

# Wind Operating Impacts

**UWIG Focus on the Northwest**

**Technical Workshop**

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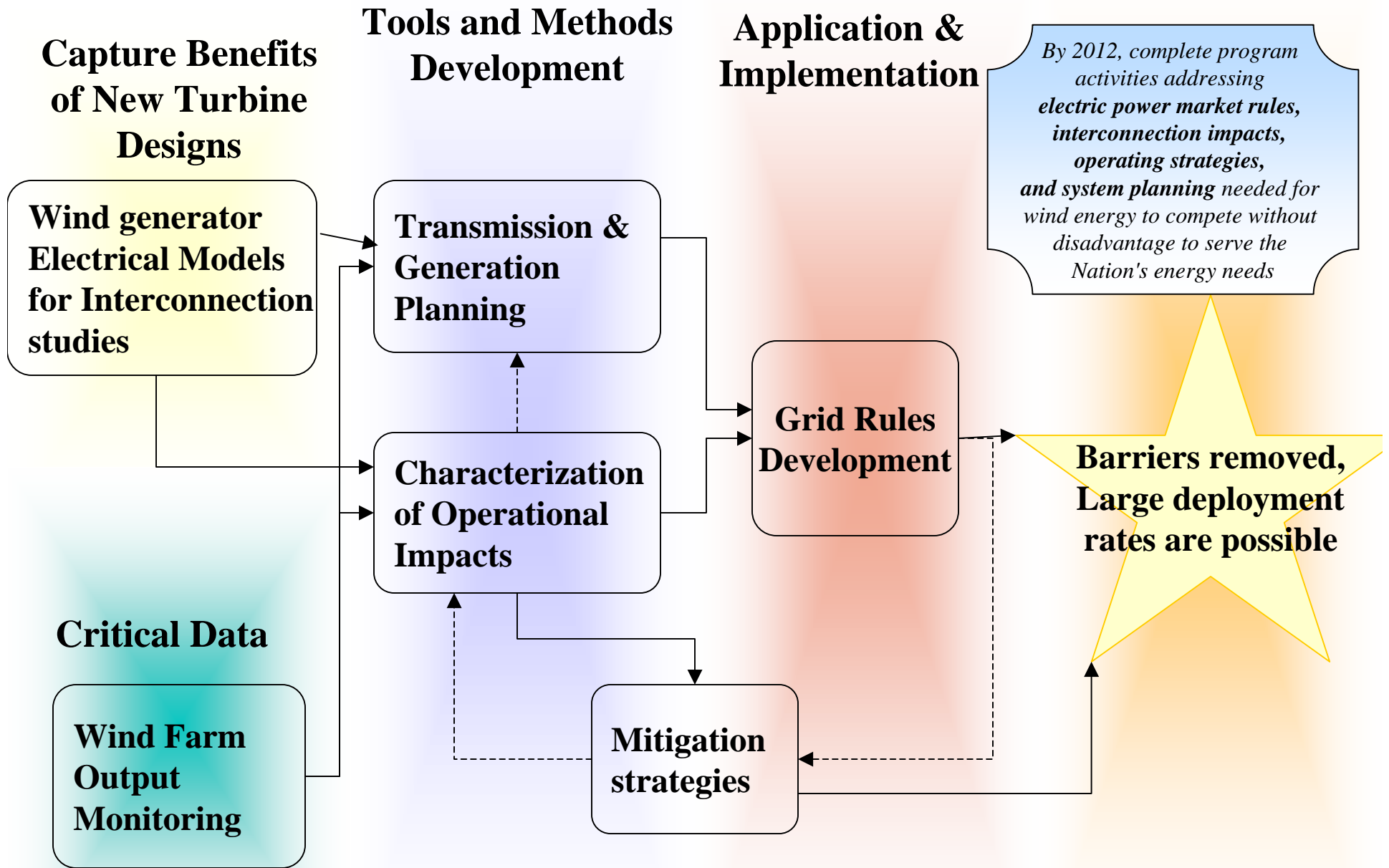
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# Wind Power's Natural Characteristics

- ***Remote:*** Wind resources often distant from major markets
- ***Variable:*** Plant output varies with variations in the wind
- ***New:*** Operators more comfortable with established power technologies with known characteristics

