



Exquadrum, Inc.

New Wind Power Generation Technology

Presented to:



AIR & WASTE MANAGEMENT
ASSOCIATION

24 April 2009



The Systems Approach

- **Meeting California's goal of 33% renewable energy by 2020 is a systems problem**
 - Advanced wind turbine technology is a valuable component of the system
- **We must address three systems issues**
 - When the wind blows, how do we reach grid parity?
 - Where does the wind blow?
 - What do we do when it doesn't blow?



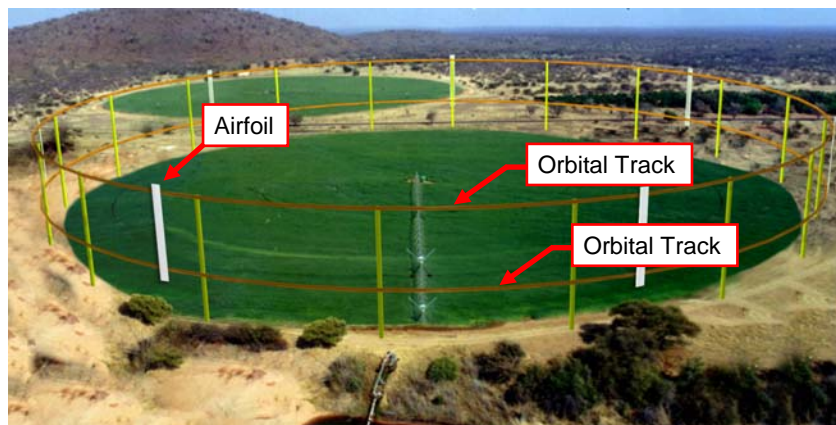
When The Wind Blows, How Do We Reach Grid Parity?

- The wind industry has been lowering cost through increasing turbine size
- According to the Department of Energy, conventional wind turbines are reaching a practical limit in size and output¹
- How can we continue to increase turbine size and achieve further cost reductions?

1. 20% Wind Energy By 2030, US Department of Energy, 2008



Orbital Track Turbine



Research funded by the USDA SBIR program



Orbital Track Turbine

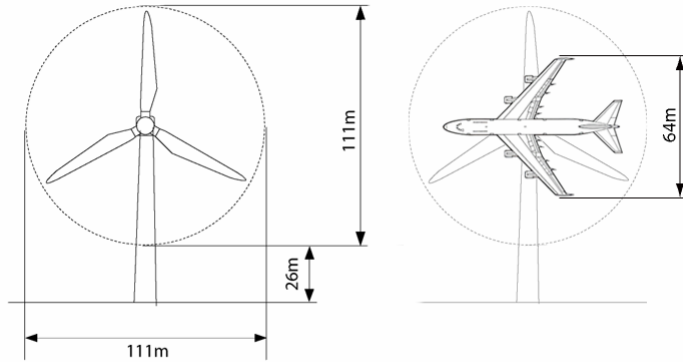


Research funded by the USDA SBIR program



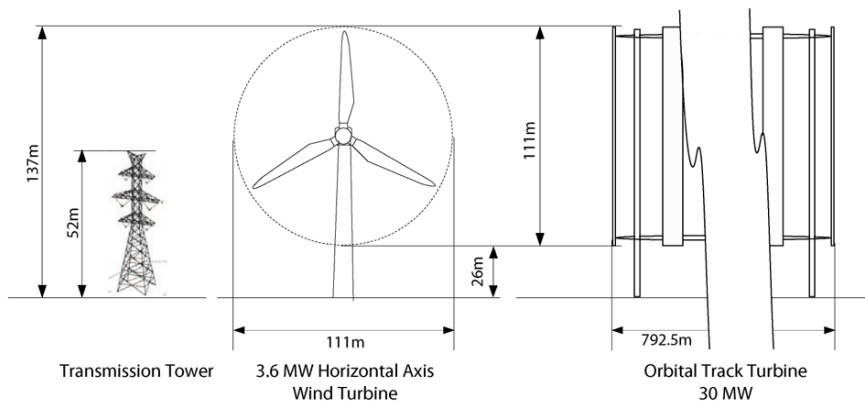
Advantages of the OTT

- **OTT wind turbines can be very large**
 - No cantilevered rotor blades
 - Steel track resists bending loads, not expensive composites
 - Cost reductions through scaling
- **High mass/maintenance items are near ground**
- **OTT airfoils are constant cross-section, low cost, & light weight**
- **Lower tower and footing costs**
 - A more efficient structure
- **OTT is insensitive to wind direction**
 - Does not need to vector into the wind



3.6 MW Horizontal Axis Wind Turbine

The GE Energy 3.6MW turbine has 111 meter rotor. A 747-400 airliner has a 64 meter (211 ft) wingspan.



Transmission Tower

3.6 MW Horizontal Axis Wind Turbine

Orbital Track Turbine 30 MW

A comparison between a GE Energy 3.6MW turbine and a 30MW Orbital Track Turbine with similarly sized airfoils.



