



vertical wind energy ltd

vertical wind energy ltd.

- partnership for success





VAWT vs HAWT

- **Omni-directional**
- **Better in turbulent wind**
- **Lower noise emissions**
- **Yield potential**
- **Aesthetics**





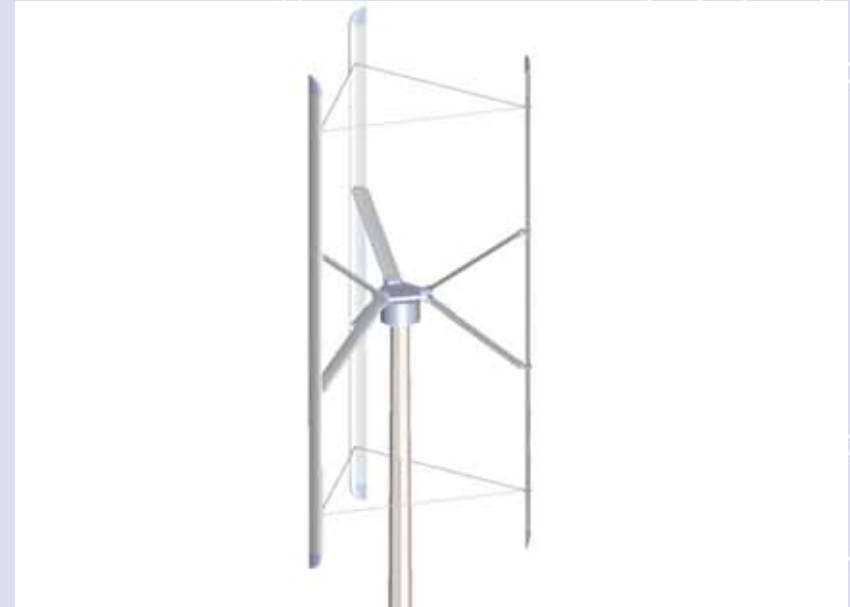
vertical wind energy ltd

Field² and Field³

Field²



Field³



Field²



Field² and Field³ Product capabilities



| Field ² Mk2 | |
|---|--|
| Start up wind speed | 4.5 m/s (10 mph) |
| Maximum Power | 3.6 kW |
| Noise power at 8 m/s | 84.5 dB(A) * |
| Annual Energy Production 5.5m/s average wind speed | 2776 kWh |
| Blade Length | 3.7 m |
| Configuration Diameter | 2.55 m |
| Swept area | 9.4 m ² |
| Material | Extruded, machined and anodized aluminium |
| Blade configuration weight | 111 kg |
| Generator Weight | 55 kg |
| Mast weights | 393 kg (10m) |
| Mast footprint | 610 x 610 mm |
| <i>* Noise levels and related data are estimated</i> | |

