AWS Truepower®
Where science delivers performance.

5 Distinct Power Curves As a Function of Shear and Turbulence In Time-Series Energy Capture Calculations

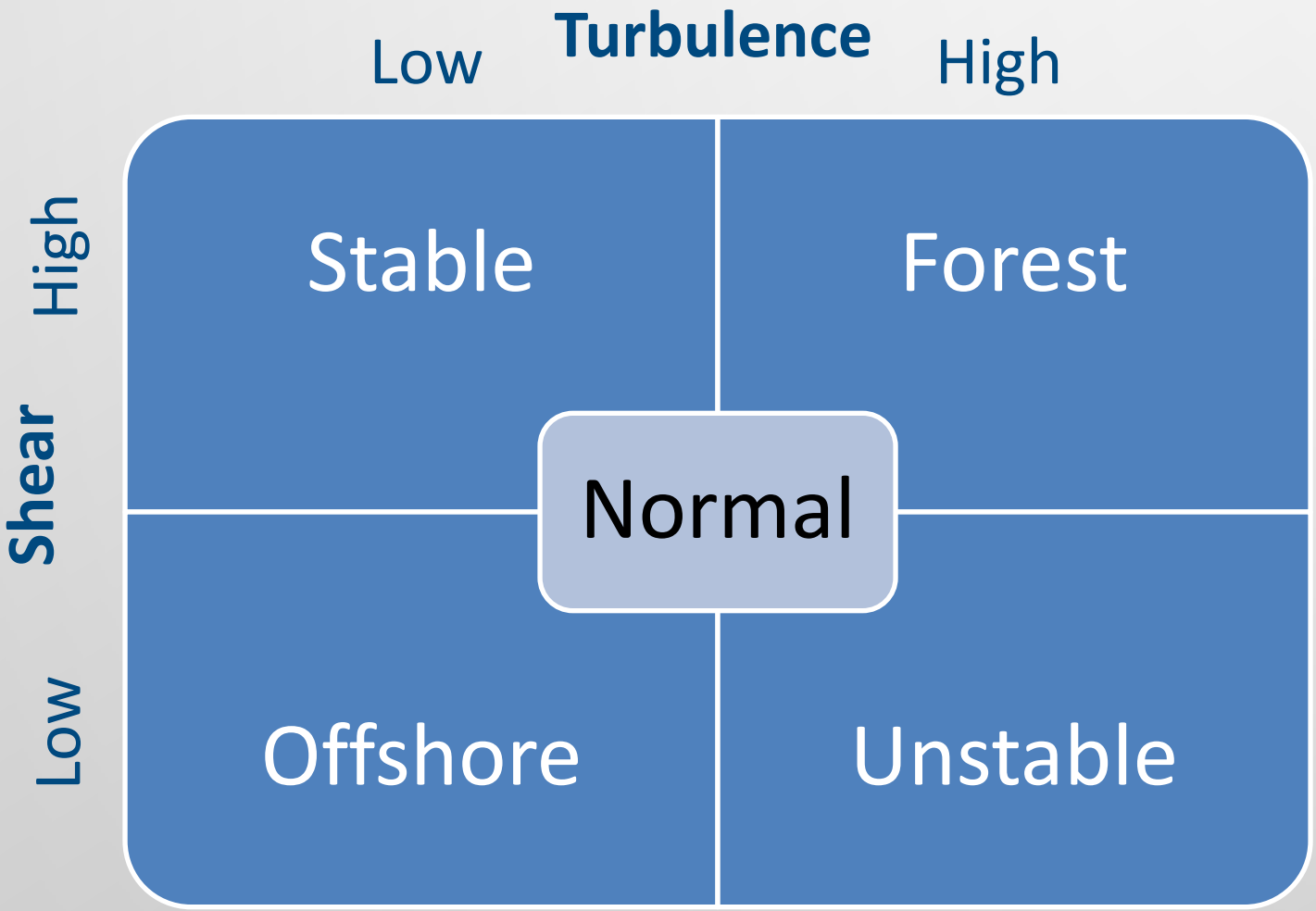
Daniel W. Bernadett, P.E., Chief Engineer

The Problem

- Site specific conditions differ from those used to define the power curve

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

Solution-use power curves for 5 distinct site conditions



Normal

- Defining “normal”
  - Manufacturers to determine shear and turbulence limits of normal conditions
  - This could be used to define warranty terms