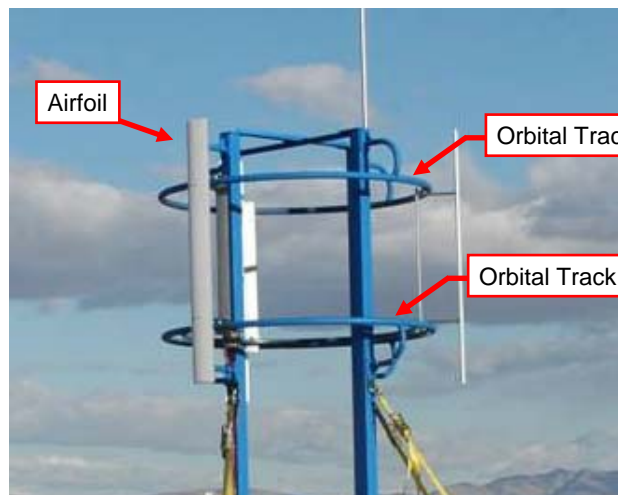
Feasibility of a 30MW Turbine

- If GE Energy can build a complex 111m rotor, then we can build a simple, 111m long airfoil
- If the Empire State Bldg was built out of steel to a height of 381m in 1931, then we can build a 137m tower
- If high speed rail is feasible, then we can operate our rail cars at modest speeds

30MW & Larger Wind Turbines Are Feasible!

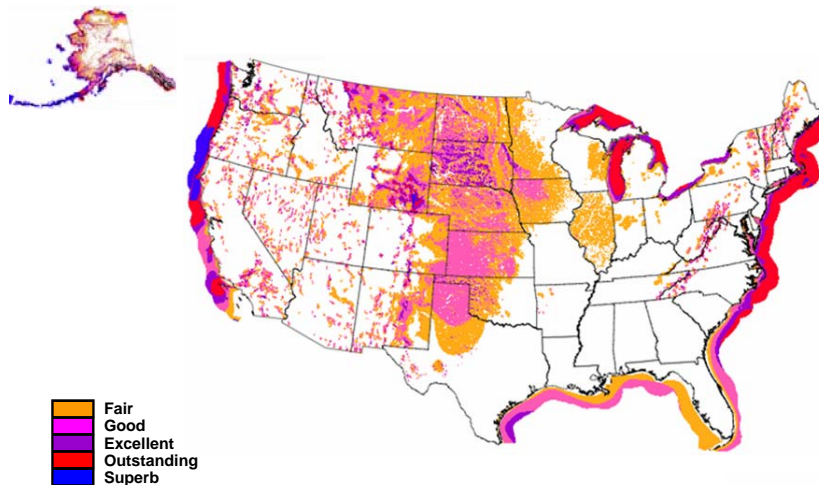


Prototype Testing





Where does the wind blow?



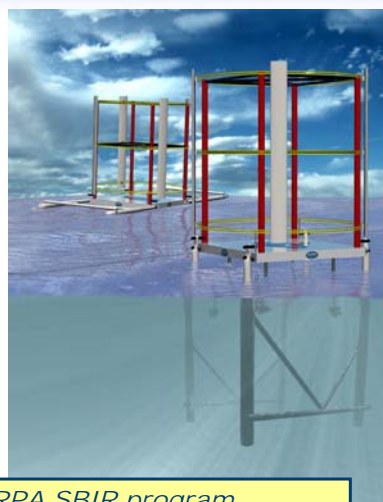
- Fair
- Good
- Excellent
- Outstanding
- Superb

U.S. Department of Energy
National Renewable Energy Laboratory



Floating Wind Power Platforms

- **Minimum cost floating wind energy platforms**
- **Allows basing in deep water**
- **Too far from shore to be seen**
- **Best wind/Lowest NIMBY**



Research funded by DARPA SBIR program

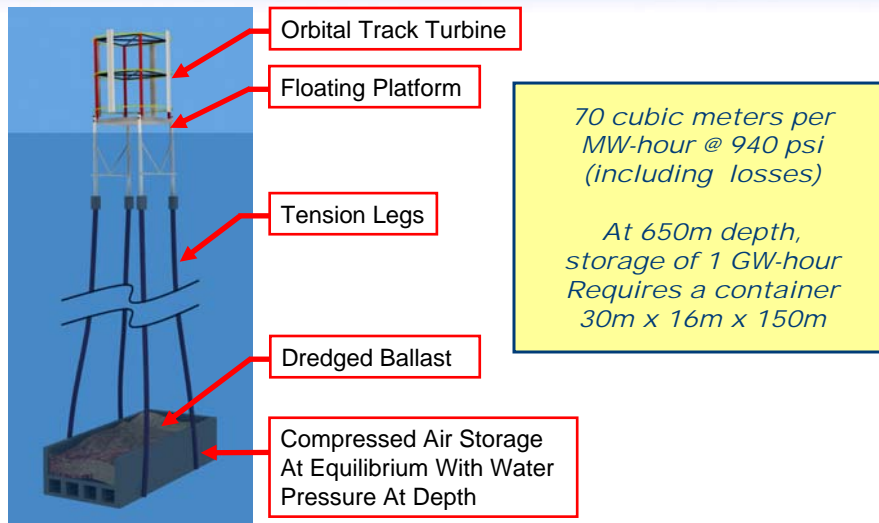


What do we do when it doesn't blow?

- **Compressed Air Energy Storage (CAES)**
 - Recognized as lowest cost energy storage
- **Compressed air can be ducted to conventional utility turbine**
 - Reduces fuel consumption by 40%
 - Allows renewables to augment conventional power generation on demand
- **A CAES storage facility could store energy from all varieties of sources**
 - Wind, solar, and other renewables
 - Off peak capacity conventional generation



Offshore Renewable Energy System





Conclusion

- Exquadrum has developed a wind energy system concept that can help meet California's renewable energy goals
- Exquadrum is seeking to scale the Orbital Track Turbine up to utility class generation
- Exquadrum welcomes utility operators and others to work with us to achieve an affordable and sustainable energy future



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