3TIER

a renewable energy information services company

Eric Grimit

Senior Scientist

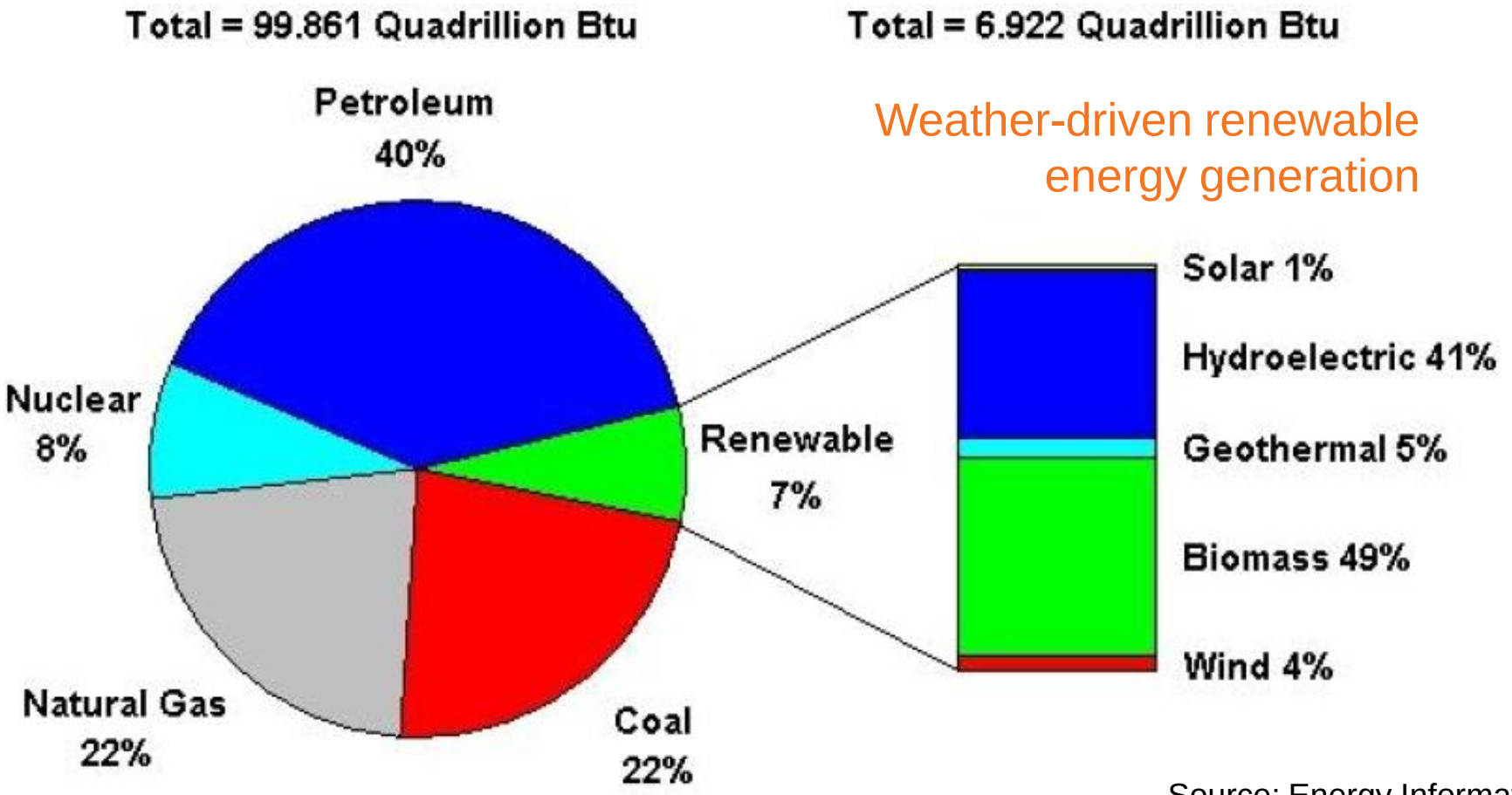
DTC National Workshop on Mesoscale Probabilistic Prediction

