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Accommodating High Levels of Variable Generation

U.S. Department of Energy - Electricity Advisory Committee
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Agenda

- About NERC
- About the Integration of Variable Generation Task Force (IVGTF)
- “Variable” Resources
- Recommendations
- Next Steps

Variable Resources

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Variable resources are types of electric power generation that rely on an uncontrolled, “variable” fuel (e.g. wind, sunlight, waves, tidal forces, and some types of rivers) to generate electricity. Most renewables fall into this category.

Reliably integrating these resources into the bulk power system will require significant changes to traditional methods used for system planning and operation.

Ongoing efforts brought together by NERC and its stakeholders have the potential to fundamentally change how the system is planned, operated, and used – from the grid operator to the average customer.

About NERC

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International regulatory authority for electric reliability in North America

- Develop & enforce reliability standards
- Analyze system outages and near-misses & recommend improved practices
- Assess current and future reliability

Integration of Variable Generation Task Force

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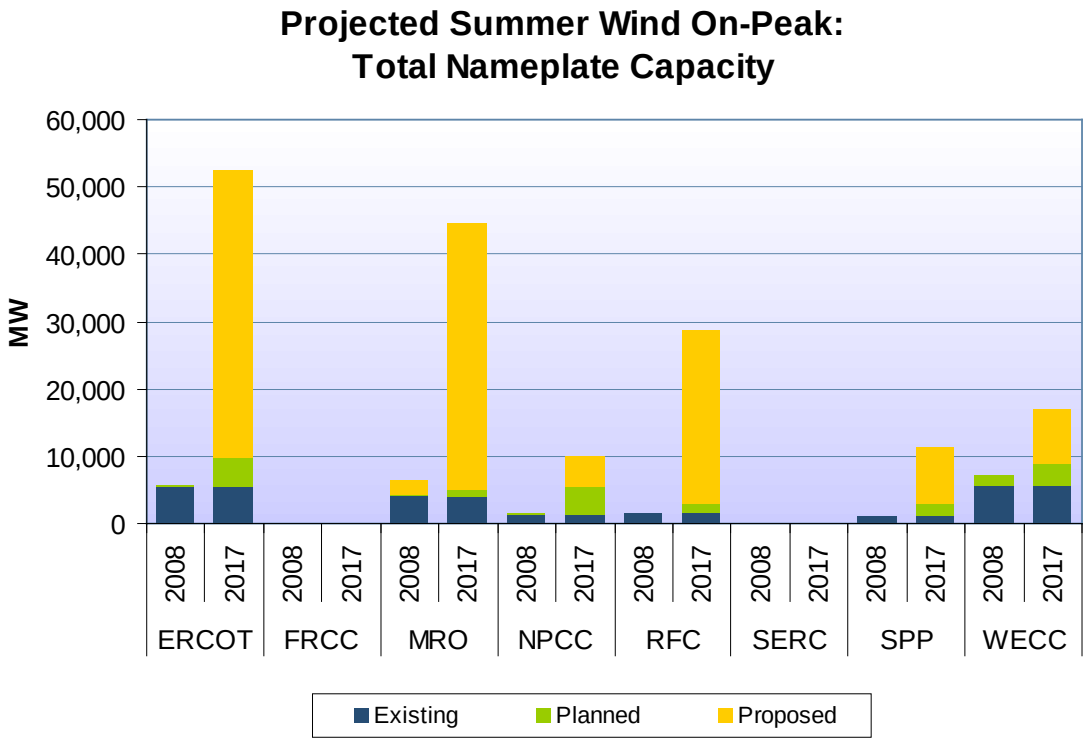
- Formed by NERC's Planning & Operating Committees in December 2007
- 47 participants, 23 official "members"
  - Utilities, ISO / RTO's, wind and solar manufacturers, associations, government
  - Strong cross-border collaboration (U.S. & Canada)
- Focus on reliability

Significant Growth Expected

- New policies & environmental priorities driving growth
- 200,000 MW of wind proposed in coming 10 years
- Increases seen in solar (i.e. 15,000 MW in California ISO queue)