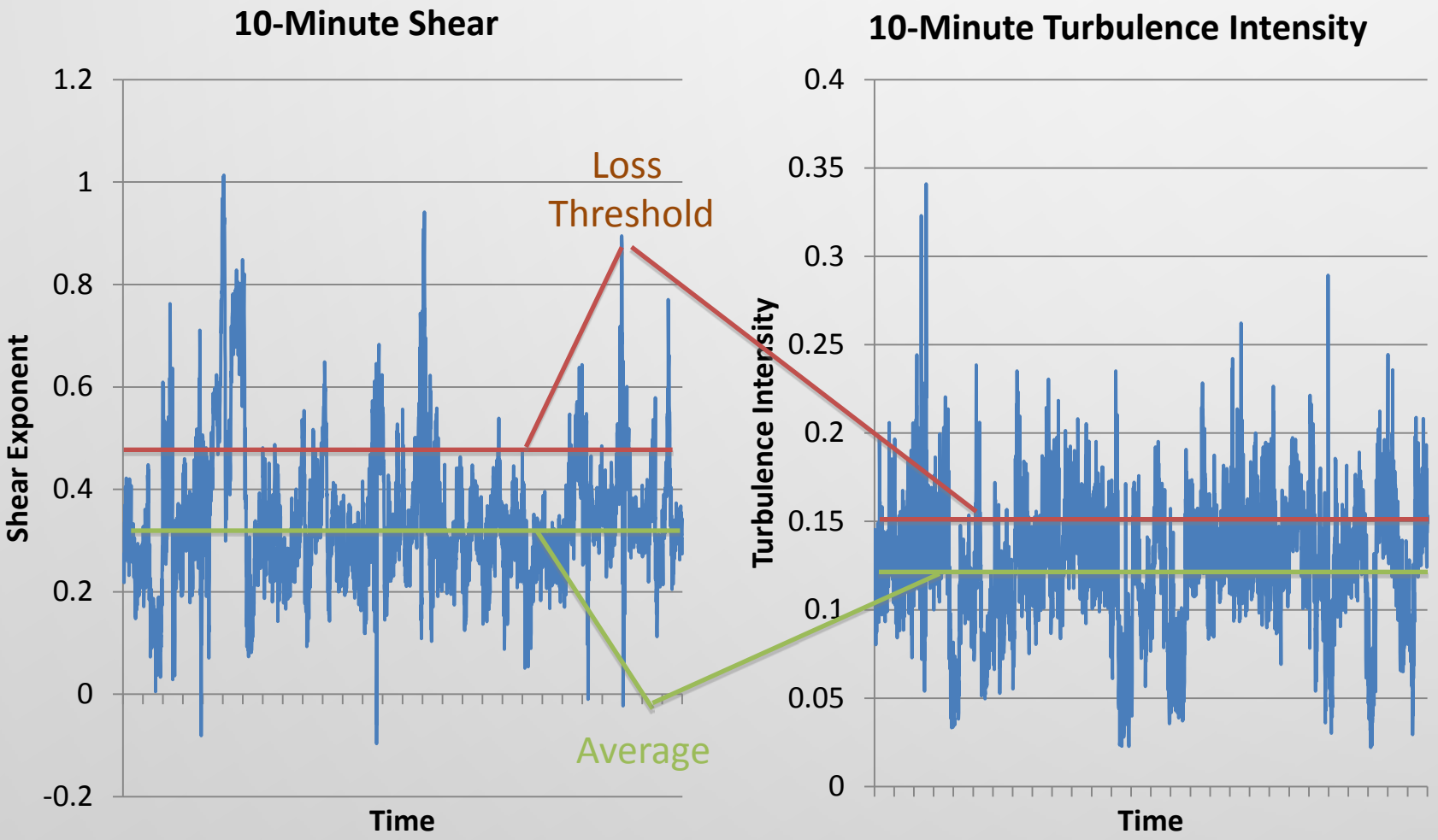
Stable and Unstable

- Stable
  - High shear, low turbulence
- Unstable
  - Low shear, high turbulence
- Extreme examples of these conditions are typical of US plains or any low surface roughness site with strong diurnal stability pattern

- Forest
  - High shear, high turbulence
- Typical of high surface roughness sites where both shear and turbulence are driven by surface roughness rather than by stability pattern
- Individually pitched blades can mitigate this problem, so performance must be determined for each turbine model