Boulder, CO

September 23, 2009

3TIER

Our Industry

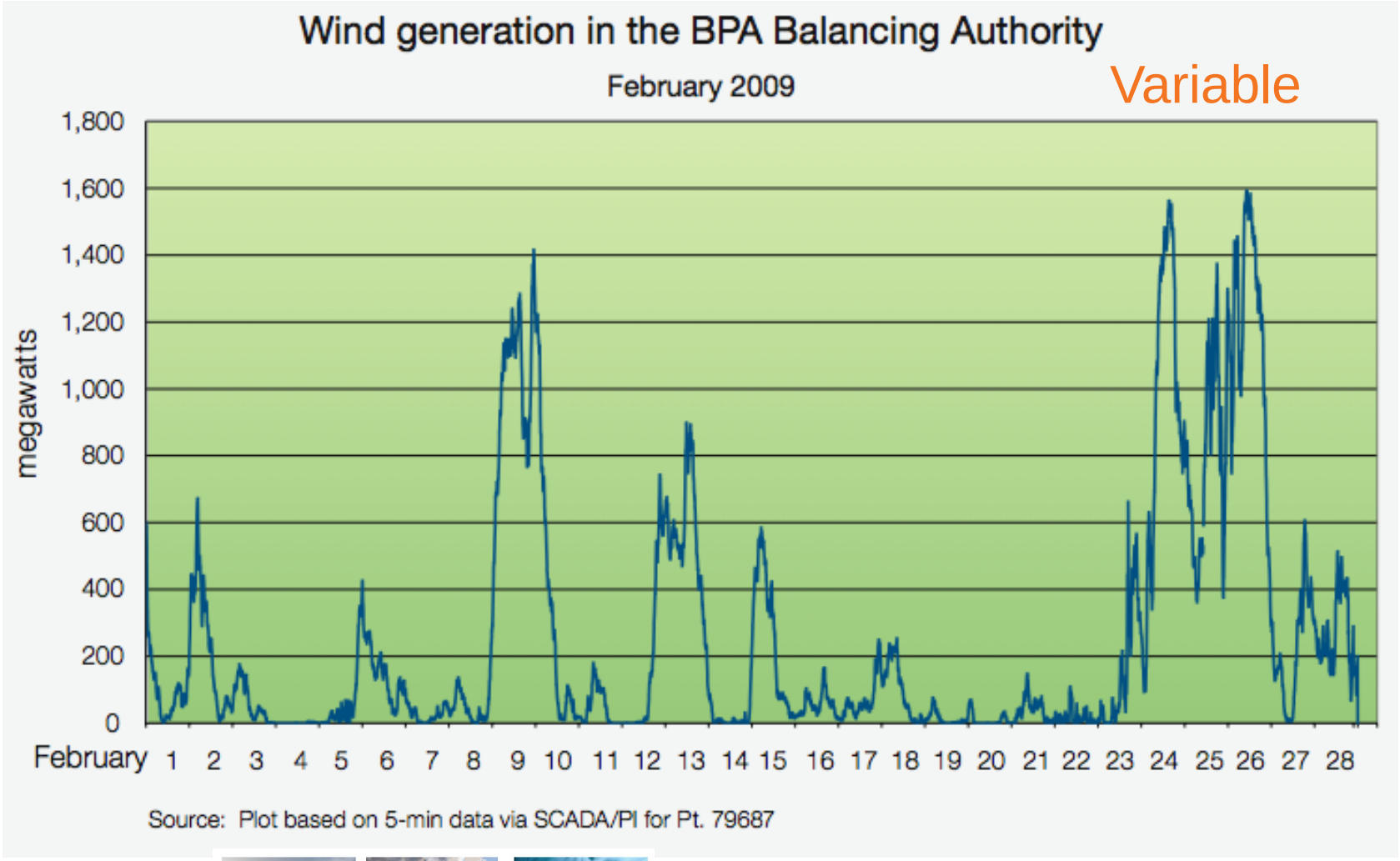


Weather-driven renewable energy generation

Source: Energy Information Administration, Office of Coal, Nuclear, Electric and Alternate Fuels, 2007

