

THE UNCERTAINTY OF UNCERTAINTY

Erik Hale

EDF Renewable Energy

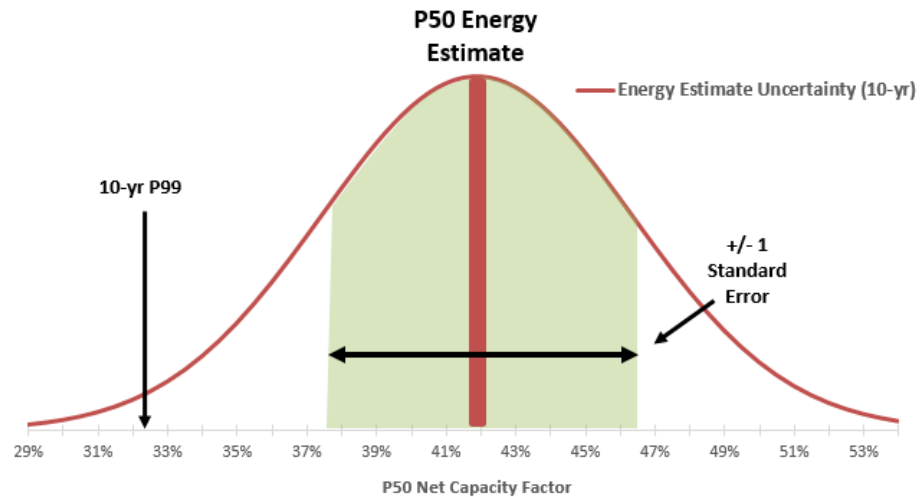
SESSION GOALS

- ❖ 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

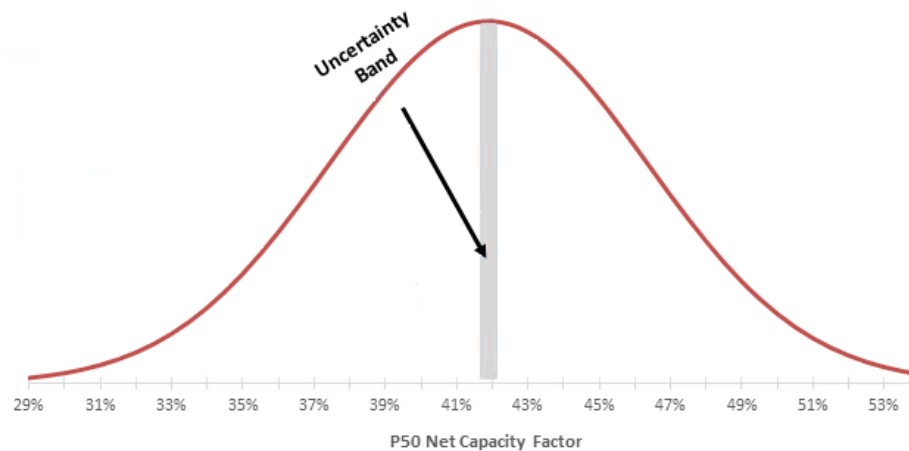


WIND RESOURCE ASSESSMENT UNCERTAINTY

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:

