The New Shape of Energy

Presentation before APSE “Opportunities for Civic Wind Energy” Seminar

Hamilton, Scotland
May 14, 2015

John B. Howe , Vice President, Public & Environmental Affairs

The clean energy transition: greatest challenge of our times

Environment and Climate

Global Security

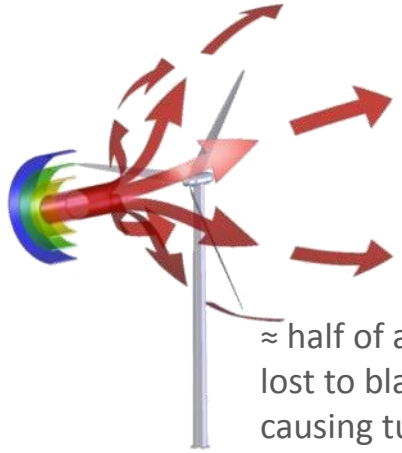
Fossil Resource Depletion

Economic Opportunity

This is Ogin: The New Shape of Energy

Aeroderivative design – large efficiency gains

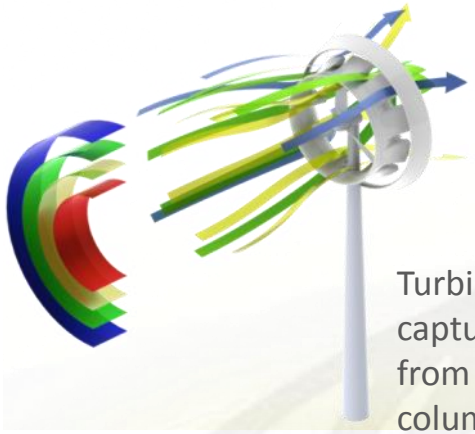
Conventional Turbine



≈ half of available energy is lost to blade tip losses – causing turbulence

Inefficient aerodynamics
Smaller turbines have even higher losses!

