Weather Forecasting and Power System Operation

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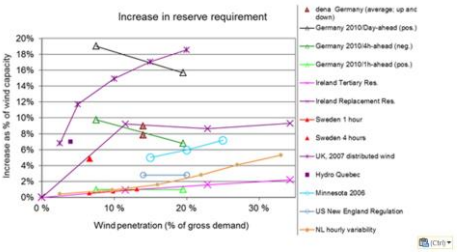
Outline of Topics

- Background
- Recent Grid Integration Studies
- Role of Transmission
- Market Evolution
- Conclusions

Variable Generation Forecasting – Why Is it Important

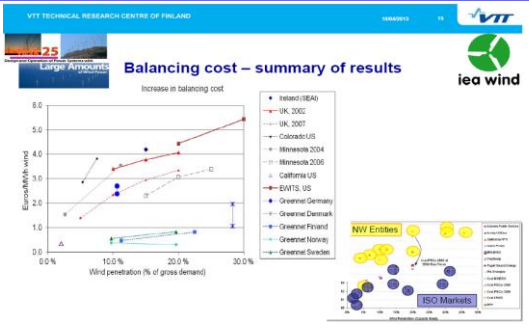
- Economics
  - Better forecasts mean lower operating reserves
  - Lower operating reserves mean lower operating costs
  - Avoid penalties for bad forecasts
- Reliability
  - Situational awareness for operators
  - System positioning for ramping events
  - Preparation for extreme events
- Market Operation
  - Understand need for and provide incentives for the right market products with high VG penetration
  - Align market rules with forecasting capabilities

Reserve Requirement Summary

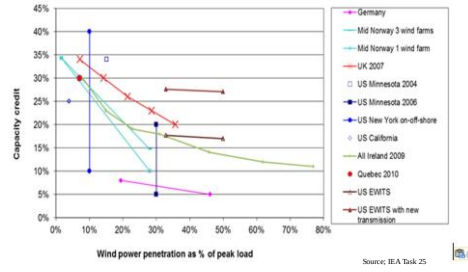


Source; IEA Task 25

Balancing Cost- Summary of Results



Capacity Credit Summary



Source; IEA Task 25

Transmission and Interconnection Policy in the US

- Major activities covered under transmission policy include:
  - Planning
  - Permitting
  - Paying (cost allocation and recovery)
- Many political and regulatory jurisdictions now explicitly recognize that significant amounts of VG cannot be delivered to load without a corresponding expansion of the transmission
- This realization has been enshrined in policy through FERC Order 1000, which requires joint and coordinated transmission planning between neighboring transmission entities, transmission operators and RTOs/ISOs

Transmission Adequacy

- Transmission planning for energy sources
  - Planning driven by LMP differences
  - Look at 8760 hours instead of peak load hour
  - New contingencies likely around times of minimum load and minimum conventional generation
  - Need wind integration study to determine ancillary service requirements
  - LOLE and ELCC calculations likely to modify planning reserve margins
- HVDC system design, use and justification across synchronous zones for aggregation, diversity and control benefits

Market Design

- Today's markets not all designed with VG in mind
  - *Energy markets*
  - Capacity markets
  - Ancillary service markets
  - Price responsive load markets
- Market shortcomings must be identified and corrected
  - Capacity/flexibility adequacy concerns
  - Energy market price volatility
  - Negative prices

A New Paradigm for Future Capacity and Flexibility Adequacy?

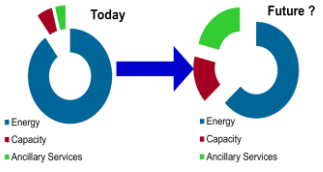


Figure courtesy of EPRI

Revenue mix will change, but paths and values are uncertain
- Capacity markets vs. long-term contracts vs. rate-based plants…
- Ample supplies of services may lead to low values
- New sources of services and flexibility are likely

Mark Ahlstrom, UVIG 2015

Conclusions

- Deploy more flexible generation and load technologies
- Improve wind plant output forecasting tools
- Aggregate wind plant output over large regions
- Improve balancing area cooperation/ACE Sharing
- Recognize wind contributions to capacity value
- Develop well-functioning day-ahead , hour-ahead, and real-time energy and price responsive load markets
- Adequate transmission capacity and comprehensive regional planning processes are critical

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