Morgan Lewis

Integrating Renewable Energy Resources into the Transmission Grid

Presented by:

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Summary of Presentation

- **Growth of Variable Generating Resources ("VERs")**
- **Challenges of VERs in the Electric Grid**
  - Power system reliability
    - Forecasting and scheduling
    - Energy imbalance practices
    - Balancing Authority coordination
  - Transmission expansion and upgrades (cost planning and recovery)
- **FERC Notice of Inquiry**
  - *Integration of Variable Energy Resources*, 75 Fed. Reg. 4316 (Jan. 27, 2010)
    - NOI requests public comment:
      - Extent to which barriers exist to integration of VERs into electric grid
      - Need for reforms

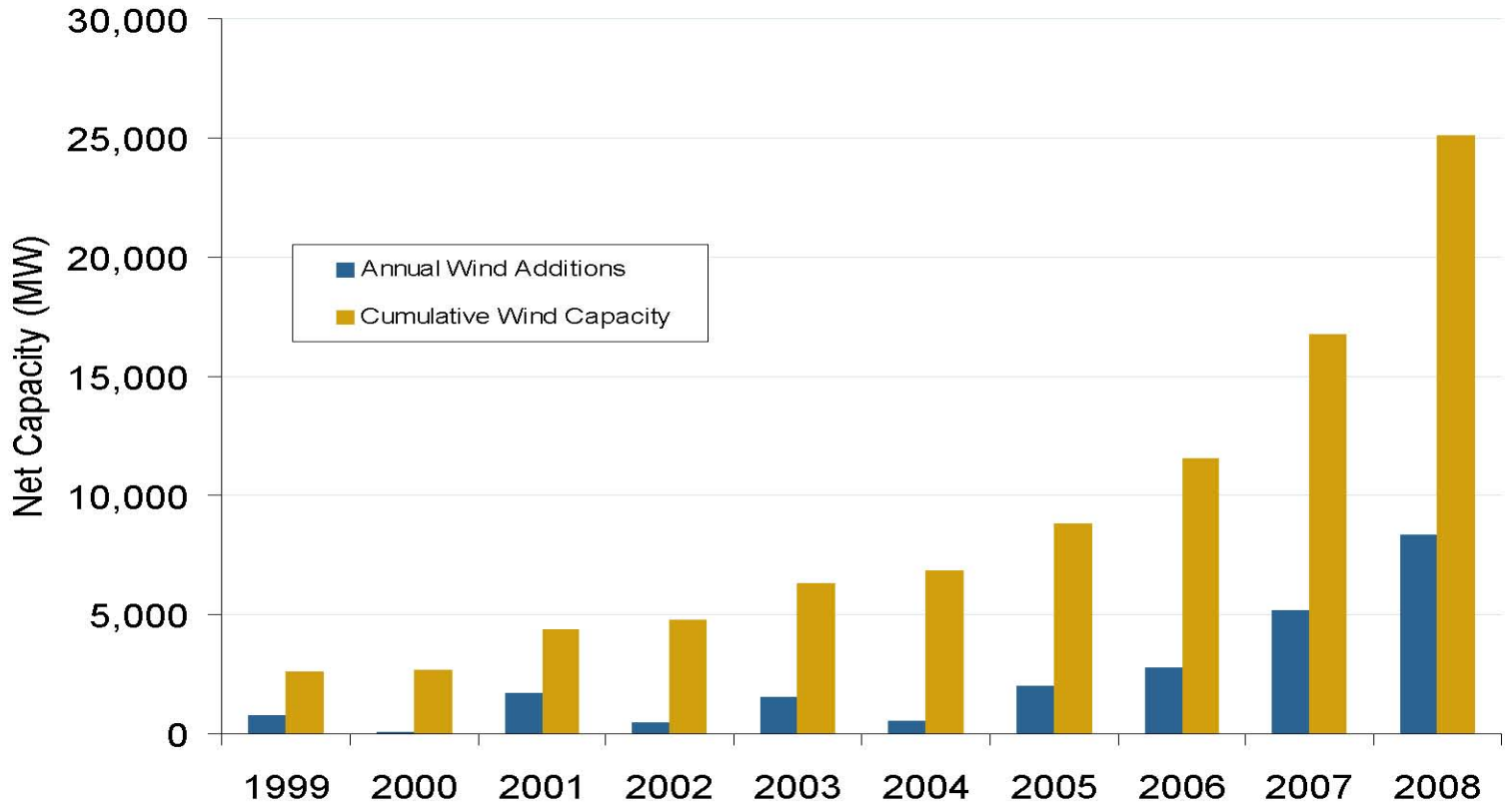
→ NOI comments due **April 12, 2010**

Growth of VERs - Wind

Renewable Power & Energy Efficiency: Annual Wind Capacity Growth

Federal Energy Regulatory Commission • Market Oversight @ FERC.gov

U.S. Wind Capacity Growth, 1999 – 2008



Source: Energy Velocity Generating Unit Capacity Dataset

Updated April 7, 2009

34000

February 2010

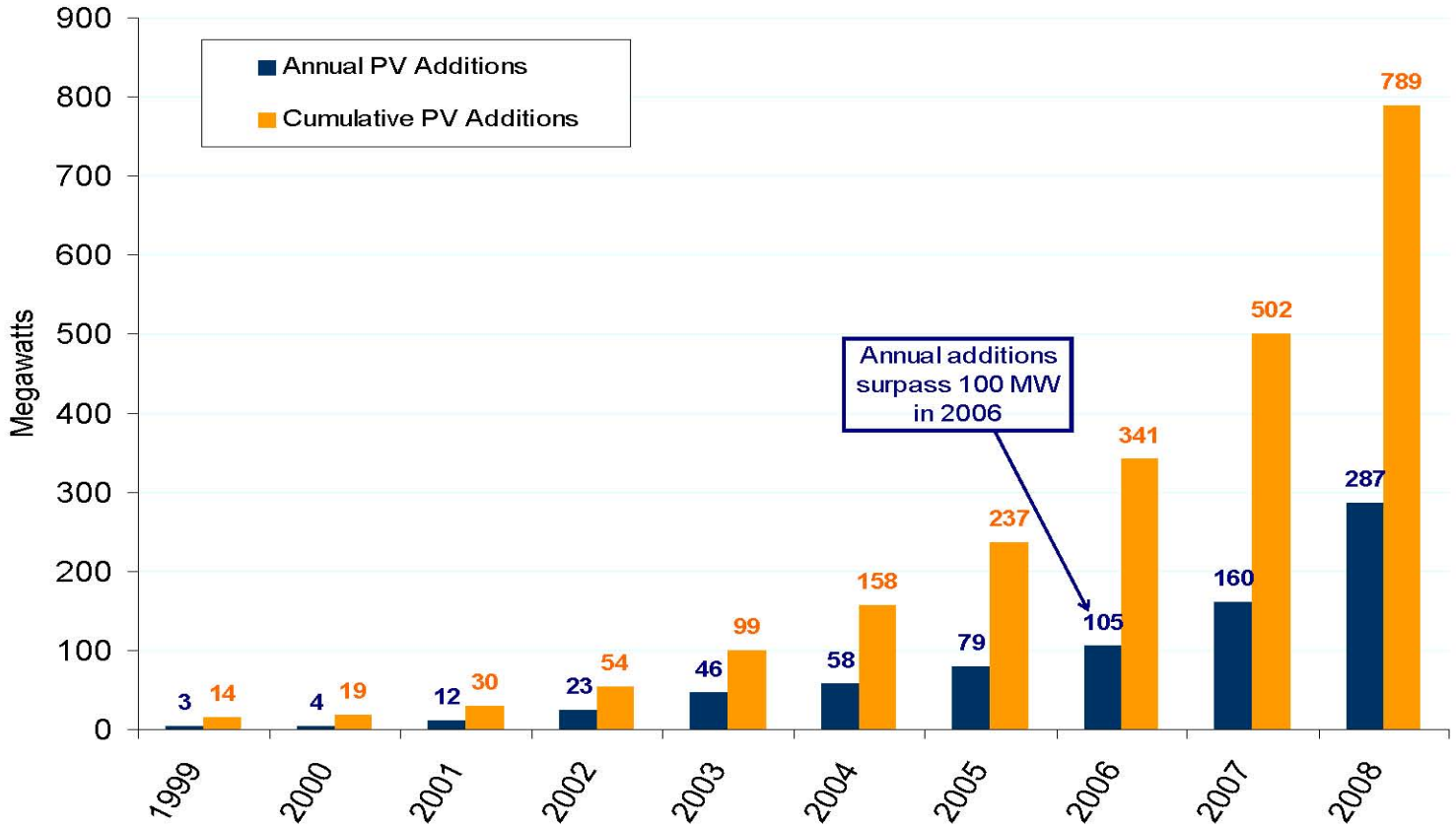
Source:http://www.ferc.gov/market-oversight/othr-mkts/renew/2010/02-2010-othr-rnw-archive.pdf