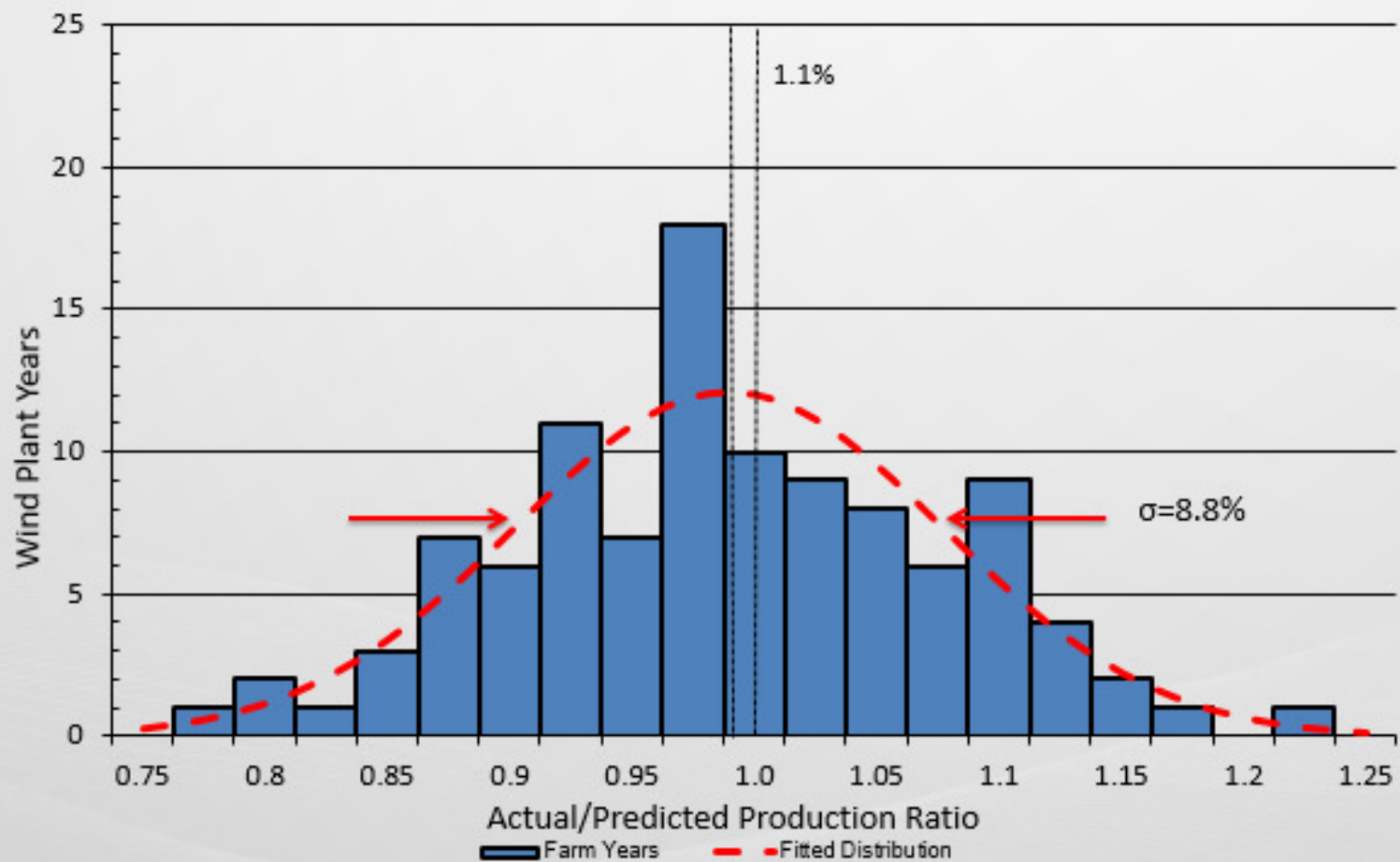
- 200MW project
- Two consultant estimates were identical at P50 level
- P95 estimate ~1% different
- Difference in project NPV... **\$1.5MM**



2014 AWEA WRA SEMINAR

- ❖ 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)