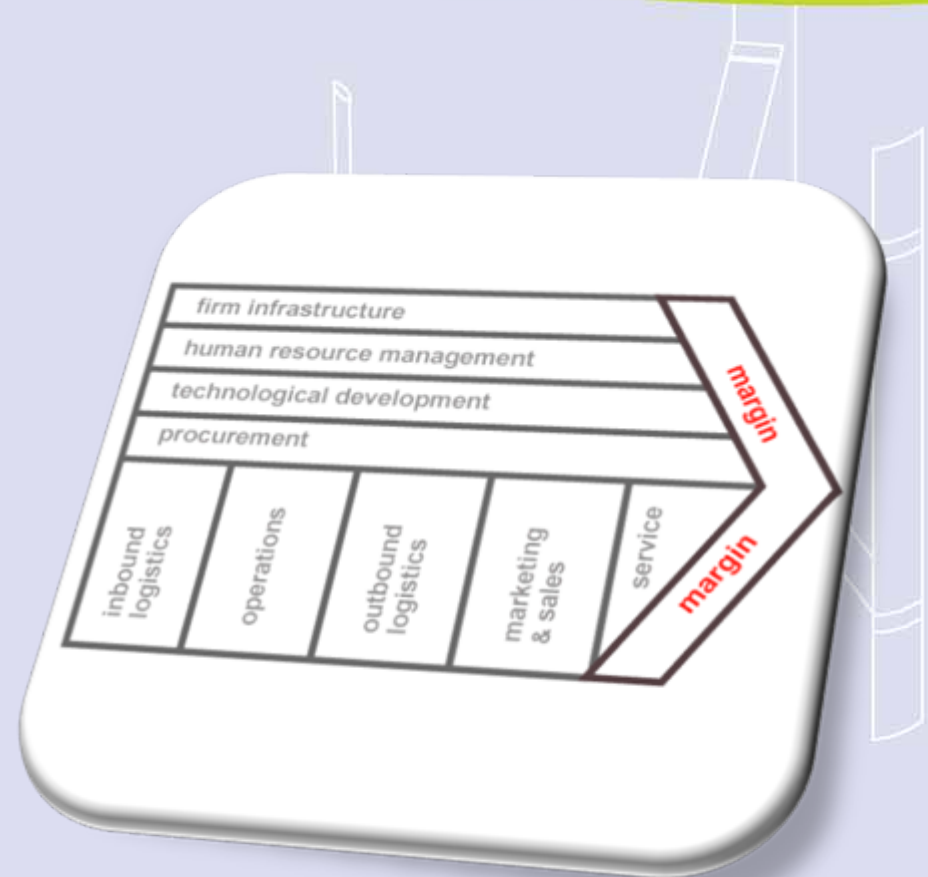
| Field ³ | |
|---|--|
| Start up wind speed | 4.5 m/s (10 mph) |
| Maximum Power | 6 kW |
| Noise power at 8 m/s | 85.5 dB(A) * |
| Annual Energy Production 5.5m/s average wind speed | 6751 kWh |
| Blade Length | 6.44 m |
| Configuration Diameter | 3.26 m |
| Swept area | 20.98 m ² |
| Material | Extruded, machined and anodized aluminium |
| Blade configuration weight | 181 kg |
| Generator Weight | 146 kg |
| Mast weights | 668 kg (12m) |
| Mast footprint | 610 x 610 mm |
| <i>* Noise levels and related data are estimated</i> | |

Standards: IEC61400-2, EN61000-6-3:2001, EN55022, BWEA Small Wind Turbine Performance and Safety Standard 29 February 2008.



Value Chain

- Where is value added?
- Partnering throughout the value chain
- Minimise fixed costs
- Develop 'Best in Class' alliances
- Focus VWE activity in key areas



Alliances



Generator, Electrical and control system design



Foundation and mast design and fabrication



Mechanical and aerodynamic design and engineering



National Installation

Company

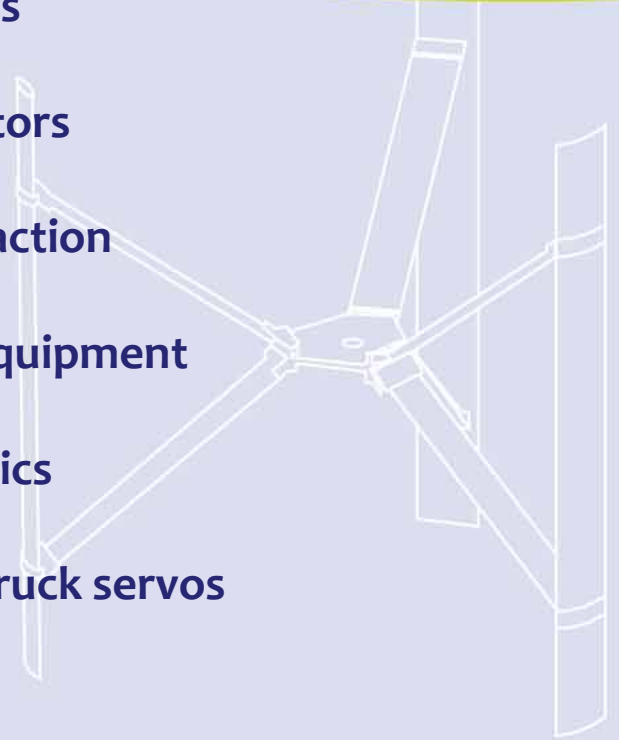
- First Ostergrens Co founded 1917
- 60 employees
- Solna (Sweden), UK and China
- Quality Mgt Systems

Services

- Electrical Engineering Design
- Control System Design
- Automotive Supplier

Products

- Electric Motors
 - Pump motors
 - Sail contraction
 - Medical equipment
- Drive Electronics
 - Fork Lift truck servos
- Transmissions
- Standard/Custom



