

# Integrating Low-Carbon Resources Into the Electric Grid

Presentation to North America 2050

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# Ways to Increase Low-Carbon Electricity Resources Absent Carbon Regulation

- Resource Standards

- Energy Efficiency Resource Standards; all cost-effective standard
- Higher Renewable Energy Standards; add thermal standard
- Clean Energy Standard

<http://www.c2es.org/publications/clean-energy-standards-state-federal-policy-options-implications>

- Net metering – Raise limits, community net metering
- Feed-in tariffs (FITs) and variations (auctions)
- Promote efficient combined heat & power (CHP)
- Risk-aware resource planning  
<http://www.ceres.org/resources/reports/practicing-risk-aware-electricity-regulation/view>
- Reduce costs of integrating wind and solar (focus today)



# Integration Challenges for Renewable Energy

- **Variability** – *The range of expected load and generation*
  - Variability is reduced with more resources spread over a wider area (diversity of weather patterns)
- **Uncertainty** – *When/how much load and generation will change*
  - Operators plan based on forecasts of loads and generation sources. Some error is inherent.
  - Uncertainty of wind and solar output is due to unknown changes in weather
- **Many types of conventional generation also impose integration costs.**



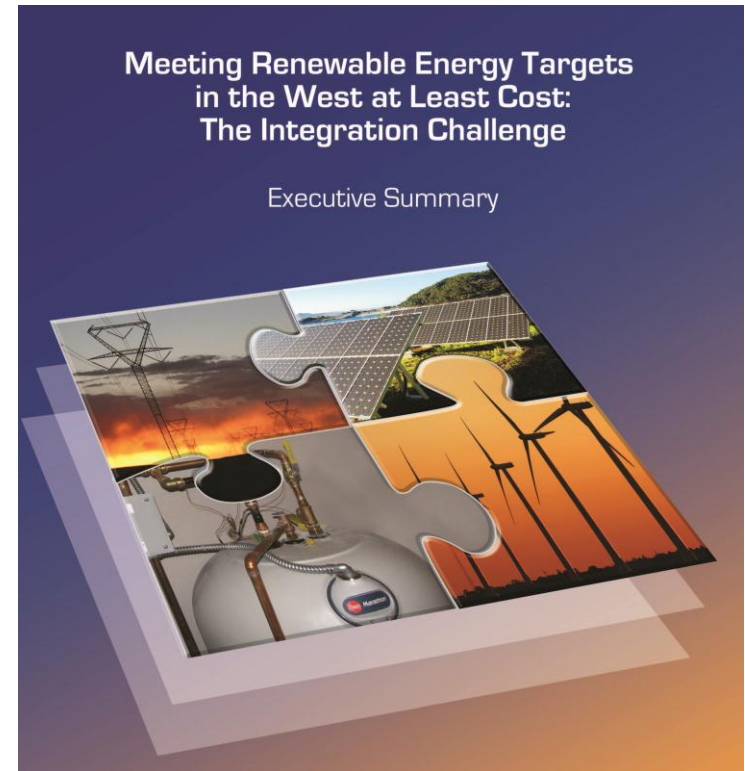
*SunEdison facility, Aurora, Colo.*

# ***Meeting Renewable Energy Targets in the West at Least Cost: The Integration Challenge***

- New Western Governors’ report explores ways to reduce costs for integrating wind and solar, barriers to cost-saving measures and possible state actions
  - By RAP (lead), Exeter Associates & NREL
  - Funded by Energy Foundation and USDOE
  - Technical committee for scoping, resources, review

*Executive summary:* [http://www.westgov.org/index.php?option=com\\_joomdoc&task=doc\\_download&gid=1602](http://www.westgov.org/index.php?option=com_joomdoc&task=doc_download&gid=1602)

*Full report:* [http://www.westgov.org/index.php?option=com\\_joomdoc&task=doc\\_download&gid=1610](http://www.westgov.org/index.php?option=com_joomdoc&task=doc_download&gid=1610)



# WGA paper identifies ways to save \$: operational and market tools, flexible demand- and supply-side resources

1. Expand subhourly dispatch & scheduling
2. Facilitate dynamic transfers between balancing authorities
3. Implement an energy imbalance market
4. Improve weather, wind and solar forecasting
5. Take advantage of geographic diversity of resources
6. Improve reserves management
7. Retool demand response to complement variable generation
8. Access greater flexibility in the dispatch of existing generating plants
9. Focus on flexibility for new generating plants

# Improved Institutional Flexibility

- Expand subhourly dispatch and scheduling
  - Faster scheduling of energy and transmission
  - **Key recommendation:**  
Foster *standardization* among Western balancing authorities (BAs\*) for updating of schedules within the hour
- Facilitate dynamic transfers
  - Moving generation from the BA area where it resides to another area in real-time, for control by receiving BA
  - Provides access to flexibility from a broader geographic area
  - **Key recommendations**
    - Identify most receptive and most restrictive transmission lines
    - Determine priority for improvements to ease restrictions
    - Automate reliability procedures such as voltage control and remedial action schemes



\*Maintain load-interchange-generation balance within their area and support interconnection frequency in real time.