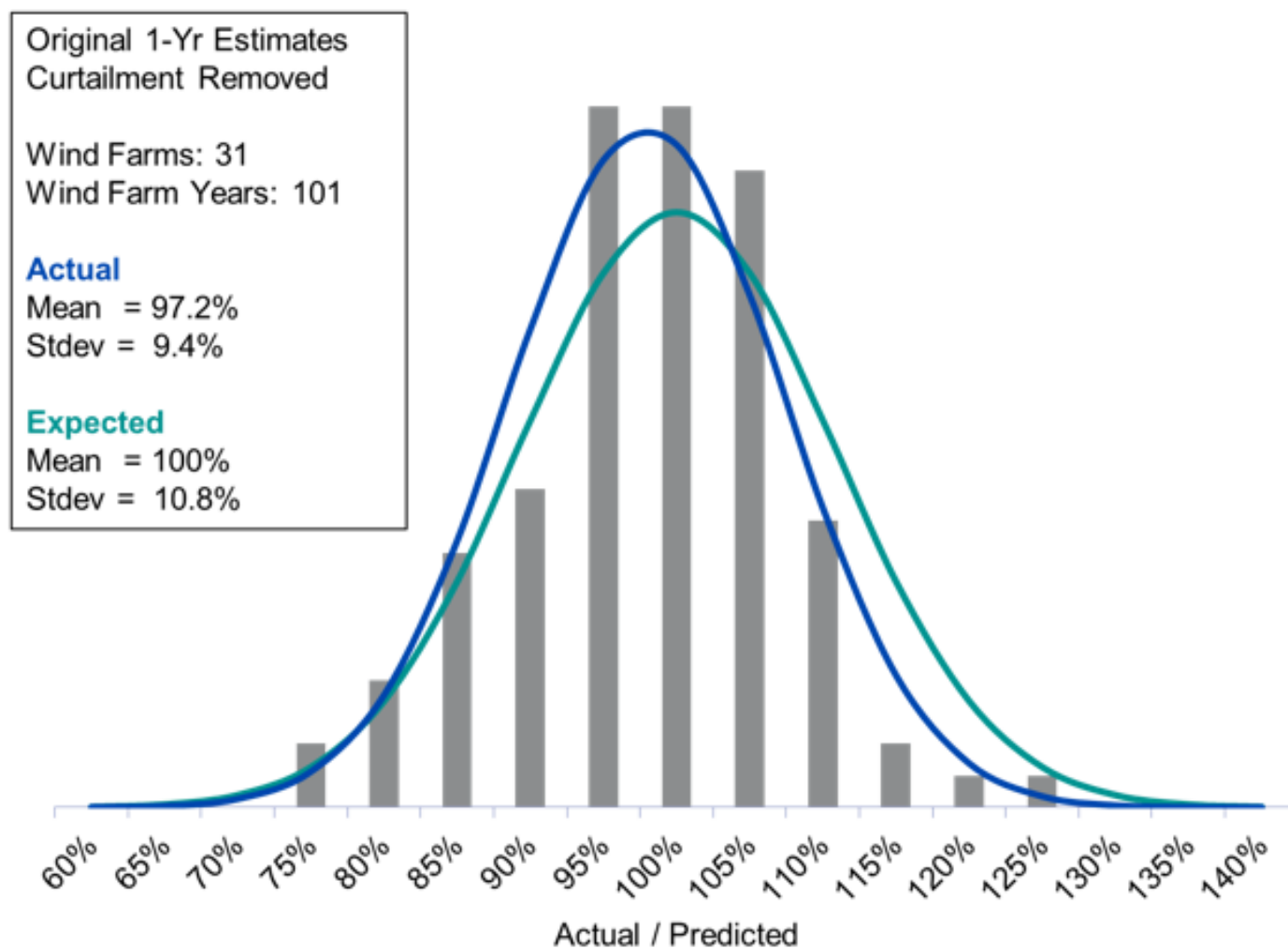
Raw Production Ratios: Actual over Predicted by Year



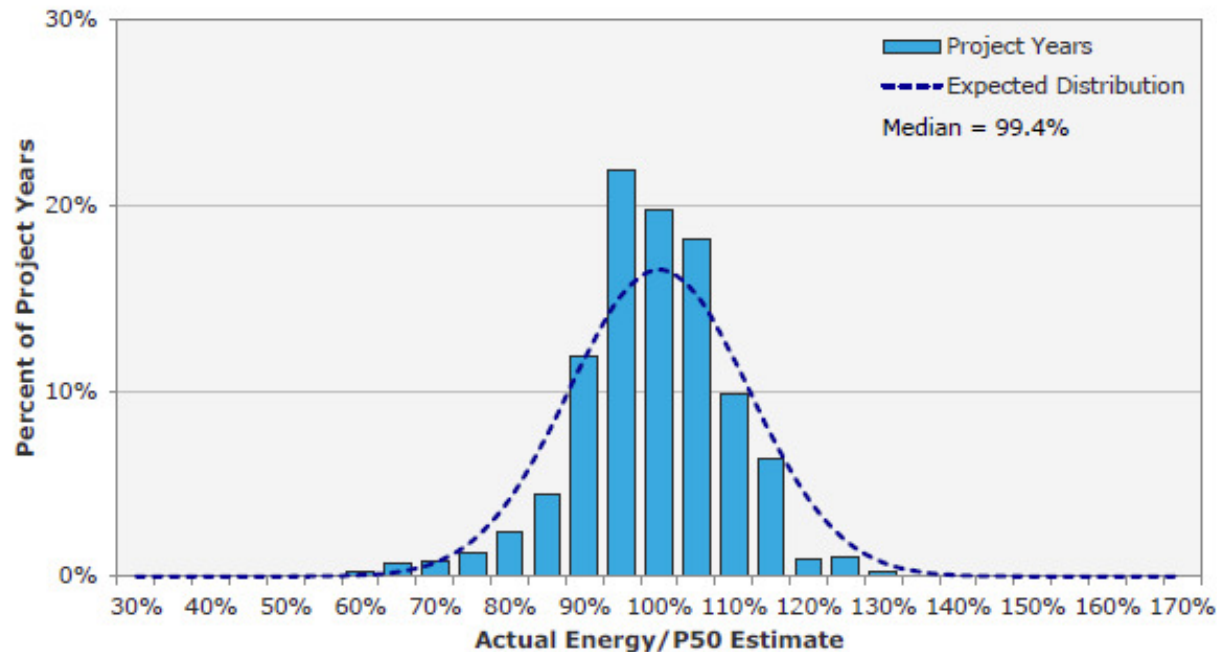
CONFIDENTIAL – Do Not Distribute

Albany, New York | Barcelona, Spain | Bangalore, India | awstruepower.com | +1 877-899-3463