Ogin Turbine

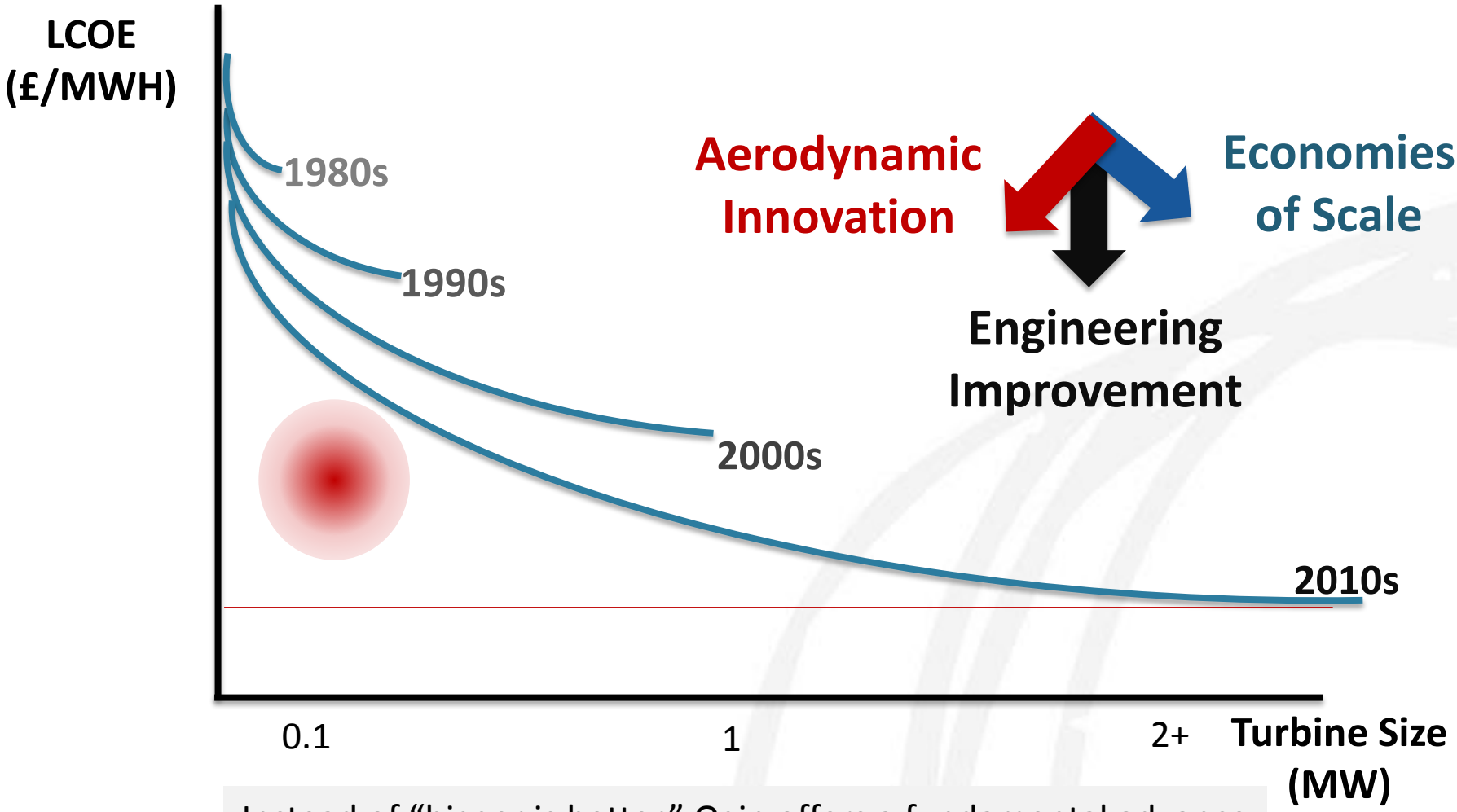


Turbine design captures energy from a larger column of air

Aerodynamically Efficient
Very low losses, even at smaller turbine size

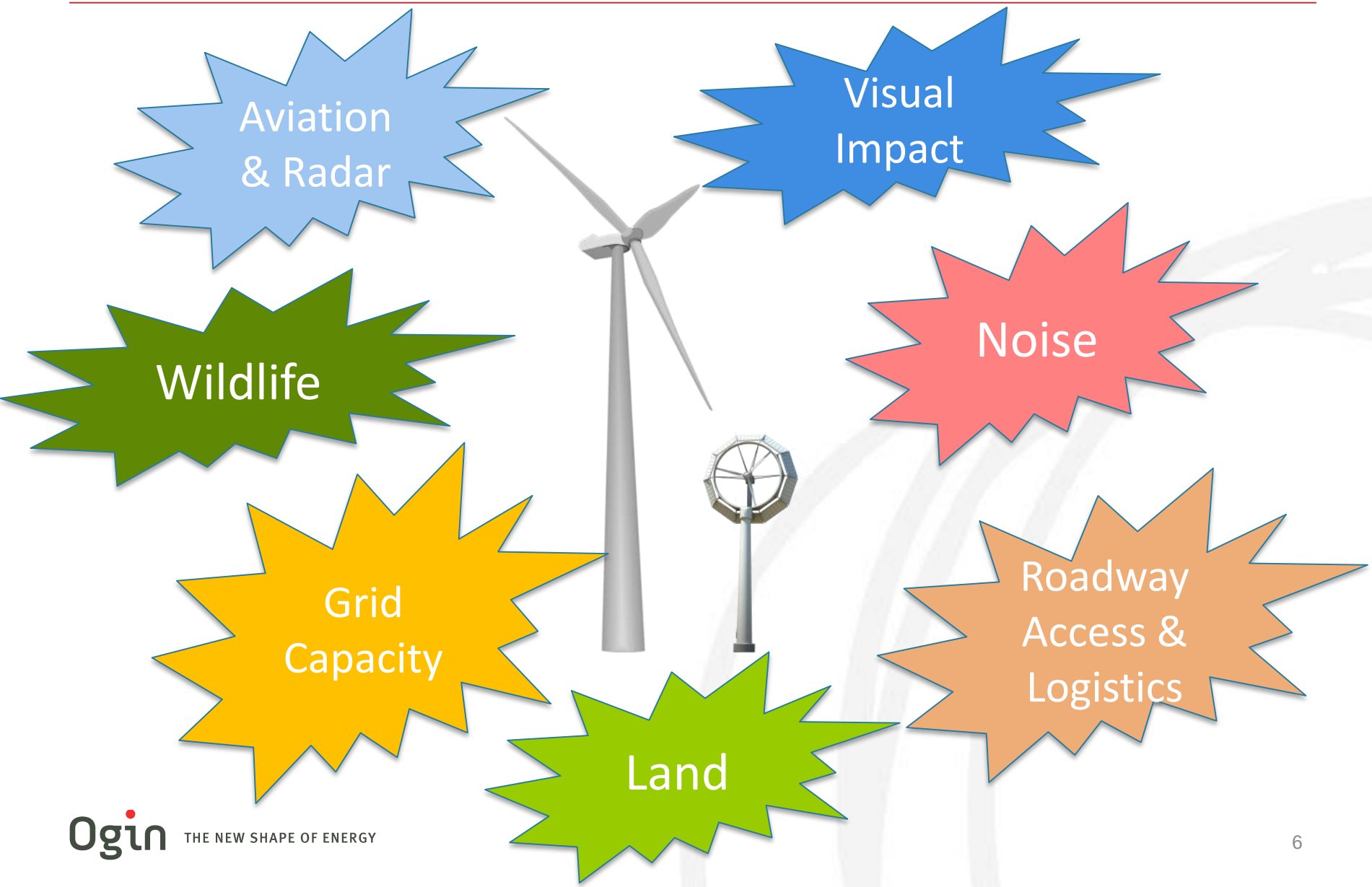
- The principle behind the Ogin Turbine: a pump with no moving parts
- ≈3x more power per unit of swept area
- ≈60% increase in annual energy production (AEP)

A new approach to enhance wind energy economics



Instead of "bigger is better," Ogin offers a fundamental advance in turbine design based on first aerodynamic principles

The UK cannot rule out one of its least-cost energy options – but there are <u>many</u> challenges to further wind expansion!

