THE UNCERTAINTY OF UNCERTAINTY

Erik Hale
EDF Renewable Energy
SESSION GOALS

- Provide developer/owner perspective on energy prediction
- Review examples of plant performance relative to predictions
- Recap the AWEA WRA Seminar Uncertainty Session
- Identify path forward
WIND RESOURCE ASSESSMENT UNCERTAINTY

Analyst view

Developer View
UNCERTAINTY IMPACT

❖ Recent example #1:
  ▪ 200MW project
  ▪ Energy estimate uncertainty ~ 7%
  ▪ Two consultant estimates were 3% different on P50 AEP
  ▪ Difference in project NPV… $17MM

❖ Recent example #2:
  ▪ 200MW project
  ▪ Two consultant estimates were identical at P50 level
  ▪ P95 estimate ~1% different
  ▪ Difference in project NPV… $1.5MM
Top consultants in North America were asked to show validation results for their energy estimation methods, with a focus on uncertainty estimates

- DNV GL (Taylor Geer)
- AWS Truepower (Michael Brower)
- WSP (Rob Istchenko)
Original 1-Yr Estimates
Curtailment Removed

Wind Farms: 31
Wind Farm Years: 101

**Actual**
Mean = 97.2%
Stdev = 9.4%

**Expected**
Mean = 100%
Stdev = 10.8%
How are accurate are DNV GL pre-construction energy predictions in North America?

- >1000 wind farm years filtered for major curtailment and as-built differences.
- Approximately 30 GW of projects (half of US market)
- Not adjusted for windiness
- Representative of current methodology
- Average operating year/project = 3.9 years

Are Deviations Correlated with Uncertainty?

Not evident so far

Production Deviation vs. Uncertainty

Standard Error vs. Uncertainty
Project Average Variance vs. Original Assessed 10-Year Uncertainty
Results look good overall, but are we getting it right for the right reason?

Note: uncertainty results are based on old uncertainty model. Details of DNV GL's new model, and its implications, will be discussed shortly.
DISCUSSION POINTS

- Uncertainty estimates in North America are not correlated to deviations from predictions
  - Turbine operation?
  - Manufacturing issues?
  - Curtailment?
  - Wind resource?

- Comparing project risk based on quantitative estimates of energy prediction uncertainty is not a valid approach based on these results.