©2012 AWS Truepower, LLC



How accurate are DNV GL pre-construction energy predictions in North America?

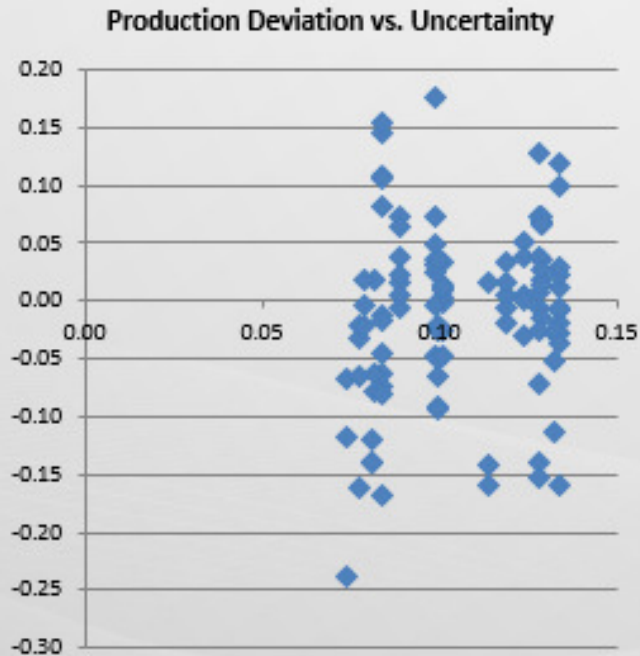


- >1000 wind farm years filtered for major curtailment and as-built differences.
- Approximately 30 GW of projects (half of US market)
- Not adjusted for windiness
- Representative of current methodology
- Average operating year/project = 3.9 years

http://www.gl-garradhassan.com/assets/img/content/DNV_GL_Wind_Power_Project_Performance_White_Paper.pdf

Are Deviations Correlated with Uncertainty?