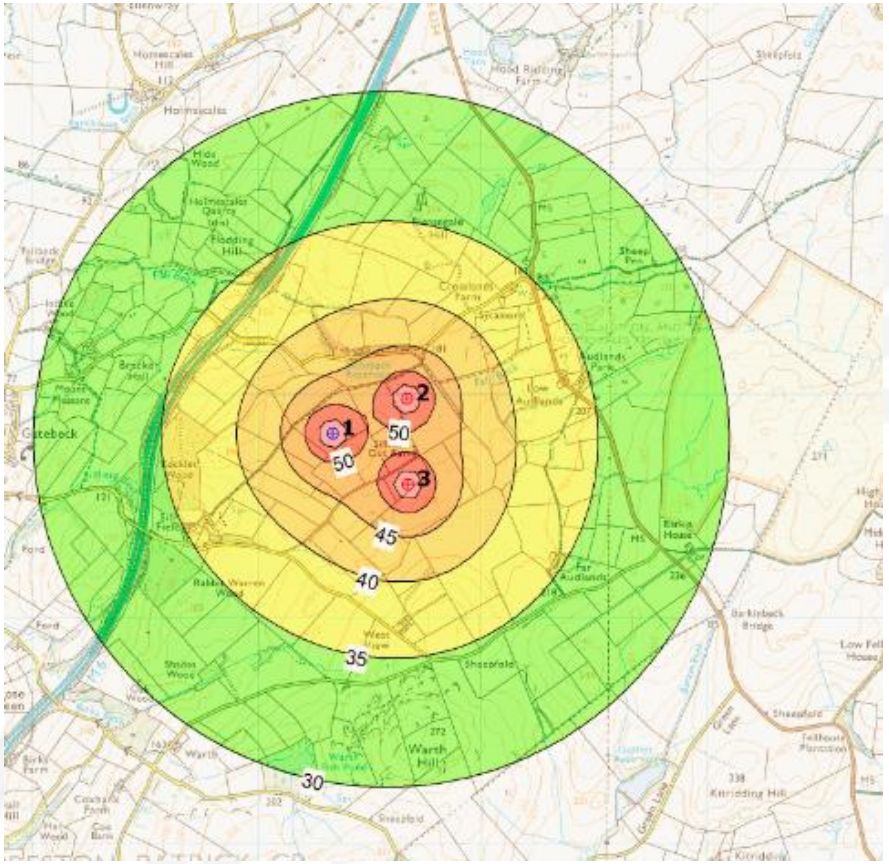


Key development constraint: visual impact

- Utility-scale turbines now reach or exceed 130m – creating conflicts as prime sites are taken and new development encroaches on developed areas
- Ogin's approach: employ a significantly lower (45m), compact design that uses advanced aerodynamic principles to accelerate air flow across the rotor
- Lower-height, smaller projects have reduced wide-area visibility impacts
- Turbine scale, height and shrouding virtually eliminate shadow flicker

Key development constraint: noise

- UK noise limit (35 dB) is low by global standards
- Difficult to find locations sufficiently far from dwellings, esp. for community-owned projects near built-up areas
- The dB scale is logarithmic – using a turbine a few dB's quieter can have a major impact on site availability
- Ogin's shroud drastically reduces turbulence (and noise) from blade "tip vortices"
- Per laws of physics, low-frequency "infrasound" propagates over longer distances
- Ogin's design and size (e.g, shorter blades, higher RPM) yields sound in a higher register with a faster rate of decay over distance



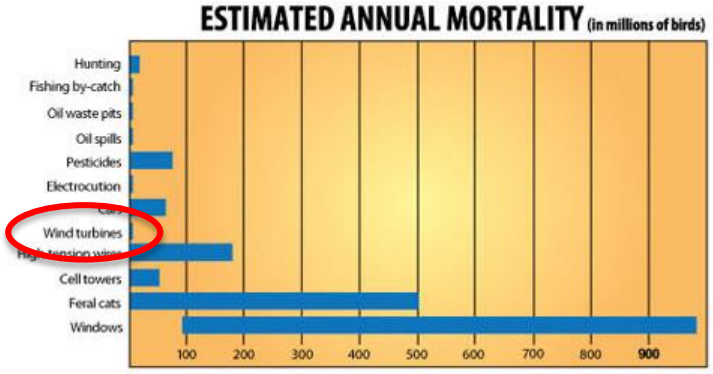
Key development constraint: aviation (flight path, radar)

- Wind turbines pose challenges for civil and military aviation, e.g.,
  - Flight path obstruction
  - Need for warning lights
  - Radar system interference including
    - Civilian
    - Military
    - Weather

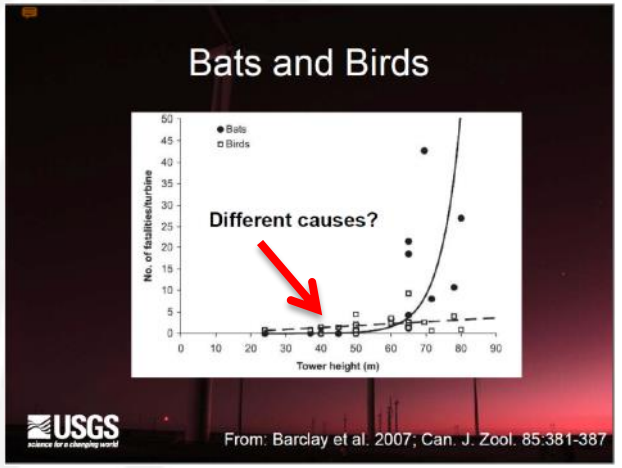
- Ogin's shorter profile (<50m) solves or mitigates these issues:
  - Facilitates development closer to airfields
  - No need for lighting at most locations
  - Reduces RCS interference from virtually all angles
- Detailed study of RCS impacts is underway

