NREL Impact: Strategic Stakeholder Engagement

National Renewable Energy Laboratory

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SYSTEMS INTEGRATION

Objective

Large-scale deployment of solar energy will require a favorable environment for interconnecting and operating solar power plants. But realizing high volumes and economies of scale will be difficult if solar penetrations are limited because of reliability, interconnection, and operational rules and requirements. NREL stakeholder engagement activities provide data, analysis, and tools that inform utilities, regulators, and policymakers. Policymakers need to know whether high penetrations of solar are technically feasible. Regulators need to understand the reliability and balancing impacts of solar. Utilities need tools and data to study high solar penetrations on their power systems.

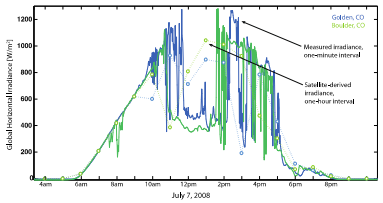
Example Activities

Providing Data: Sub-Hour Solar Power Data

Motivation
Rapid changes in solar power, caused by passing clouds, are observable only in sub-hour time series.

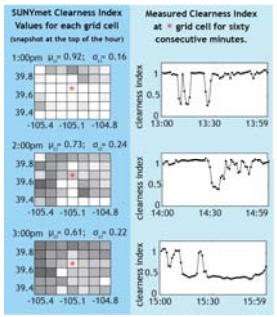
Objective
Develop and share sub-hour solar power data sets that have appropriate variability at various timescales; intra-plant and plant-to-plant spatial correlation; temporal correlation; capacity factor; and forecast error distributions in time, space, and magnitude for use in integration studies and production cost modeling.

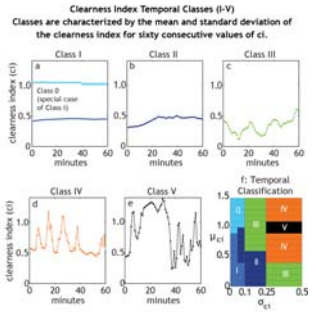
Impact
Sub-hour, spatially correlated data sets are necessary to answer questions about thermal unit ramping, intra-hour reserve requirements, and aggregate/system-wide response to high-penetration solar power. Measured, 1-minute resolution global horizontal irradiance at two sites (Boulder and Golden, Colorado) and hourly average satellite image-derived irradiance values. Sub-hour data sets must account for spatial and temporal correlations across all locations at all times. This is called coherence.



Details
- The algorithm generates simulated global horizontal irradiance (GHI) values at an interval of 1 minute for a specific location using SUNYmet hourly irradiance values for that grid cell and grid cells within 40 km.
- During each hour, the observed GHI value for the grid cell of interest and the surrounding grid cells is related, via probability distributions, to one of five temporal cloud coverage classifications (Class I, II, III, IV, V).
- Each class of cloud coverage variability has a separate algorithm to select 1-minute time-step GHI values based on the classification of the grid cell of interest in a particular hour.
- Sub-hour GHI values are integrated with other meteorological data to generate an input file for solar power conversion via the System Advisor Model (SAM).

Conclusions
- Using spatial variability as an input to the sub-hour solar power algorithm generates a data set with appropriate spatial-temporal ramping correlation statistics.
- Individual site simulated time series show a remarkable degree of similarity to sites with measured time series.
- Large-scale data set (~1200 locations) is in use by the Western Wind and Solar Integration Study Phase 2, Demand Response and Storage Integration Study, and the Variable Generation Subcommittee of the Western Electric Coordinating Council





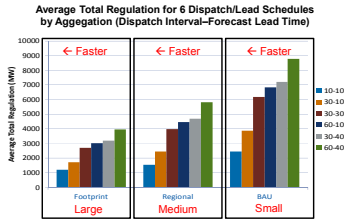
Conducting Analysis: Energy Imbalance Market

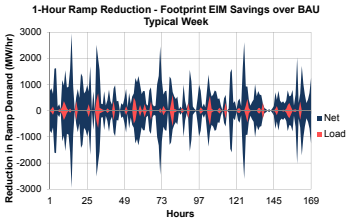
Objective
Provide inputs to operation modeling and develop insights into potential operational changes (e.g., ramping needs and flexibility reserves) of an energy imbalance market (EIM) to inform Western regulators about options for the cost-effective integration of renewable energy.

