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The role of smarter grids in variable renewable resource integration




Mackay Miller, Research Analyst
National Renewable Energy Laboratory

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Mackay.Miller@nrel.gov

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Smart Grids and VRR Integration

This presentation contains material and findings from a forthcoming International Smart Grid Acton Network (ISGAN) white paper: *Smart Grid Contributions to Variable Renewable Resource Integration,* co-written by Mackay Miller (NREL) and David Beauvais (Natural Resources Canada), and currently in review.

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Disclaimer

The ISGAN white papers are meant as inputs into the broader ISGAN dialogue. The findings, analysis, and opinions expressed therein are those of the listed authors only.

Key SG Contributions to VRR Integration

Mitigating Specific Integration Challenges

- ❑ Transmission
- ❑ Magnitude of hourly overall ramping requirements
- ❑ Regulation capacity and intra-hour variability
- ❑ Overgeneration
- ❑ Large, near-instantaneous production ramps

System Integration

- ❑ Demand- and delivery-side intelligence
- ❑ Activating markets
- ❑ Enabling distributed generation and microgrids
- ❑ DSO and TSO intelligence and coordination
- ❑ Control room improvements

Key Planning Concepts

1: Ensure alignment between smart grid roadmaps and scenarios for future renewable energy supply

VRR generation targets; Projected geographical distribution; Mix of distributed vs. utility-scale; Efficiency targets

2: Evaluate smart grid VRR integration solutions in the context of the full range of integration solutions

Other tools are context specific, and include market reforms, system operation changes, conventional generator cycling

Mitigating Specific Integration Challenges

- **Transmission**

  Wide-Area Situational Awareness; Phasor Measurement Units; High-Voltage DC Transmission; Flexible AC Transmission Systems

- **Magnitude of hourly overall ramping requirements**

  Industrial & agricultural load resources -- e.g. agricultural water pumping; industrial refrigeration, wastewater storage pumping

- **Regulation capacity and intra-hour variability**

  Fast or instantaneous industrial, commercial, and residential load resources – e.g. lighting, HVAC, water pumping with storage

- **Overgeneration**

  Industrial, commercial & residential load resources -- e.g. municipal water storage pumping, thermal mass pre-cooling, PHEV charging

- **Large, near-instantaneous production ramps**

  Volt & var optimization systems, distribution automation, active power electronics

Sources: Kiliccote et al, 2010; Neal & Bravo, 2011

SG in the context of other integration tools

- ❑ SG solutions may be cost-effective in many contexts
- ❑ The relative economics of the integration solution set is grid-specific, geography-specific, and seasonal
- ❑ The economics of the demand response "supply curve" is grid-specific and seasonal, and changes over time
- ❑ SG solutions may require complementary market- and/or system operation changes
- ❑ Projected characteristics of VRR capacity and generation should inform SG planning and investment