, but the variable flows in the urban environment reduce efficiency to **< 5% capacity factor**





- **Vertical Axis** works in any direction, but faces the **Pitch challenge**:

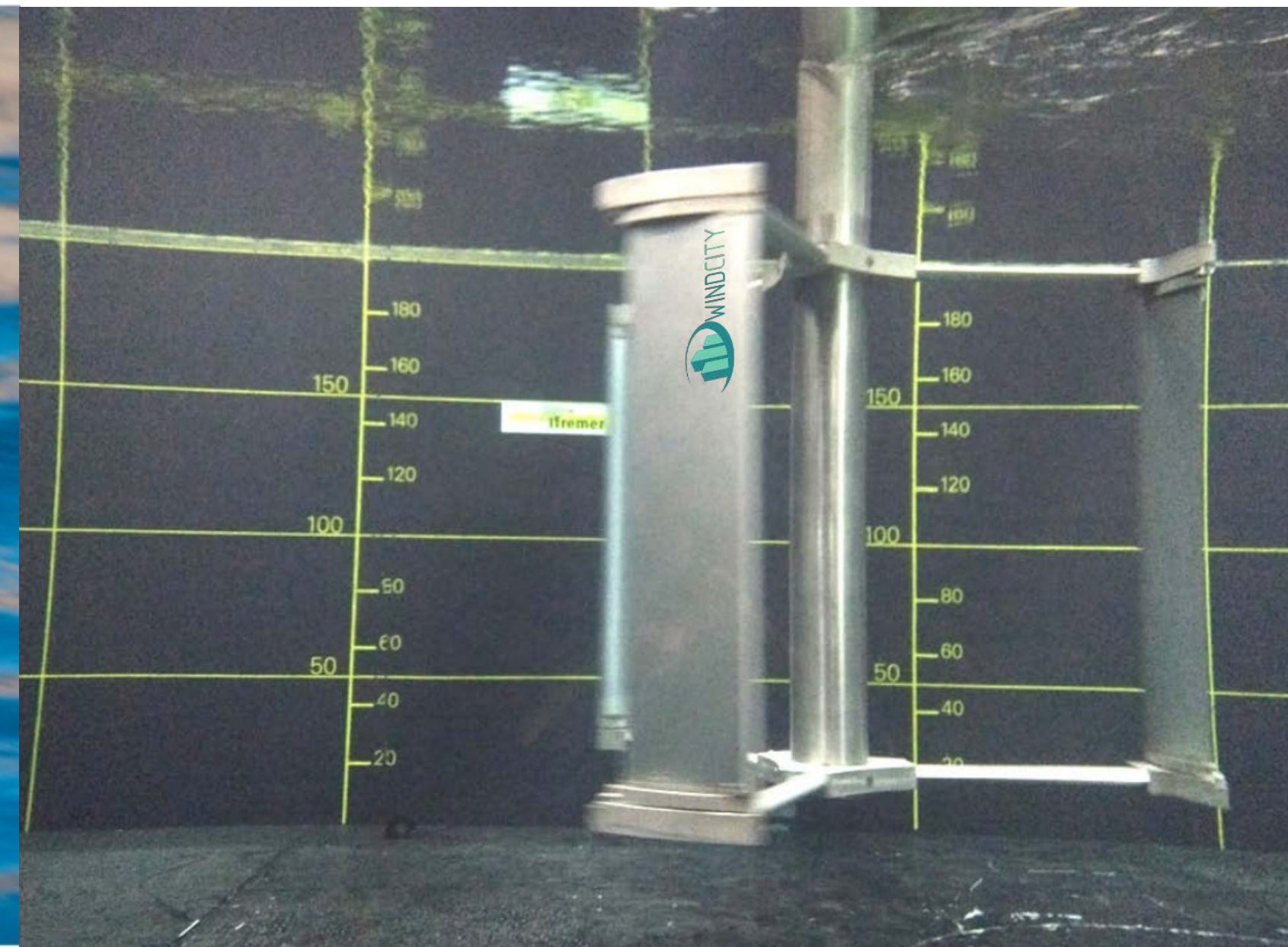
No pitch regulation **no starting**, but max power

Max pitch for self-starting, or **Drag driven** rotors: but **only 25% power!**

If we could just have both in the same machine...

Never stop exploring

Consider Wind & Water: One turbine, two fluids



When are we asking ourselves: why the two fluids together? Could we take advantage of a technology transfer ?
These creatures of Nature tell us about how much there is in common between the world of Air and the world of Water: Reynolds number similitude made self-evident

Aquatic Environment tests: the same Passive Variable Geometry concept in a turbine of similar dimensions can generate up to 10 times more energy going from wind to water variable flows. We develop the technology for the Blue Growth and shared value/licensing opportunities through B2B in the marine operations markets.