Bulk Power System Designed to Meet Demand in Real Time

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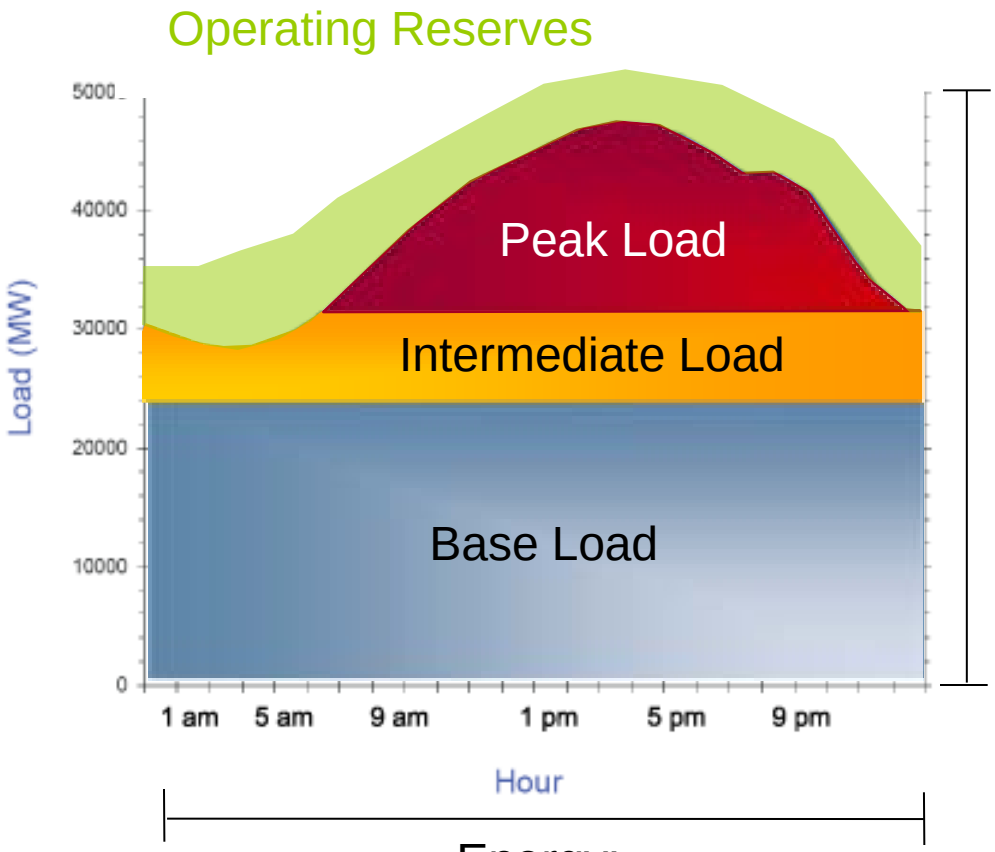
Typical Daily Demand Curve