Growth of VERs – PV Solar

Renewable Power & Energy Efficiency: Regional PV Capacity Growth

Federal Energy Regulatory Commission • Market Oversight @ FERC.gov

U.S. Grid-Connected Photovoltaic Capacity Growth, 1999 – 2008



Source: IREC: Interstate Renewable Energy Council

Updated February 5, 2010

34005

Source:http://www.ferc.gov/market-oversight/othr-mkts/renew/2010/02-2010-othr-rnw-archive.pdf

Growth of VERs – More to Come

Renewable Power & Energy Efficiency Market: Renewable Portfolio Standards

Federal Energy Regulatory Commission • Market Oversight @ FERC.gov

30 States including D.C. have Renewable Energy Portfolio Standards (RPS)

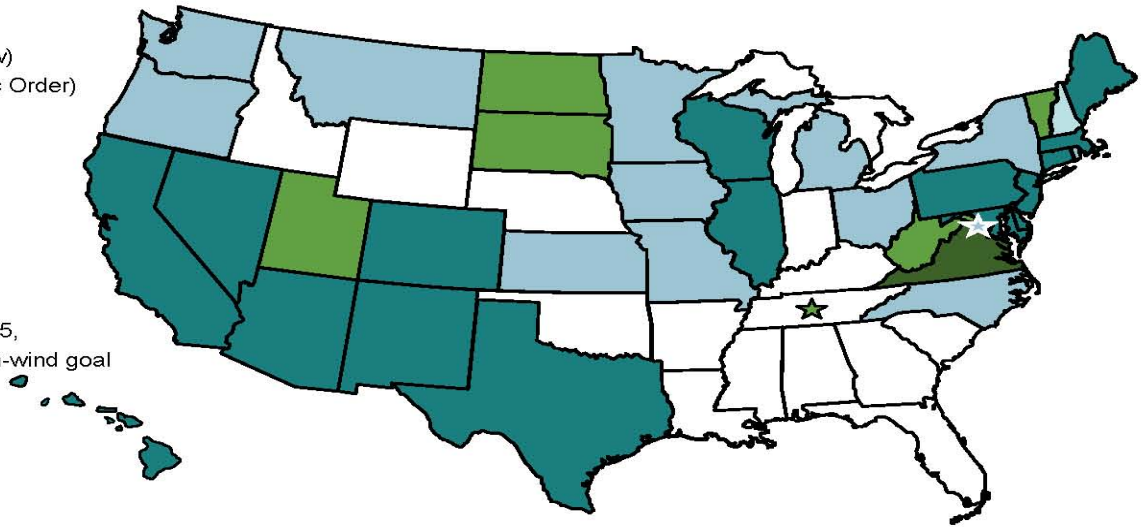
ND: 10% by 2015
SD: 10% by 2015
KS: 20% by 2020

MN: 25% by 2025; Xcel: 30% by 2020
IA: 105 MW, plus 1 GW wind goal by 2010
MO: 15% by 2021

MI: 10% MWh and 1,100 MW by 2015
WI: 10% by 2015
IL: 25% by 2025 wind 75% of RPS
OH: 12.5% by 2025

ME: 40% by 2017, plus 3 GW wind goal by 2020
NH: 23.8% by 2025
VT: 20% by 2017; all growth to 2012 from RE and EE
MA:15% by 2020 then 1% each year, plus 2 GW wind goal by 2020
RI: 16% by end 2019
CT: 27% by 2020
NY: 25% by 2013
NJ: 22.5% by 2020
PA: 18% by 2020
DE: 20% by 2019-2020
DC: 20% by 2020 ★
MD: 20% by 2022
VA: 15% by 2025; goal with production incentives
WV: 25% by 2025 with alternative and renewable resources
NC: 12.5% by 2021
TVA: 50% by 2020 ★

WA: 15% by 2020
OR: 25% by 2025
CA: 20% by 2010 (law) 33% by 2020 (Exec Order)
MT: 15% by 2015
NV: 25% by 2025
UT: 20% by 2025
CO: 20% by 2020
AZ: 15% by 2025
NM: 20% by 2020
TX: 5,880 MW by 2015, plus 500 MW non-wind goal
HI: 40% by 2030



Updates at: http://www.ferc.gov/market-oversight/othr-mkts/renew.asp

Abbreviations: EE – Energy Efficiency; RE – Renewable Energy
Notes: An RPS requires a percent of an electric provider's energy sales (MWh) or installed capacity (MW) to come from renewable resources. Most specify sales (MWh). Map percents are final years' targets. *TVA's goal is not state policy; it calls for 50% zero- or low-carbon generation by 2020. Alaska has no RPS.
Sources: Derived from data in: LBNL, PUCs, State legislative tracking services, Pew Center, and the Union of Concerned Scientists. Details, including timelines, are in the Database of State Incentives for Renewables and Energy Efficiency: http://www.dsireusa.org