Company

- Engineering Consultancy formed in 1993
- West Sussex Based
- State-of-the-Art Computational Analysis Services
- 10 Staff

Team

- Structural engineers and aerodynamicists
- Advising across the entire spectrum of structural, fluid flow, aerodynamic and thermal management disciplines
- Technology development and innovation

Expertise

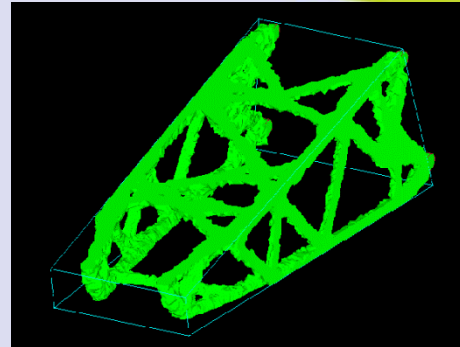
- Wealth of engineering experience
- Performance and Reliability improvement
- Cost reduction
- Shorter development timelines



Engenuity Activities

Structural Optimisation

- Composites
- Aluminium
- Magnesium
- Steel

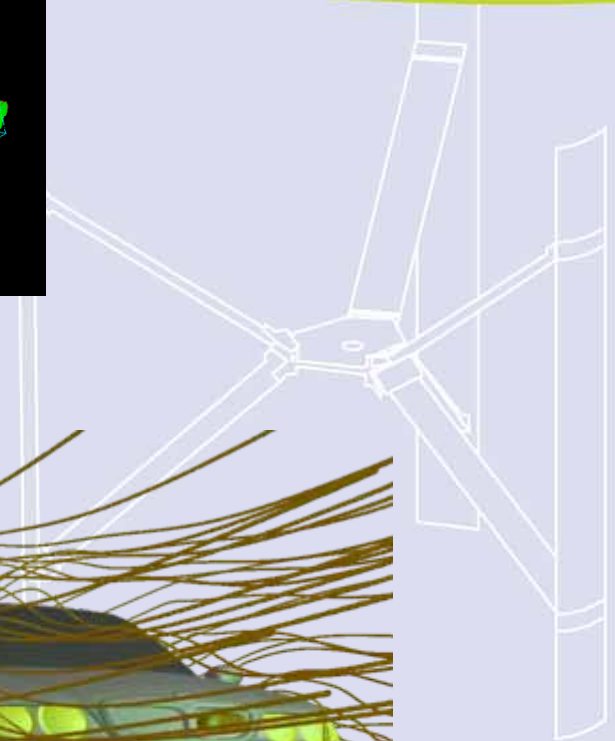
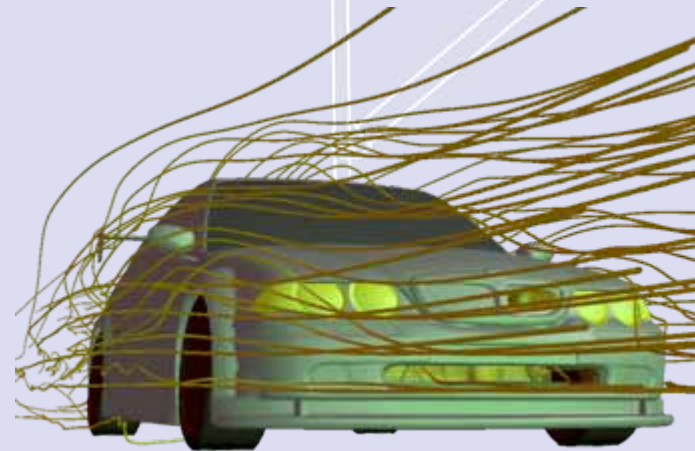


Industries

- Motorsport
- Military
- Automotive
- Aerospace

Technologies

- Aerodynamics
- Thermal Analysis
- Reliability Analysis
- Performance Prediction
- Data Acquisition