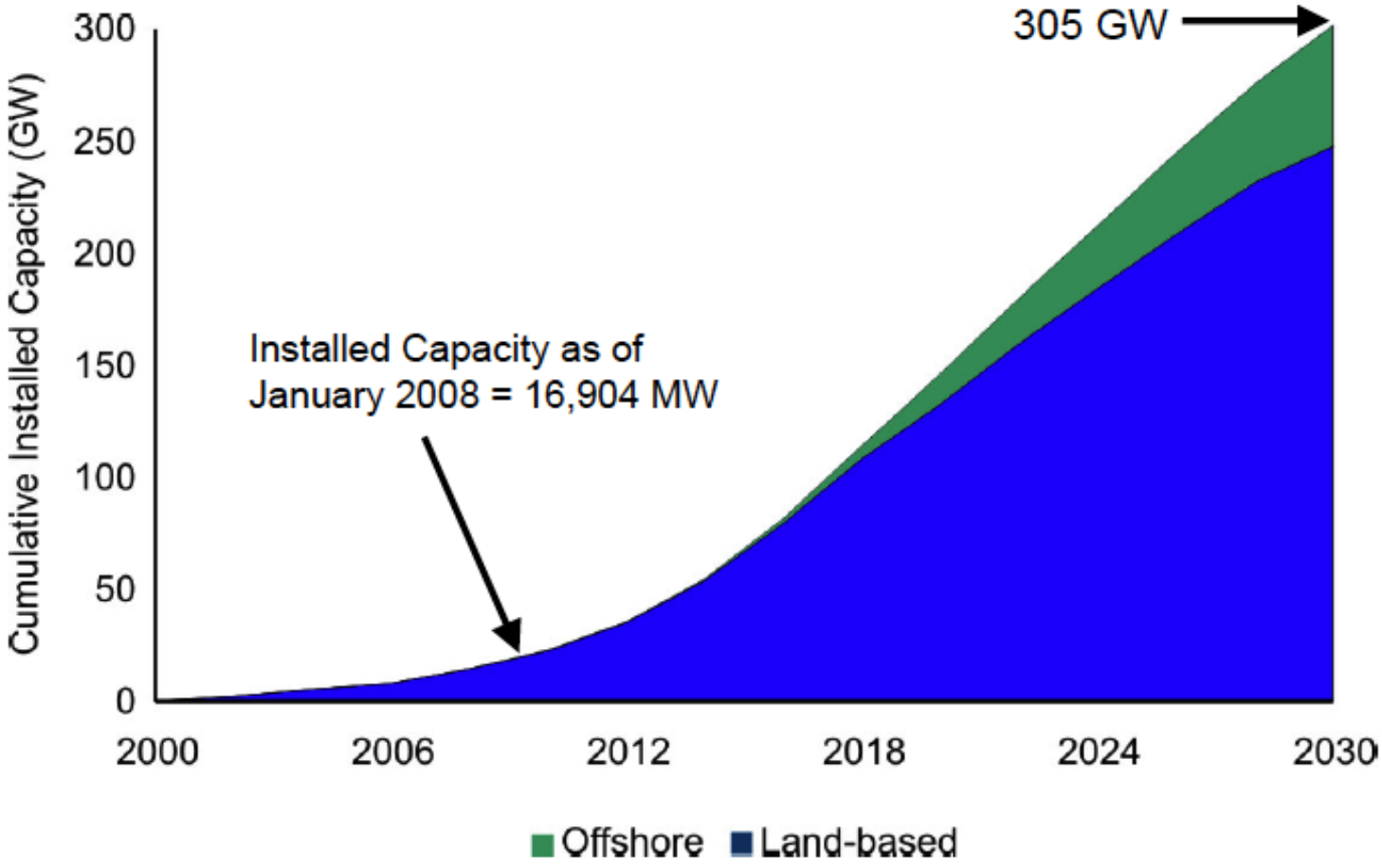
3TIER

Weather-Driven Renewables



3TIER

Rapid growth – 20% wind scenario US



3TIER

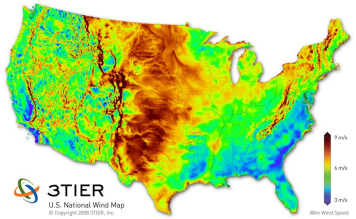
3TIER - renewable energy information services