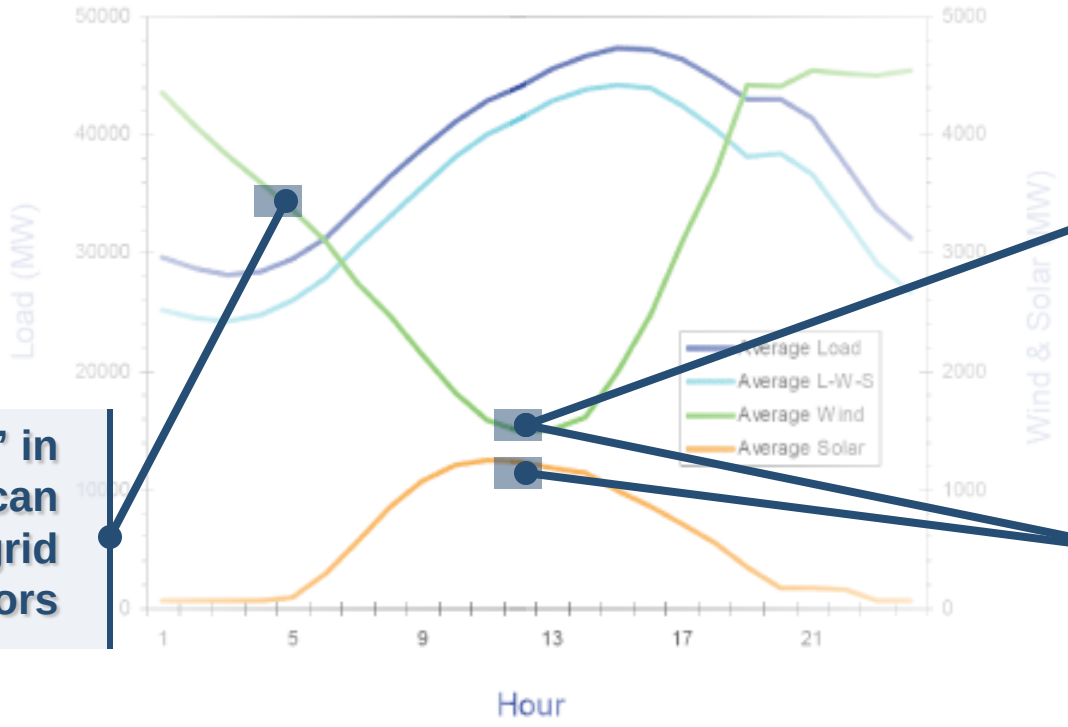


Capacity:
Instantaneous measure of electricity available at peak

Energy:
Electricity Produced over Time

Variable Fuels Must Be Used When Available

- Variable generation often does not positively correlate with electricity demand



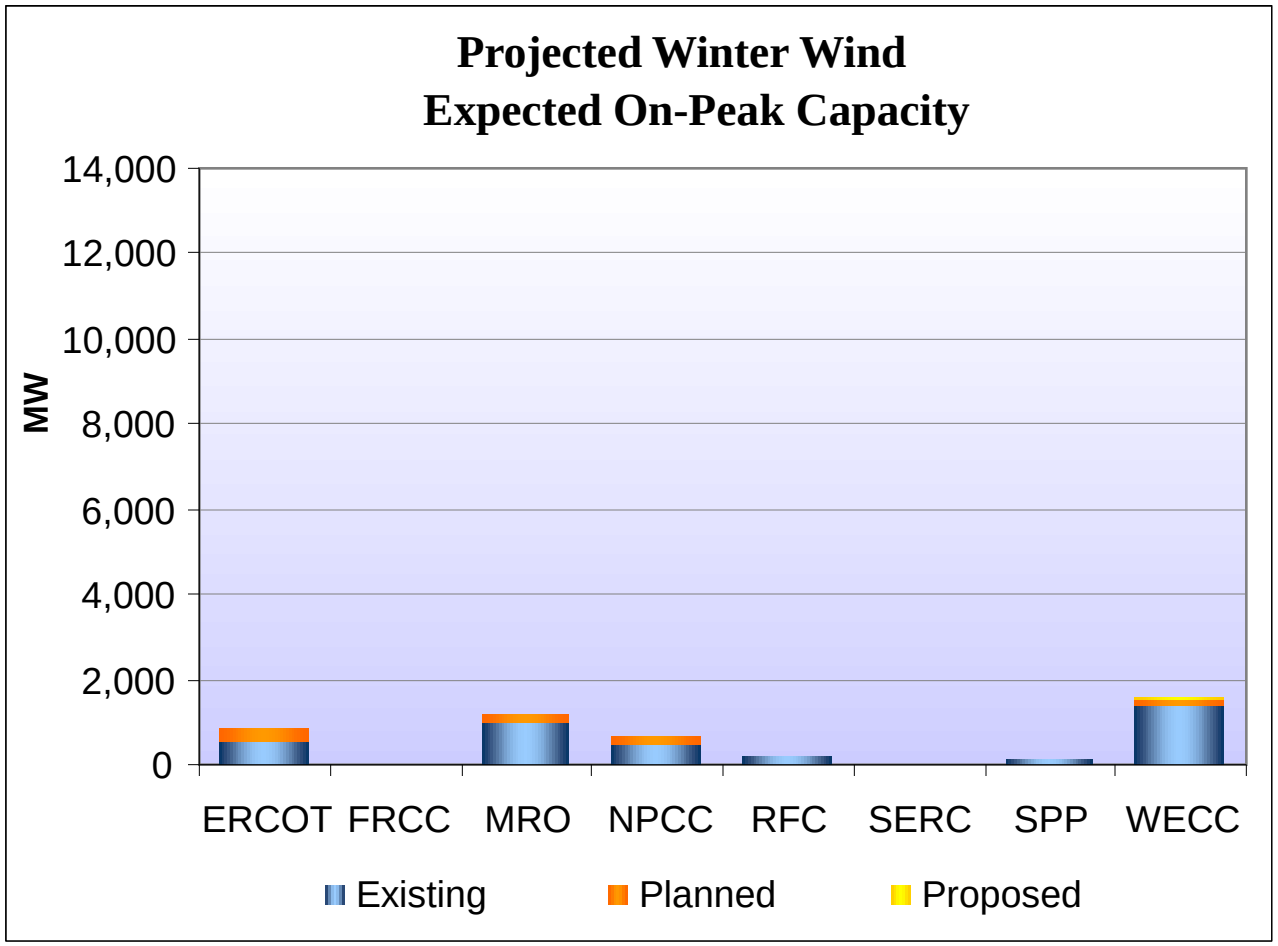
Only 8 – 26% of wind's "nameplate" capacity is available at times of peak demand for electricity