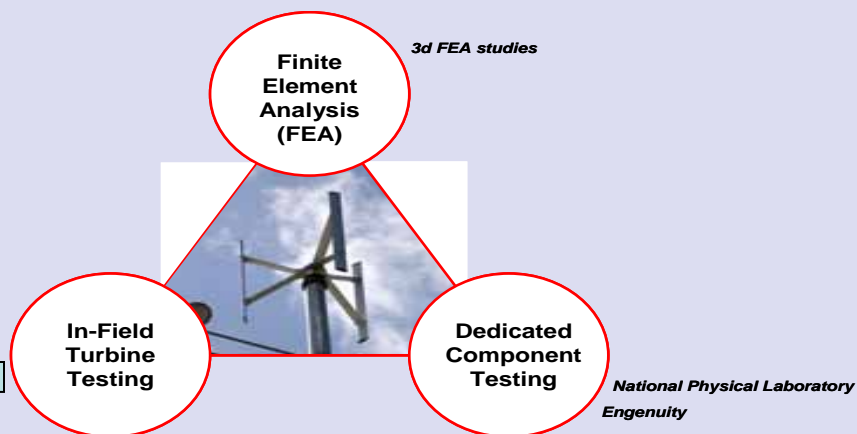


Technical Development

Structural Performance

Safety Issues

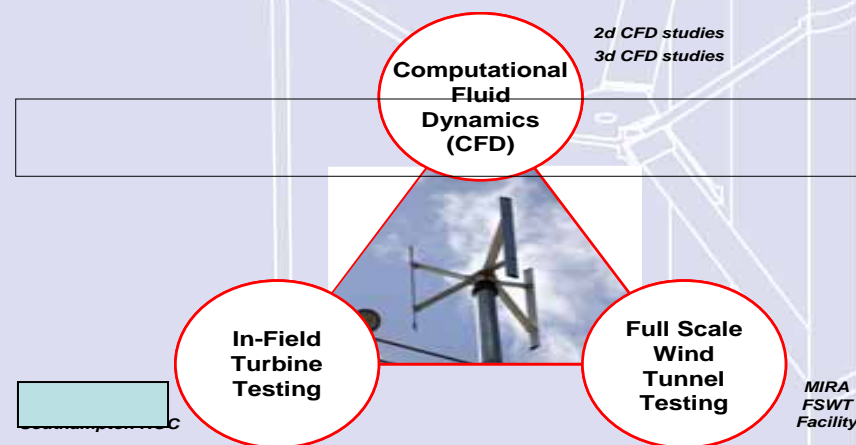
Life Determination



Aerodynamic Performance

Performance assessments