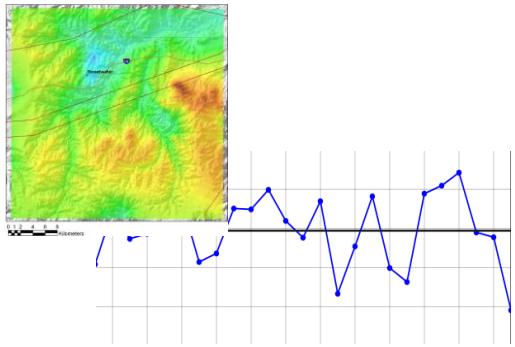
Prospecting and Pre-feasibility

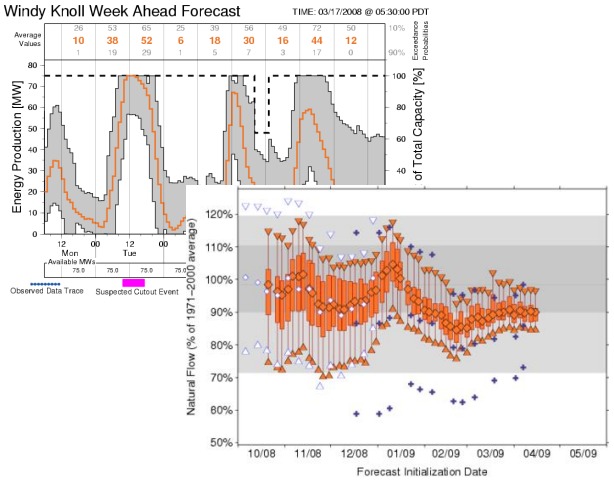
Feasibility and Due Diligence

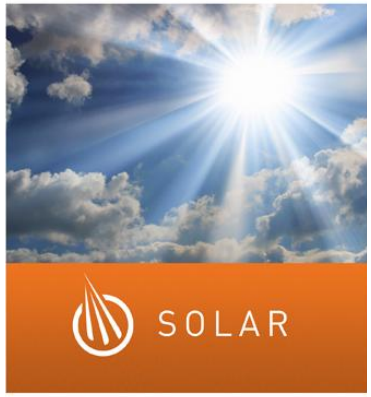
Design and Construction

Operations



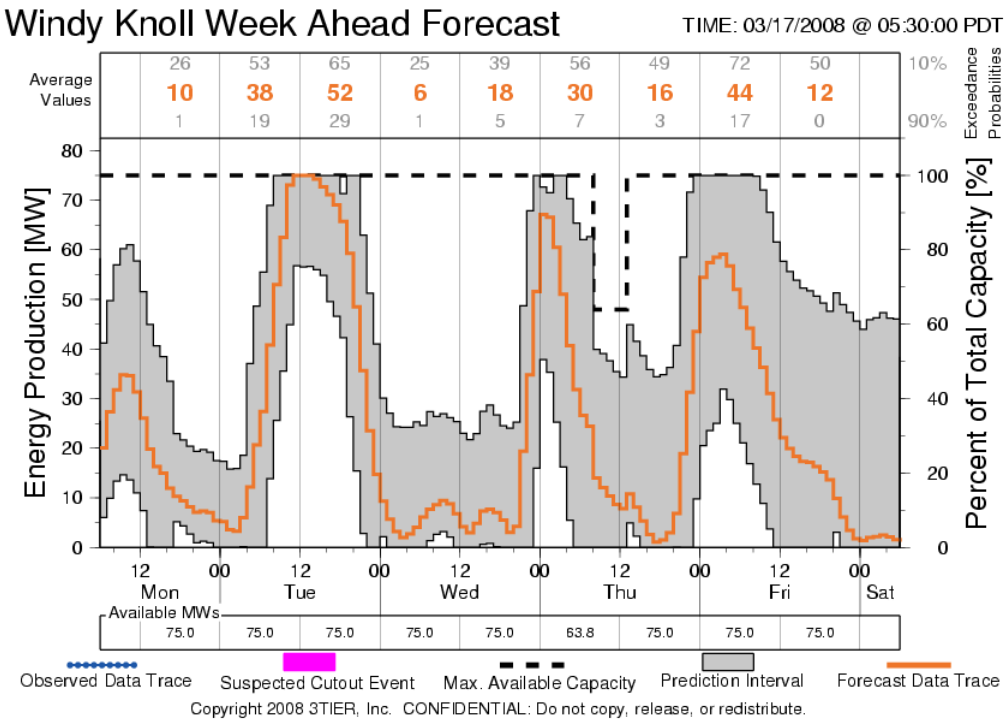


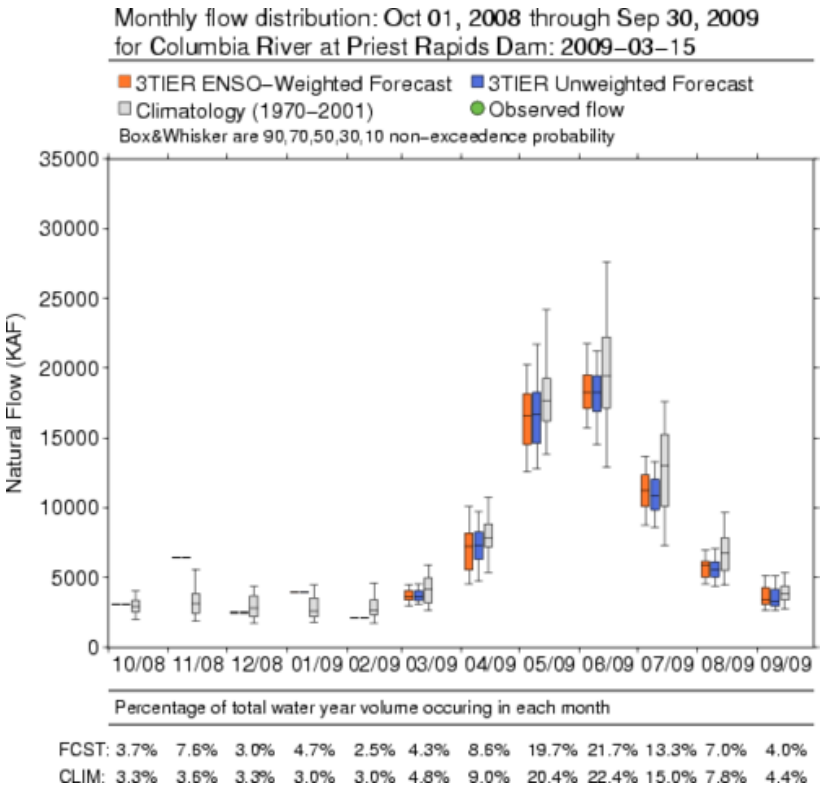




3TIER

Current Forecast Examples





- Contain both deterministic and probabilistic elements
  - Primarily based on deterministic forecasts
  - With error climatology sampling (e.g. local quantile regression)