*Key Issue: How do you fairly account for wind's natural characteristics?*



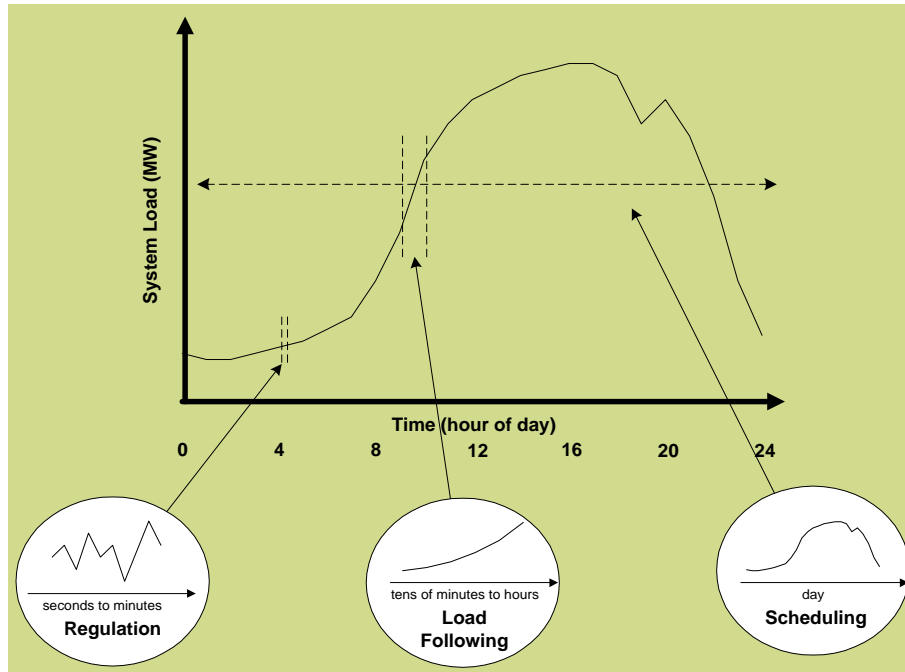
# System Integration Task Relationships

## *First Cut Analysis: Wind looks BAD due to lack of history and experience*

- No firm reliability (capacity value) since there is no control switch on the fuel source
- Dedicated backup needed at 100% of wind nameplate in case wind stops blowing
- Allocation of needs to wind plant only
- Lead to concept of a very low penetration *limit* and *high* integration costs that often exceeded the value of the energy

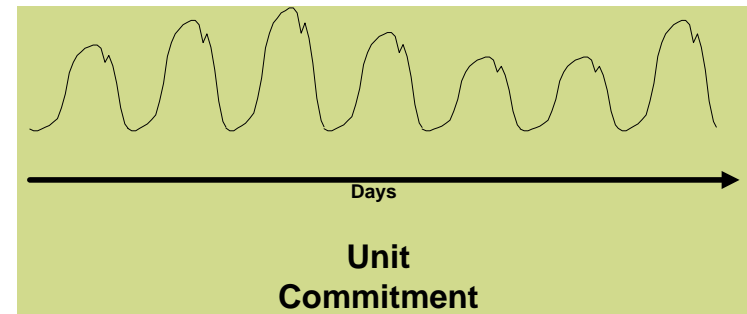
Without better understanding of wind and true system impact, utilities are reluctant and often establish very conservative rules based on worst-case scenarios

# Power-System Operation Impacts



- Regulation -- seconds to a few minutes -- similar to variations in customer demand (loads)
- Load-following -- tens of minutes to a few hours -- usage follows predictable patterns, wind less so

- Scheduling and commitment of generating units -- one to several days -- wind impacts unclear



Wind controlled by nature, not power-plant operators!

## *Variability* Can Increase Operating Costs

- Committing unneeded generation
- Scheduling unneeded generation
- Allocating extra load-following capability
- Violation of system performance criteria
- Increased cycling operation
- **These are reflected in *ancillary services* costs**

Incremental cost added by wind's variability:  
Is it  $\sim 0.1\text{¢/kWh}$  or  $\sim 1\text{¢/kWh}$ ?

## *Mitigating Factors (not accounted for)*

- Actual wind farm power output characteristics
  - Multiple generator smoothing (intra- and inter-site)
  - New generator and farm interface abilities
- Large scale geographic diversity
- *System* characteristics (loads and generators) and statistical, not deterministic nature
- Ability to forecast
- Evolution of competitive wholesale markets (near real time operations and unscheduled deviation practices)

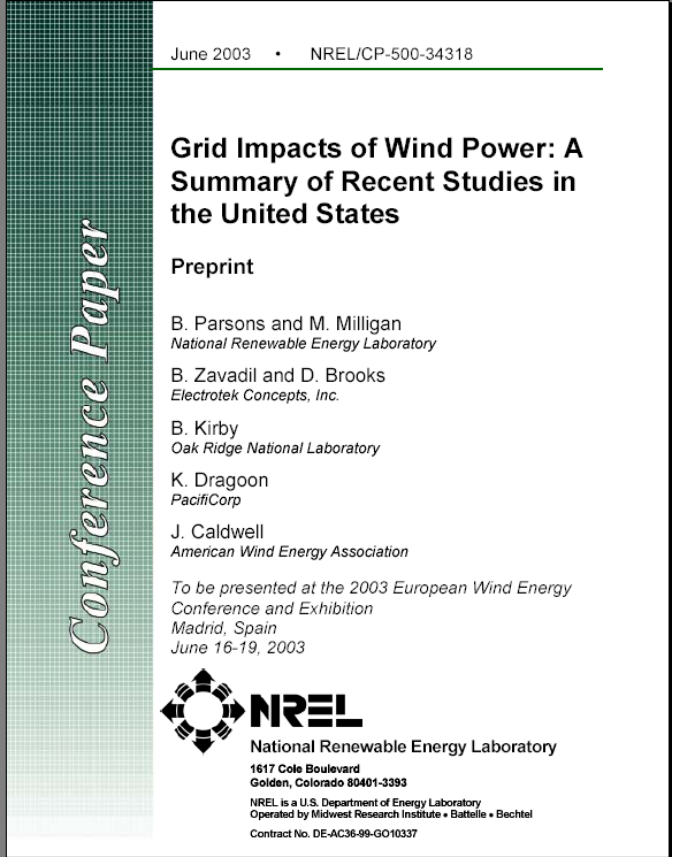
**Need for in-depth data and analysis**

# Resources and analyses

- "Grid Impacts of Wind Power: A Summary of Recent Studies in the United States; Preprint"

[www.osti.gov/servlets/purl/15004469-1r8Tgt/native](http://www.osti.gov/servlets/purl/15004469-1r8Tgt/native)

- European Studies
- UWIG Operating Impact User Group
- Ongoing/Future work
  - Xcel Southwest/Hirst
  - NYSERDA
  - California, Phase 2
  - MN Department of Commerce/Xcel round 2
  - Hawaii Intermittent Generation Assessment Protocol



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**Grid Impacts of Wind Power: A Summary of Recent Studies in the United States**

Preprint

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