RPS
Accelerated or strengthened RPS
Voluntary standards or goals
Strengthened voluntary standard

Updated December 8, 2009

34002

February 2010

Source:http://www.ferc.gov/market-oversight/othr-mkts/renew/2010/02-2010-othr-rnw-archive.pdf

Challenges to Power System Reliability – Operational Issues

- **Variable output / limited dispatchability of VERs**
- **"Ramping" by wind generation facilities**
  - Rapid increase or decrease of wind generation
  - Impacts on power flowing through bulk power system
- **Limited capacity value for variable resources**
- **Operational impacts on bulk power system not fully understood**

Challenges to Power System Reliability – Forecasting Challenges

- **Existing forecasting tools and methodologies may be inadequate**
  - Increased amount of variable generation
  - Addressing ramping and other generation variations
  - Risk assessments needed
- **Are forecasting tools improving?**
  - WSJ, March 2, 2010:

    "A new [ERCOT] forecasting tool is doing a good job of predicting when the wind will blow."

    Natural Gas Tilts at Windmills in Power Feud, Wall Street Journal, 3/2/2010

Challenges to Power System Reliability – Forecasting Challenges

- **Advanced forecasting tools leading to increased accuracy**
  - Meteorological forecasts and data
  - Multiple/diverse reporting locations
  - Centralized wind forecasting system for regions (e.g., ERCOT, PJM)
  - What else is needed?

- **Regulatory regimes**
  - Reporting requirements
  - To whom? What?

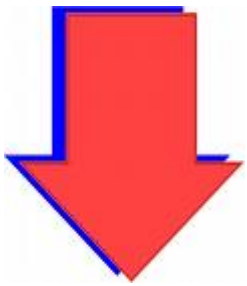
Challenges to Power System Reliability – Scheduling Practices and Challenges

- **Scheduling intervals**
  - Hour-ahead vs. intra-hour scheduling
- **Regional variations**
  - Real-time markets vs. traditional balancing authority areas

Challenges to Power System Reliability – Scheduling and Imbalances

- **Imbalance penalties / incentives**
  - Increased demand for balancing services
  - *Pro forma* OATT deviation penalties

- **Should variable resources make adjustments to schedules and/or output?**
  - Adjust schedule DOWN for under-generation
  - REDUCE output for over-generation



Challenges to Power System Reliability – Imbalances and Reserves

- **Ramping events create need for reserves**
- **Does deployment of variable generation result in inefficient use of reserves?**
  - Does inefficient use of reserves increase prices?
  - Should variable resources self-supply reserves?
- **Other/new reserve products**
  - Storage, etc.

Challenges to Power System Reliability – Balancing Authority Coordination

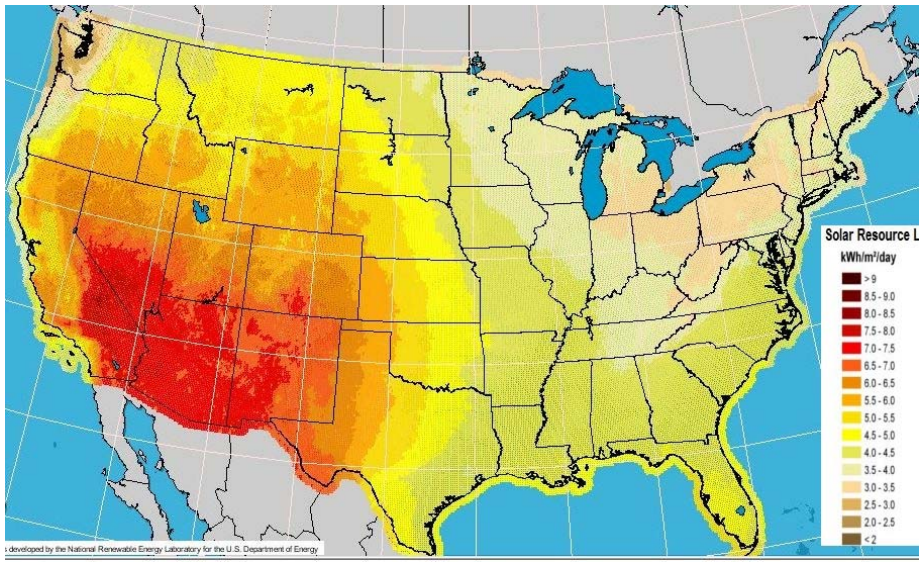
- **Current Balancing Authority Areas and Challenges**
  - RTO footprint vs. individual utility
  - Balancing authorities must constantly balance load and generation
  - Integration of variable resources by smaller balancing authorities