Energy Yield assessments

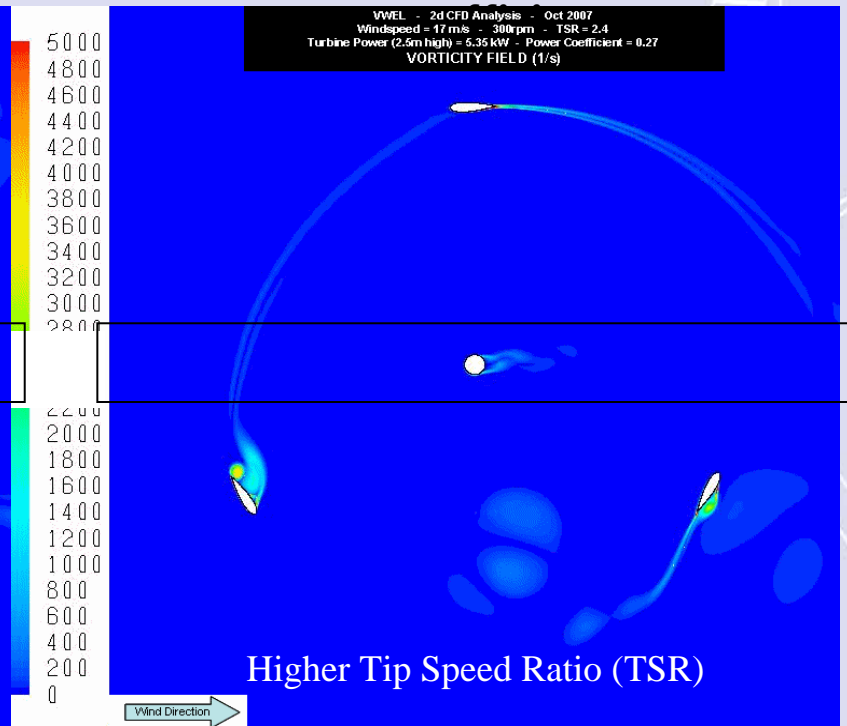
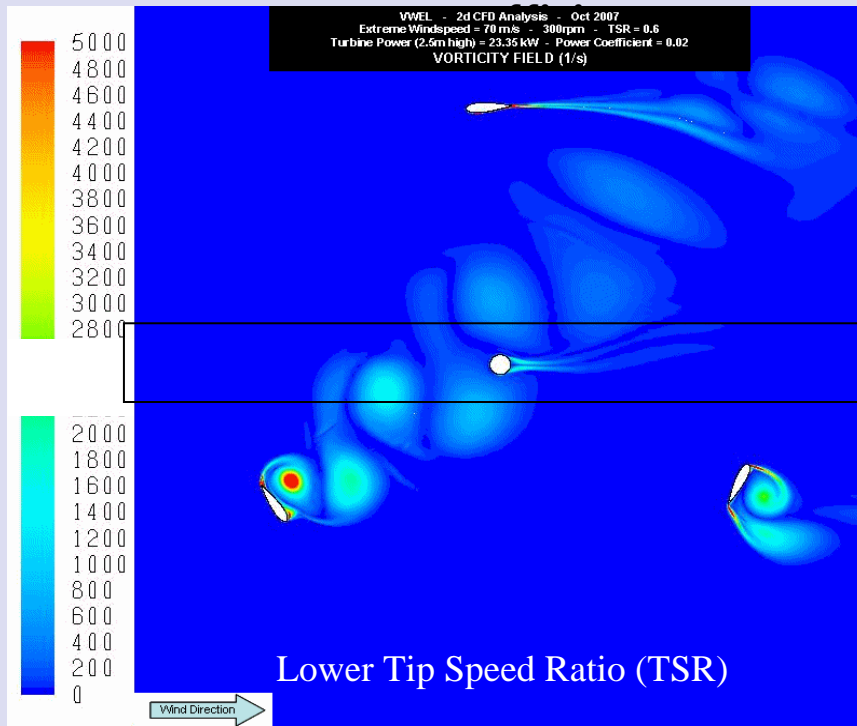


VAWT Aerodynamics Basics

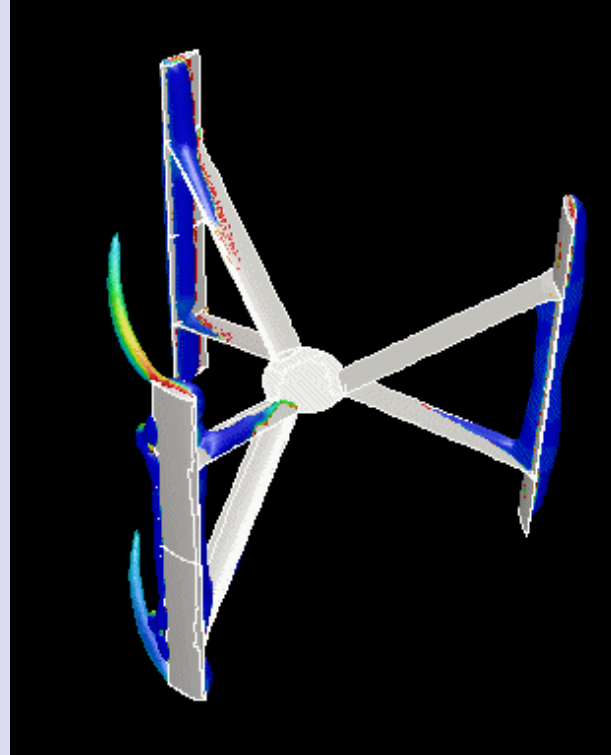
Rotational Speed vs Windspeed \Rightarrow Peak Power