- **Implement an energy imbalance mechanism**

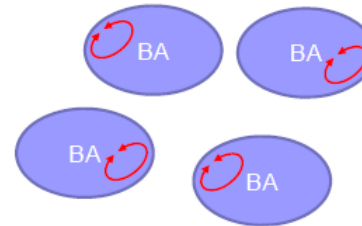
Energy imbalance = generator schedule deviations plus load forecast errors (both up and down)

- An EIM provides centralized re-dispatch of generation every 5 minutes to address energy imbalance and manage grid congestion
- Enables dispatch of generation and transmission *across* BA areas to resolve energy imbalances using the full geographic diversity of load and generation in the EIM footprint

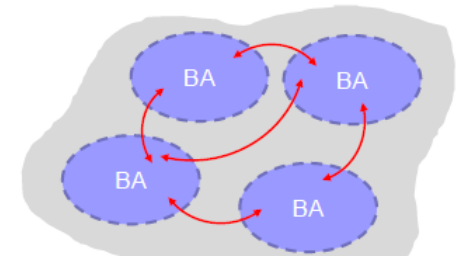
- **Key recommendations**

- Explore financing options
- Investigate in PUC proceedings costs and benefits to ratepayers
- Support continuing efforts to explore EIM governance and address concerns (e.g., no RTO)
- Define rates/terms for transmission service agreements for each entity
- Support Northwest Power Pool's evaluation of an EIM and West-wide efforts to design an EIM for the broadest footprint

Today:  
Balancing occurs within each BA



In an EIM:  
Balancing occurs among BAs



- **Improve weather, wind and solar forecasting**
  - Use weather observations, meteorological data, Numerical Weather Prediction models, and statistical analysis to generate short, medium, and long-term wind and solar forecasts
  - Improves scheduling of other resources, reducing reserves needs, fuel consumption, operation & maintenance costs and emissions
  - **Key recommendations**
    - Encourage expanded use of variable generation forecasting by BAs and forecasting improvements
    - Study feasibility of using forecasts for day-ahead unit commitments and schedule updates
    - Encourage regional forecasts or exchange of forecasts among BAs
    - Review whether existing forecasting systems adequately predict ramps



*Alstom 2010. Photo courtesy of DOE/NREL*



- Take advantage of geographic diversity

- Variations in output from wind and solar plants are reduced over a large area
- Lowers aggregate variability and forecast errors, reducing reserves needed

- **Key recommendations**

- In resource and transmission planning and resource acquisition, consider sites that minimize variability of aggregate output and coincide with utility load profiles
- Support right-sizing of interstate lines (increasing project size, voltage, or both to account for future resource needs) that access renewable resources from zones designated through a stakeholder-driven process
  - when project benefits exceed costs



NREL

## • Improve reserves management

- Reserves are generation and demand-side resources available as needed to maintain electric service reliability.
  - Contingency reserves are for unforeseen events, such as an unscheduled power plant outage.
  - Balancing reserves are for daily balancing of generation & demand.
- Management options: reserve sharing, dynamic calculations (varying amount based on system conditions), using contingency reserves for wind events, and controlling variable generation

### – **Key recommendations**

- Expand reserve-sharing
- Explore dynamic reserve requirements
- Assess benefits of using contingency reserves for wind
- Equip more generation with AGC\*



*\*AGC is equipment that automatically adjusts generation from a central location*

# Demand Response That Complements Variable Generation

- Shift loads up and down to complement wind and solar through direct load control and real-time pricing with automation
- **Key recommendations**
  - Consider DR to complement wind and solar
  - Test value propositions to assess customer interest in strategies for frequent control of loads both up and down
  - Encourage participation of 3<sup>rd</sup> party aggregators
  - Allow demand response to compete on a par with supply-side alternatives in utility resource planning and acquisition
  - Examine ratemaking that may discourage cost-effective DR



# A More Flexible Generating Fleet

- Assess whether some existing generating plants can be retrofitted to increase flexibility
  - Lower minimum loads, reduce cycling costs and increase ramp rates
- Focus on flexibility for new generating plants
  - **Key recommendations**
    - Rethink resource adequacy analysis to reflect the benefits of flexibility service
    - Examine and amend guidance for evaluating flexibility needs in utility resource planning
    - Use competitive procurement processes to evaluate alternative flexible capacity solutions



# A Few Things to Pay Attention to

- FERC Orders
  - New FERC rules on integrating variable energy resources require 15-minute scheduling or consistent/superior alternatives like an energy imbalance market
  - Order 1000 requires procedures to identify transmission needs driven by Public Policy Requirements and evaluation of potential solutions in consultation with stakeholders.  
(<http://www.westgov.org/order1000/site/documents.htm>)
- Reliability concerns – Recent outages are driving interest in real-time information-sharing, visibility, automation
- Interest in economic development
  - Opportunities to promote clean, local generation
- Regional cooperation on energy efficiency reduces costs and increases savings – e.g., Northwest, so. Cal. utilities
- Low natural gas prices won't stay low forever.

# And Ways to Leverage Existing Tools to Shine a Light on Electricity Imports

- Use acid rain program emissions data and renewable energy tracking systems to:
  - Identify individual generators
  - Aggregate net emissions from adjacent regions
  - Allow for a reasonable characterization of non-specific energy purchases
- Explore policies to address carbon accounting, linkage between regions

See [http://www.rggi.org/docs/ProgramReview/LearningSession1/Presentation\\_David\\_Farnsworth\\_RAP.pdf](http://www.rggi.org/docs/ProgramReview/LearningSession1/Presentation_David_Farnsworth_RAP.pdf)

## About RAP

The Regulatory Assistance Project (RAP) is a global, non-profit team of experts that focuses on the long-term economic and environmental sustainability of the power and natural gas sectors. RAP has deep expertise in regulatory and market policies that:

- Promote economic efficiency
- Protect the environment
- Ensure system reliability
- Allocate system benefits fairly among all consumers

Learn more about RAP at [www.raonline.org](http://www.raonline.org)

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