- **Moving forward …**
  - Coordination: enlarge the base of generation and demand
  - Increase customer (e.g., variable resource) access to energy, capacity, and reserve products
  - Dynamic scheduling

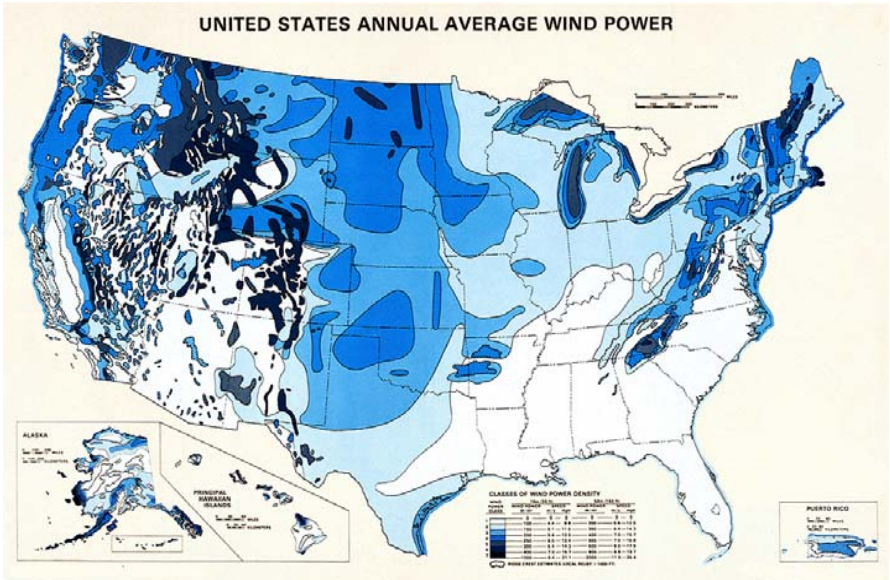
Renewable / Variable Generation Sources

- Localized geography
- Far from load centers

Solar



Wind



(Source: National Renewable Energy Laboratory)

Challenges to Transmission Infrastructure and Utility Companies

- **Geographic location of variable resources**
  - Away from load centers
- **Growing size of facilities**
  - e.g., large-scale wind farms (100s of MWs)
- **Increased number of facilities**
  - State renewable portfolio/energy standards

→ Solution: New transmission facilities / upgrades

Smaller-scale projects

- **More facilities smaller than commercial scale**
  - e.g., individual solar facilities (output in kWs)
  - Introduction of net-metering

→ **Costs associated with meters, other operational expenses**

→ **Reduced demand = loss of income**

Interconnection and Queue Reform

- **Delays in processing of interconnection queues**
  - FERC requested queue reforms
  - *Interconnection Queueing Practices*, 122 FERC ¶ 61,252 (2008)

- **RTOs developed queue reforms**
  - e.g., Midwest ISO, SPP
  - Fast-tracking of "ready" projects
  - Earlier/optional phases for projects in preliminary stages

Cost Allocation

- **Benefit-based allocation: upgrades paid for by the entities who enjoy the benefits of expansion project**
  - MISO, Docket No. ER09-1431
- **License plate (utility-based) allocation: each utility assumes the costs of its transmission investment and recovers the costs of its investment**
- **Postage stamp allocation: transmission expansion costs are recovered on a uniform basis in a defined region or market area**
- **Hybrid models: combining some aspects of the allocation methodologies above**

FERC NOI: *Integration of Variable Energy Resources*

Integration of Variable Energy Resources

Notice of Inquiry in FERC Docket No. RM10-11-000

130 FERC ¶ 61,053 (January 21, 2010)

75 Fed. Reg. 4316 (January 27, 2010)

→ Comments due: Monday, April 12, 2010

FERC NOI: *Integration of Variable Energy Resources*

NOI Areas of Inquiry – Perceived barriers, and suggested solutions to remove barriers, to integration of VERs

- Reserve requirements necessary to address VER variability
- Data and Forecasting
- Scheduling Flexibility and Scheduling Incentives
- Day-Ahead Market Participation and Reliability Commitments
- Balancing Authority Coordination
- Reserve Products and Ancillary Services
- Capacity Markets
- Real-time Adjustments

Effective NOI Comments

- **Specific examples of technical and operational challenges to VER integration**
- **Specific suggestions for changes to policies or practices that would facilitate VER integration**
- **Suggested revisions to OATT, LGIP/LGIA, or transmission provider business practices to ease VER integration challenges**

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