"Ramps" in availability can challenge grid operators

Wind & Solar Electricity Production Appears Complementary

While variable generation differs from traditional generation in important ways, properly integrated variable resources do not reduce reliability or otherwise negatively affect the grid.

Variable Fuels Must Be Used When Available



This does not mean that the wind does not blow during peak periods. However, for resource adequacy purposes, planners must derate wind capacity to an expected value—typically between 8-26% of the nameplate value.

Variable Fuels Must Be Used Where Available

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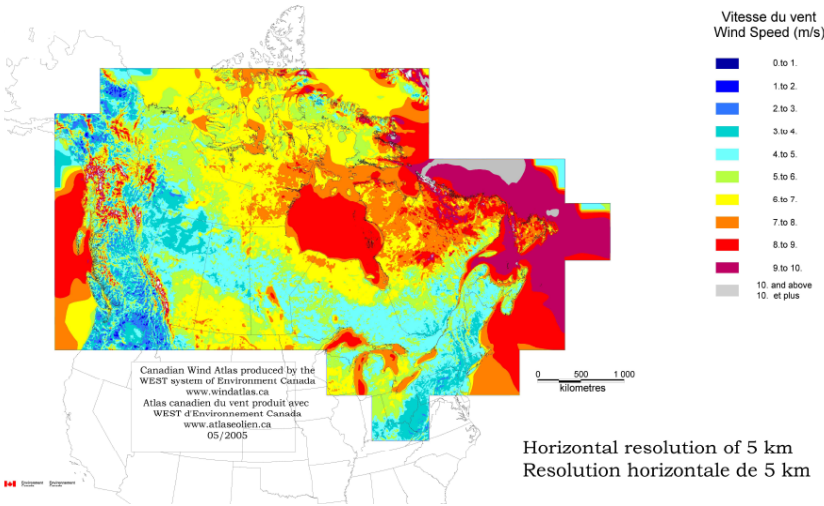
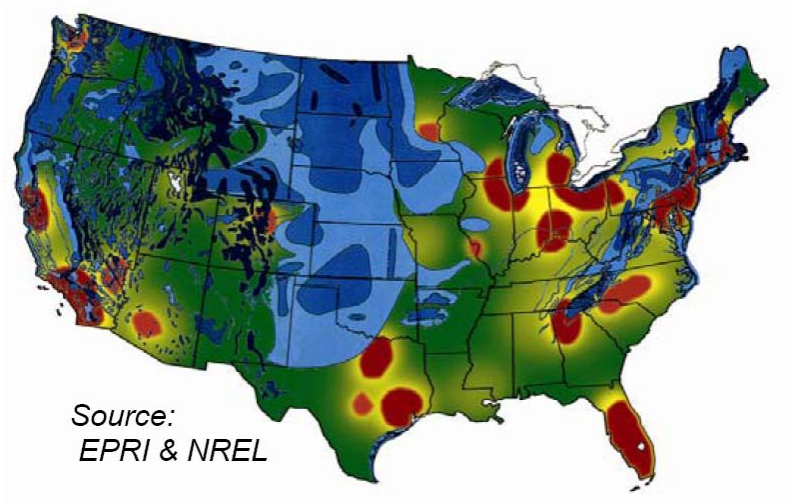
- Variable generation often located in areas remote from demand centers and existing transmission infrastructure