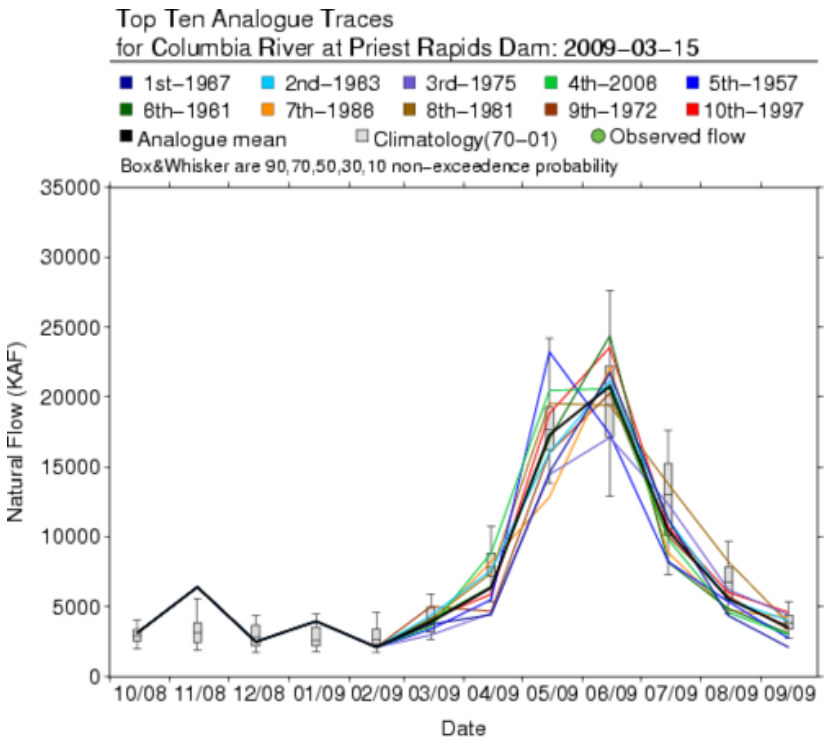
3TIER

User Feedback

- Intervals and exceedance probabilities are typically not used
  - Exceptions:
    - avoid being caught short of water resource
    - high confidence of low winds (maintenance)

- Frequently Asked Questions:
  - What does the upper/lower bound mean?
  - How do I choose which forecast value to use?
  - Does the prediction interval show the expected intra-period variability?
  - Can the exceedance probabilities be changed (are they configurable)?