Not evident so far

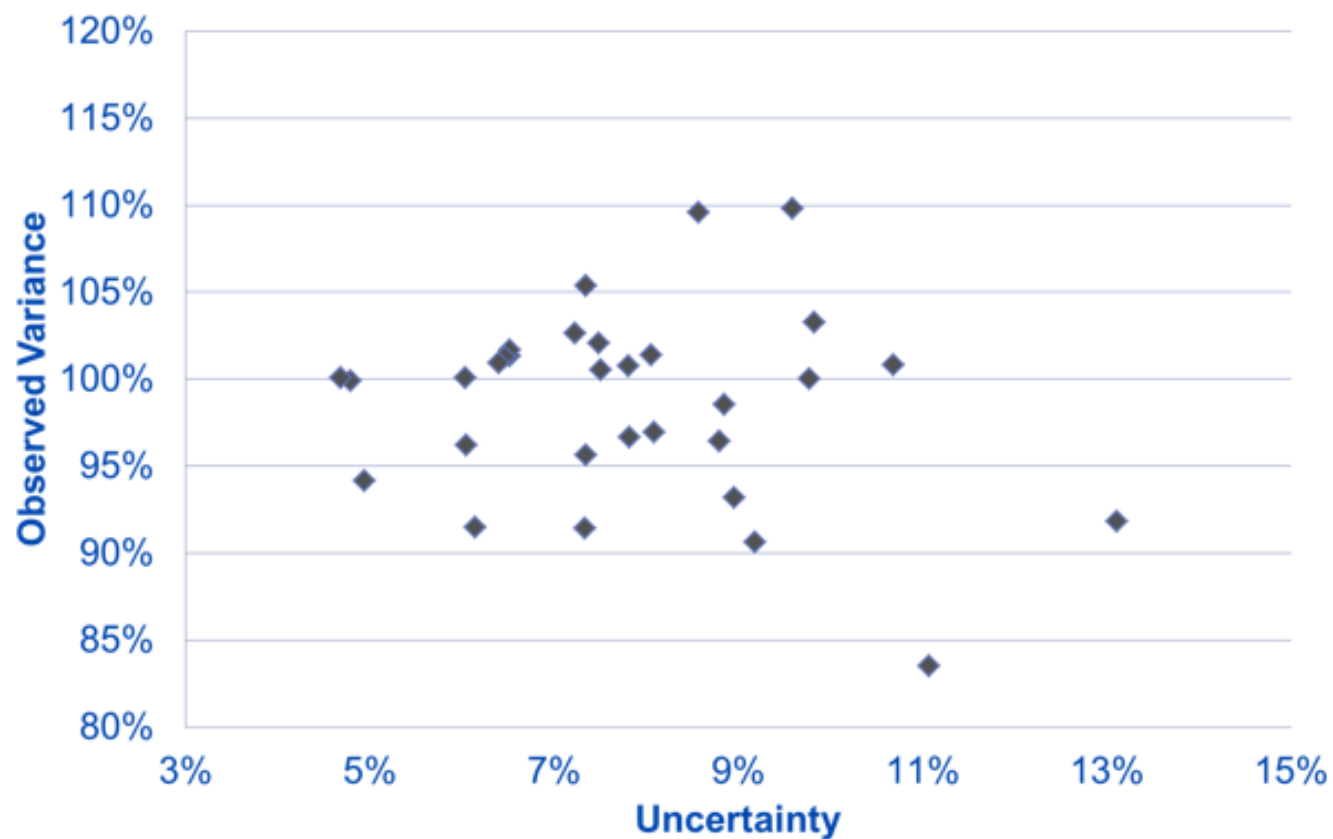


CONFIDENTIAL – Do Not Distribute

Albany, New York | Barcelona, Spain | Bangalore, India | awstruepower.com | +1 877-899-3463

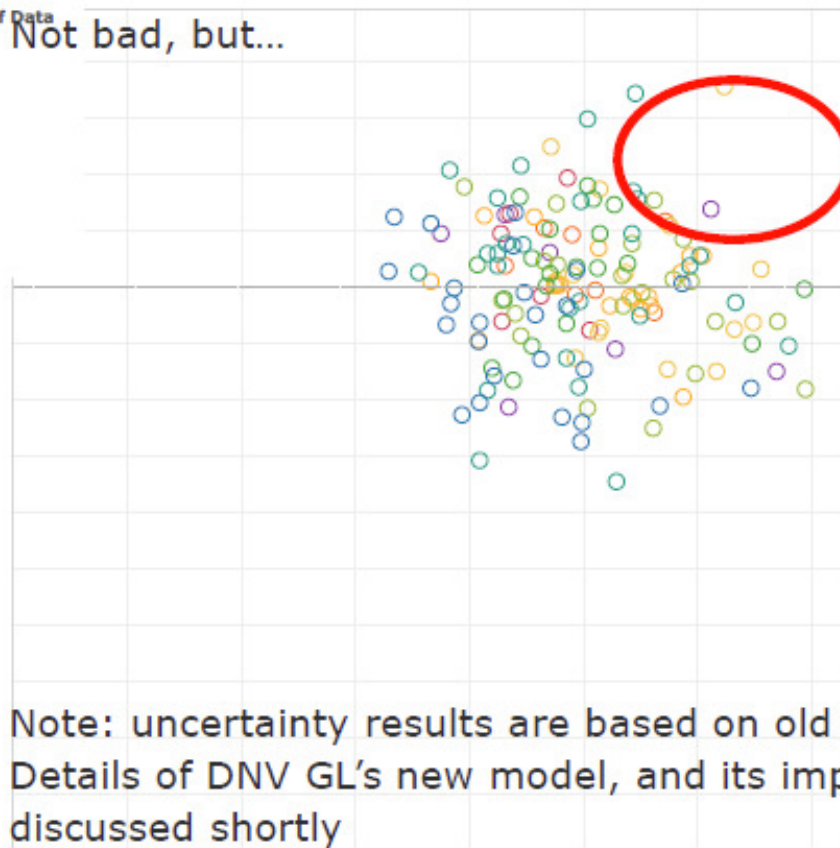
© 2012 AWS Truepower, LLC

Project Average Variance vs. Original Assessed 10-Year Uncertainty



Results look good overall, but are we getting it right for the right reason?

Years of Data
Not bad, but...



Where are the
high-uncertainty
high-performance
projects?

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.