Highly Separated Flowfield - Less

Attached Flow Dominates - More



'3-Dimensional' Aerodynamic Effects



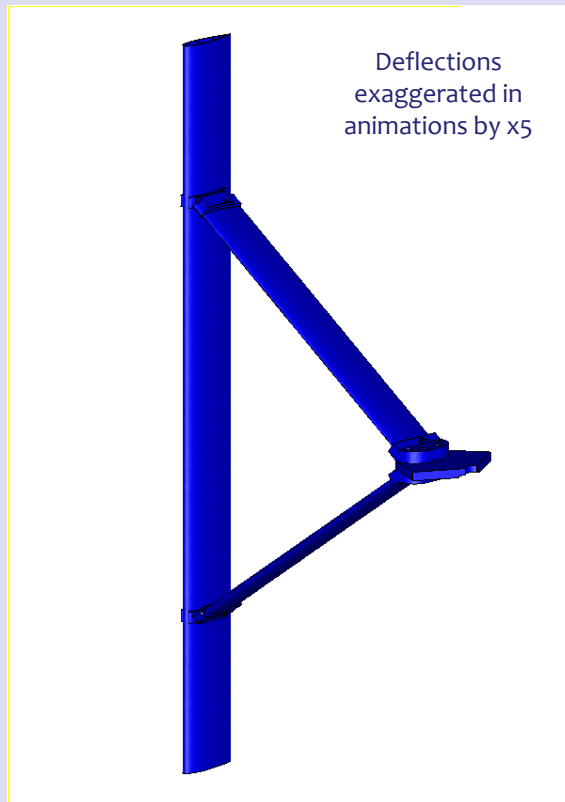
TSR = 2.3

- Additional 3d unsteady aerodynamic effects impact turbine performance
 - Blade tip vortex shedding
 - Strut drag
 - Blade / Strut junction interference

On-Going Development Summary

Summary of F² Turbine Detailed Design

Rotational speed = 300rpm



Significant Turbine Mass Reduction

- Redesign and Validation through FEA, Component Testing & Full Scale Testing
- Structural integrity of current design significantly enhanced
- Structural integrity of current design greatly exceeds lifetime requirement of 20 years
- Modular design concept retained through all redesign processes
- All redesign strategies bear minimal impact on component costs
- Larger turbines will benefit from the redesign philosophies implemented

Company

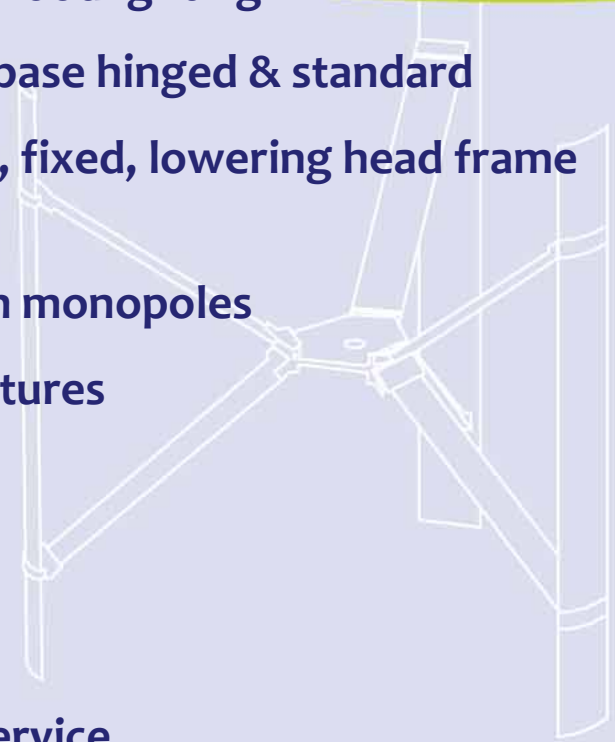
- 230 Employees
- 50 years / £25M Revenues
- UK and China Mfg

Products

- Amenity, road and floodlighting
- Lighting columns, base hinged & standard
- High mast systems, fixed, lowering head frame and base hinged
- Telecommunication monopoles
- Wind turbine structures

Services

- Lighting design
- Structural design service
- Civil, mechanical and electrical installation
- Maintenance



Company

- 16 locations nationwide
- Leicester Head Office
- 15 Service delivery centres
- In house staff
- 1500 employees

Services

- UK's largest installer of Home Insulation
- Over 2 million energy saving measures installed
- Over 6,000 installations every week
- 500+ dedicated energy saving team
- UK's largest installer of Domestic Wind Turbines
- National Accreditations

Alliances



Generator, Electrical and control system design



Foundation and mast design and fabrication

ENGENUITY

Mechanical and aerodynamic design and engineering



National Installation



Questions