Common Barriers To (Proper) Use



Streamflow Scenarios / Analogs

- Misunderstanding the forecast quantities
  - Non-exceedance probability

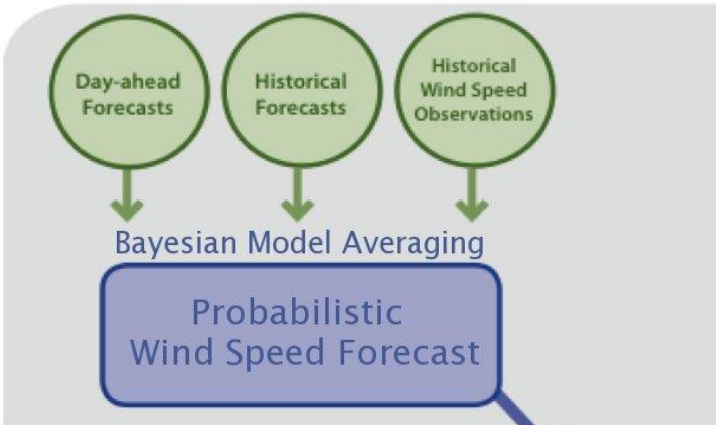
    "1 in 10 chance that the actual streamflow will be lower than this value"
  - Temporal averaging period

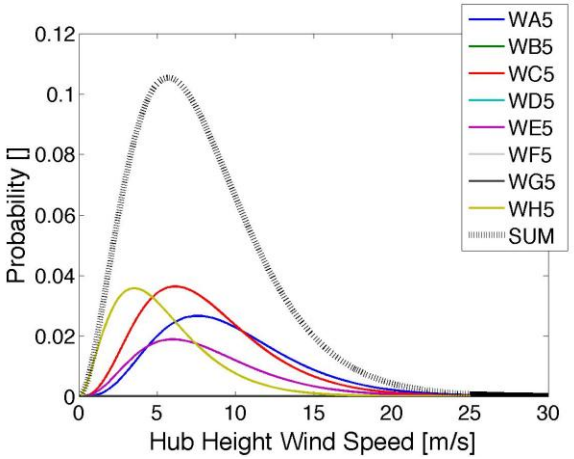
    "1-hour avg wind power generation"
- Unknown client risk tolerance
  - Changing economic factors
  - Not quantifiable (too complex)

    (e.g., electric reliability is priceless)
- Lack of interactivity
  - Need to do scenario analysis

3TIER

Ensemble-Based Forecast Creation





- Combined poor-person's ensemble with home-grown, mixed-physics WRF model ensemble (w/ out data assimilation)
  - Used MOS and BMA to calibrate over (pseudo) re-forecast data set
  - Event timing errors and missed events were still significant
  - Need (client demand) for 0-6 hour estimates of event risk

- Have avoided full-scale ensemble data assimilation and forecast system so far.

Recommended MEPS/SREF Requirements

- Improved Member Diversity in Short-Range (0-3 days)
  - Especially needed at 0-6 hrs (ensemble/hybrid data assimilation)
  - Needs to include lower BC uncertainties (ocean and land surfaces)

- Comprehensive Data Availability, Including Re-Forecasts
  - Full model output fields on native grid resolution at 1-hr. intervals
  - Re-forecasts for at least 1 cycle, out to 3 days, over previous 3 yrs.
    - invaluable for calibration and site-specific model development