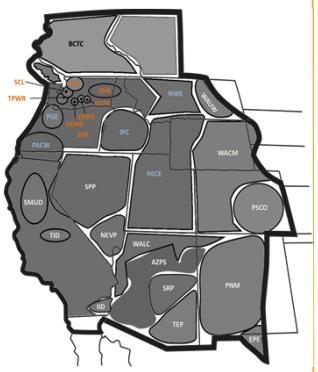
Partners
Xcel Energy, Western Interstate Energy Board, Western Electricity Coordinating Council (WECC), Energy Exemplar

Details
- Develop flexibility reserves analysis for multiple EIM footprints and scheduling periods
- Run electricity production simulations of the EIM with PLEXOS to evaluate the impact of sub-hourly economic dispatch over a large electrical footprint
- Provide input to the Western Electricity Coordinating Council and its consultants and analysis assistance to individual balancing areas
- Offer educational webinars to stakeholders
- Support to WECC Technical Advisory Subcommittee Modeling Work Group to incorporate flexibility reserves into Transmission Expansion Planning Policy Committee cases
- Author multiple conference papers and reports

Conclusions
- Full-footprint EIM cuts flexibility reserve deployment approximately 50% compared to business as usual
- Reserve impact depends on who participates in the EIM, how many separate EIMs exist, the penetration of wind and solar, and the dispatch interval
- Reserve analysis does not account for transmission constraints, increased efficiency of dispatch, potential coordination among participating balancing areas that find themselves overcommitted (EIM does not coordinate unit commitment), or long-term implications for resource requirements
- PLEXOS modeling will address transmission constraints and efficient dispatch





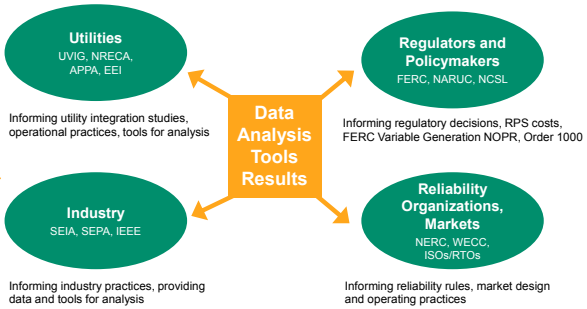


Existing balancing areas of the Western Interconnection

Engaging Stakeholders: Outreach

Objective
Encourage stakeholder engagement by offering workshops and training; engaging in influential committees and working groups; advising on analyses and applications; participating in solar utility forums; and developing technical reports, journal articles, fact sheets, and webinars

Partners
- Subcontractors: Utility Variable Generation Integration Group (UVIG); Mark O' Malley of University College Dublin/Electricty Research Centre; Ed DeMeo; Brendan Kirby
- Partners and collaborators: NERC, WECC, IEEE, NARUC, NCSL, SEIA, SEPA, utilities, ISOs/RTOs



Utility Variable Generation Integration Group

Mission
To accelerate the development and application of good engineering and operational practices supporting the appropriate integration of wind and solar power into the electric system

UVIG is the leading forum for convening the wind and solar utility industry on integration and transmission topics. Its offerings include:

- Annual spring and fall technical workshops
- 2012 Solar Integration Workshop
- 2012 Distributed Generation User Group Meeting
- Annual Forecasting Workshop
- 2010, 2011 Advanced Methods Workshops
- 2010, 2012 Short Course

In addition, UVIG co-sponsors the Western Area Power Administration Interconnection Workshop.

North American Electric Reliability Corp. Integrating Variable Generation Task Force

Through NERC's Integrating Variable Generation Task Force, industry working groups address reliability issues and concerns.

Sample issues addressed include operating reserves, forecasting, ancillary services, and balancing area coordination.

The NERC "stamp of approval" on important issues and potential solutions is based on broad industry input.

The task force has produced reports on ancillary services, flexibility requirements, operating practices, probabilistic methods, and capacity contributions (2010–2012).

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