Horizontal resolution of 5 km
Resolution horizontale de 5 km



Source:
EPRI & NREL

Legend

Demand Centers

High Wind Availability

Keeping Reliability in the Balance

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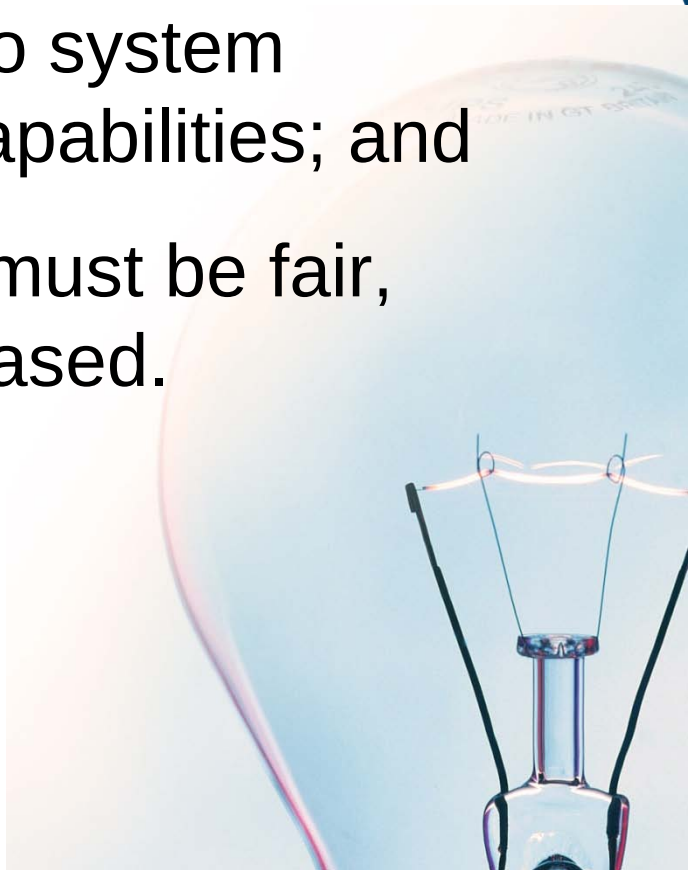
- Bulk power system reliability must be maintained, regardless of the generation mix;
- All generation must contribute to system reliability within their physical capabilities; and
- Industry standards and criteria must be fair, transparent and performance-based.



Areas of Further Study & Effort

- High levels of variable generation will require **significant transmission additions** and reinforcements. Barriers to transmission development should be addressed
- **Additional flexible resources**, such as demand response, plug-in hybrid electric vehicles, and energy storage may help balance steep “ramps”
- **Improved measurement**, forecasting, and modeling of variable generation output is needed

2010 All Electric Chevrolet Volt
Courtesy of General Motors

Areas of Further Study & Effort

- **More comprehensive planning approaches and operational practices** are needed, including probabilistic planning approaches
- In aggregate, variable generation connected at the distribution level (i.e. **local wind generation and rooftop solar panels**) may impact bulk power system reliability
- Deploying **complementary types of variable generation** (e.g. wind and solar), **leveraging fuel diversity** over large geographic regions, and **advanced control technologies** show promise in managing unique operating characteristics
- Greater **access to larger pools of generation and demand** may facilitate the large-scale integration of variable resources

Status of Work Plan Activities – Completed

Completed

Probabilistic Techniques	Planning	Interconnection	Operations	Reference Manual
Flexibility Requirements and Metrics for Variable Generation Final on 9/15/2010	MOD Standards Models of VG Final on 5/18/2010		Variable Generation Power Forecasting for Operations Final on 2/23/2010	

Status of Work Plan Activities – Under Review

Under Review/Approval

Probabilistic Techniques	Planning	Interconnection	Operations	Reference Manual
Accurate Methods to Model and Calculate Capacity of Variable Generation Review 12/15/2010	Potential Reliability Impacts of Emerging Flexible Resources For Approval on 12/15/10		Ancillary Services and BA Solutions Review 12/15/2010 Regional Diversity VG Review 12/15/2010	

Status of Work Plan Activities – Under Development

Under Development

Probabilistic Techniques	Planning	Interconnection	Operations	Reference Manual
Probabilistic Techniques and Planning Approaches Targeted for 2012	Reliability Impacts of Distributed Resource Review 12/15/2010	Inter-connection Requirements Targeted for 2011	BA Communication Targeted for 2011	Reference Manual Targeted for 2011
		Low Voltage Ride-through Targeted for 2011		

Key Take-Aways

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Spawned by governmental policy drivers and societal benefits, renewable energy is growing at an unprecedented rate. The electric power industry must be prepared to reliability accommodate the expansion.

Reliably integrating these resources into the bulk power system will require significant changes to traditional methods used for system planning and operation.

While variable generation differs from traditional generation in important ways, properly integrated variable resources do not reduce reliability or otherwise negatively affect the grid.

Question & Answer