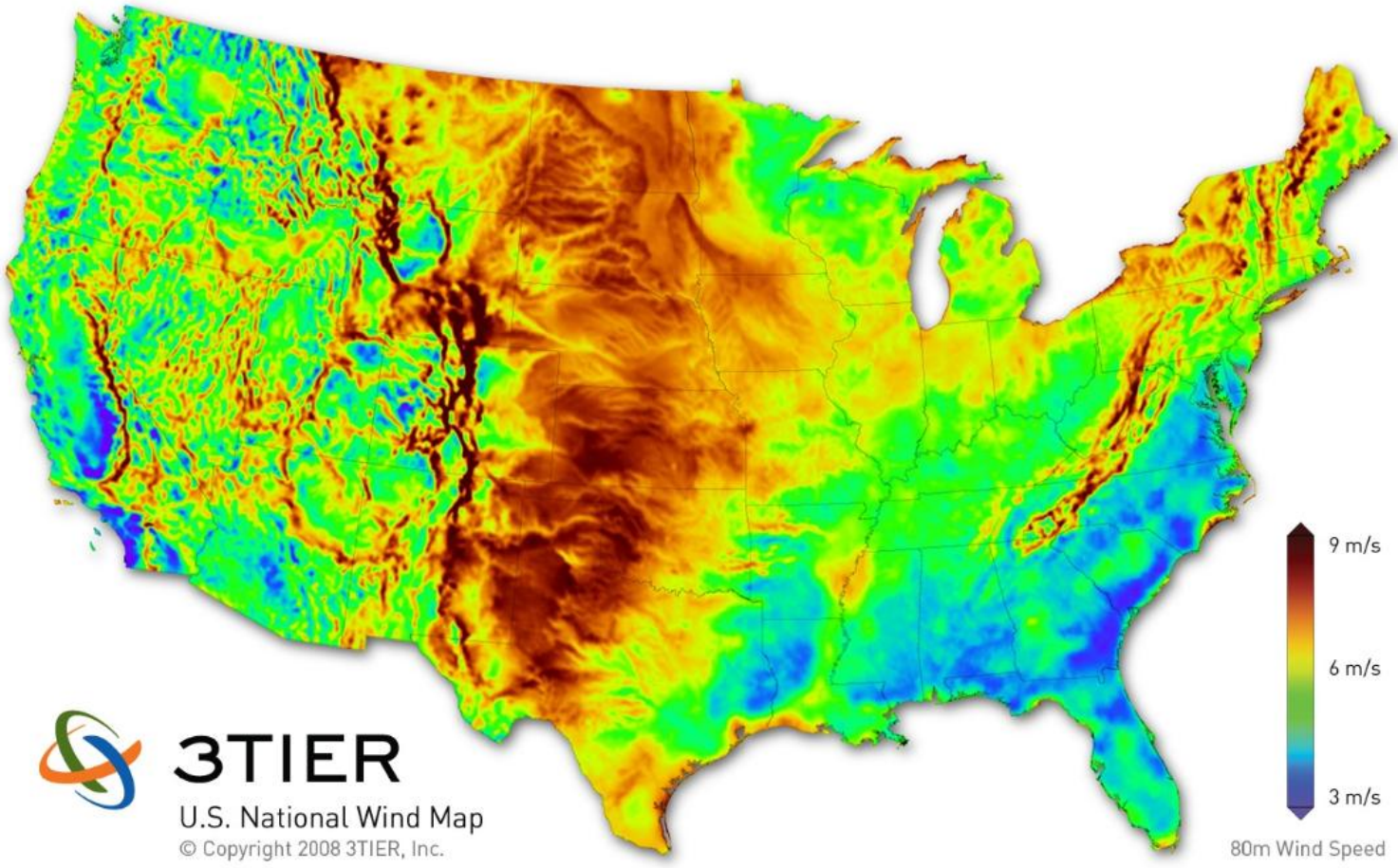
- Timeliness and Rapid Refresh
  - Needs to be available within assimilation cycle period
  - Becoming more important as utilities and grid system operators begin to ask for sub-hourly updates

Closing Remarks

- A stronger, cohesive U.S. NWP effort, which includes a rapidly refreshed, mesoscale ensemble data assimilation and prediction system, is needed to support the energy industry.
  - Full gridded model output should be made available, if possible.
- Industry-specific post-processing (calibrated products for industry decision-making) should be handled by the private sector.
  - Hazardous weather and general public weather forecast post-processing should continue to be handled by NOAA.
- Generalized ensemble forecast verification results performed in the energy industry ought to be shared with modeling system developers and the operational centers.

3TIER

Our Potential Is Vast



3TIER

Remaining Challenges

- Technical Factors:
  - Timing errors are significant
    - Improved ensemble prediction system (size and IC diversity)
    - Incorporate time-shifting into BMA calibration
  - Finding regime-dependent training sets (analogs)

- Human Factors:
  - User Interface Must:
    - Convey understanding of the (coupled) forecast quantities
    - Allow requests for user-defined quantiles or intervals
    - Support interactive viewing of different requests