Wind Technology

150+ Projects
North America and UK

3 Billion kWh
And Counting

1.3 GW
Operating Assets

10 GW
Operating | Construction | Pipeline
Wind - The Basics

EVOLUTION, DEPLOYMENT, DEVELOPMENT

Evolution of Wind Technology
• Moved from a 1MW to 2MW to 3 MW and next 4 MW platforms
• Larger machines reduce balance of plant costs on a per MW basis
• Reliable installation procedures of a mature industry

Wind Projects
• Distributed generation less than 20 MW
• Utility scale projects

Development Timeline
• Wind resource varies by terrain and location
• Interconnection
• Permitting & Studies
• Site acquisition
• 24 to 36 months
Wind

MONTANA

Resource In Montana
• Good wind resource mostly in the eastern 2/3 of the state
• Seasonal resource variability, summer vs winter
• Time of day resource variability
• Locational variability

What Wind Offers
• Energy as available
• Paired with storage to offer capacity
Wind

MEASURING THE RESOURCE

Cost of Energy
• Average annual wind speed
• Duration of measurement campaign
• Uncertainty P50 vs P99
• Turbine selection
• Wake losses
Wind

COST & RELIABILITY

Cost
• Varies by site and added infrastructure
• Site preparation work
• Interconnection
• Improvement in turbine reliability and increase in turbine size
• Turbines make up approximately 2/3 system cost
• Over all project size

Reliability & Life
• 30 year life
• Capacity factors in the high 30s low 40s
• Large rotational machinery

Keys To Operational Reliability
• Service agreement arrangement
• Product warranty, turbines and balance of plant
• System monitoring – key performance indicators

Pioneer Wind Park
Glen Rock, WY
80 MW
2017 Eclipse