Key development constraint: wildlife impacts

- Wind turbines pose a minor wildlife threat compared to other factors, but major impacts at poorly-sited projects have led to adverse public perception
- Experts agree Ogin's shrouded turbine should be readily detectable by birds (using acute vision) and bats (using echolocation)
- Ogin's hypothesis: compact size and shrouding will pose a physical and a visual obstacle to birds' and bats' entry into the rotor zone
- Ogin has undertaken several steps to evaluate these impacts early, before broad-scale commercialization, through transparent, in-depth, in-field study



Source: US Ornithologist David Sibley, Ph.D.



Key development constraint: access and logistics

- Size and quality of local access roads can pose a barrier to the use of today's large-scale utility turbines
- Multiple-turbine, large wind farms can afford extensive road upgrades – but this is usually too expensive for small community-based projects
- Ogin's modular design enables use of standardized shipping containers and/or flatbed trucks, enabling delivery over existing road networks

First Ogin Turbine in the UK: Rochdale, Greater Manchester

Visual Simulation

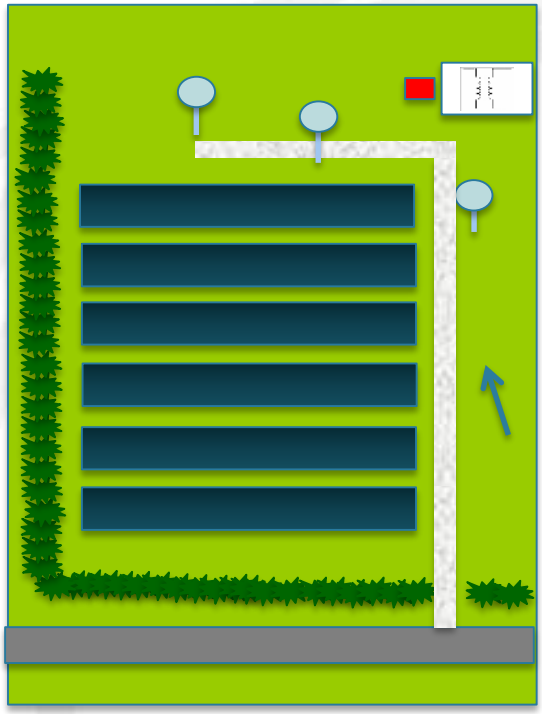
- Gained planning consent by 6-1 vote at April 23 council meeting
- Located at Birch Business Park, village of Heywood
- Turbine is being purchased by the Council using prudential borrowing authority
- Project currently slated for completion by year-end 2015
- Council or community ownership – many potential development models

Hybrid clean energy: a new model for meeting local needs

- Challenge: sustain recent RE momentum over decades in order to achieve required 80% CO2 reductions by 2050

- Obstacles to further RE deployment are numerous:
  - Vanishing grid capacity for export projects
  - Limited land availability for large-scale PV projects
  - Planning and siting concerns for all forms of renewables
  - Production profiles do not always match local needs of DNOs
  - Further growth in PV deployment will soon become self-limiting due to “duck curve” problem now being seen in California

- A potential solution: small-scale (500kW-5MW), distributed “hybrid” renewable energy projects
- combining and balancing mid-scale wind + solar PV + on-site battery storage
  - Synergistic benefits of co-locating wind and solar PV: enhances output and lowers grid connection costs for each source
  - Modest on-site storage increases the value of output and can enable the scheduling of power flows into the DNO’s system
  - Ogin’s compact, high-efficiency and low-turbulence design makes it especially well suited for such hybrid schemes
  - Community ownership can facilitate project success



Questions – Discussion

Thank you!

Contact:
John B. Howe
Vice President, Public & Environmental Affairs
07756 678715 (M)
jhowe@oginenergy.com