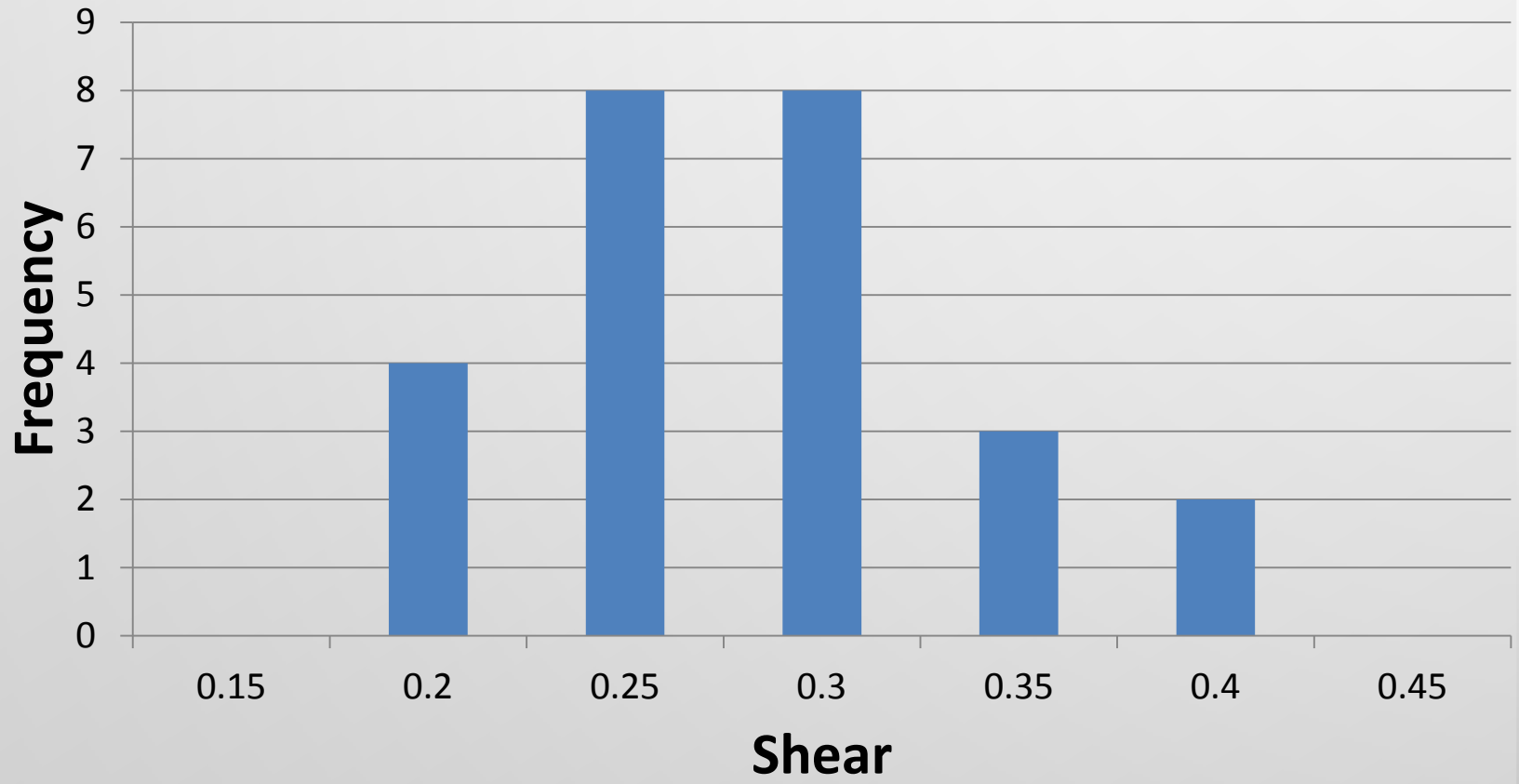
Albany, New York | Barcelona, Spain | Bangalore, India | **awstruepower.com** | +1 877-899-3463

Don’t Forget the Time Dimension



Shear at a number of sites

State/Province	shear	sites
Maine	0.31	2
Massachusetts	0.23	1
New York	0.23	8
Pennsylvania	0.28	1
Ontario	0.30	3
New Brunswick	0.29	8
Nova Scotia	0.40	2
Average/Total	**0.26**	**25**



Offshore

- Offshore
  - Low shear, low turbulence
- water body depresses strength of stability pattern
- low surface roughness allows for both low shear and low turbulence

Questions

Do we need 5 performance categories, or would 4 be enough?

- Is there a low shear performance penalty that is physically distinct from high TI?
- Is there a low TI performance penalty that is physically distinct from high shear?
- Are the only performance penalties for high shear and high TI?
- If so, the low TI – low shear (offshore) curve should be the same as the moderate shear and TI (normal) performance curve and 4 categories would be enough

Conclusion

- 5 power curves as a function of shear and turbulence could better establish the effect of site-specific conditions on performance
- Manufacturers have the best data to determine how their turbines behave under a range of conditions
- The next big improvement in energy production estimates is turbine performance - let's work together!