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# Eastern Renewable Generation Integration Study: Initial Results

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## About the Study

*The Eastern Renewable Generation Integration Study (ERGIS) aims to answer critical questions about the future of the Eastern Interconnection (EI) under high levels of solar and wind penetration. The study is developing a robust production cost simulation database with detailed subhourly data on solar, wind, and thermal plants, and load. ERGIS uses an advanced production-cost model (PLEXOS) at a subhourly time resolution to understand the impact of 30% solar and wind penetration on ancillary services, interchange, and net load. ERGIS will address the following questions:*

- *What does the variability and uncertainty of net load look like under high penetrations of solar and wind power?*
- *How could unit commitment and dispatch change under high penetrations of renewables?*
- *Are there any operational strategies that could be used to minimize the cost of integrating high penetrations of solar and wind?*
- *What are the regional impacts of high solar and wind penetrations?*

## Technical Review Committee

*NREL worked with the Department of Energy to bring together industry experts for a technical review committee to aid in the development of necessary data sets and analyze results as they become available. In 2013, the committee oversaw the development of several aspects of the project, including:*

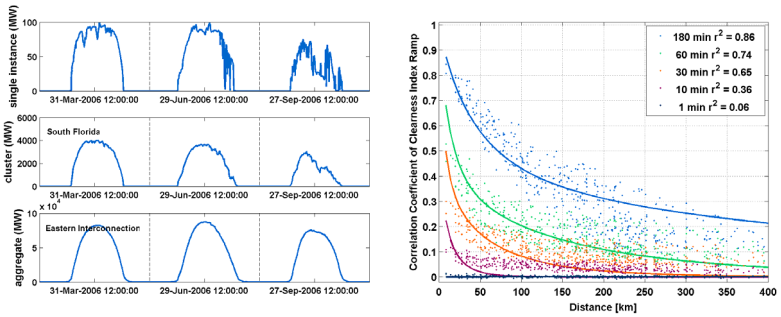
- *Scenario Development*
- *Thermal Fleet Expansion*
- *Transmission Expansion*
- *Solar Profile Development*
- *Canadian System Modeling*

## Solar Profile Development

*ERGIS scenarios include up to 10% solar penetration in the EI and up to 30% solar penetration in certain regions of the EI. These penetrations require subhourly solar generation profiles for a large amount of installed solar capacity in the EI, which did not previously exist. ERGIS uses a method previously developed at NREL to create realistic solar power profiles from satellite images. The key characteristics for the solar data set are:*

- *Appropriate number and size of ramps at each location*
- *Appropriate coincidence of ramps at closely clustered locations*
- *Appropriate ramps in the sum of solar power throughout a region*

***Figure 2: The solar profile development algorithm produces statistically probable correlations between solar sites at different locations and under different time scales.***




## Scenarios

*ERGIS is considering four scenarios designed to evaluate the impact of different solar and wind penetrations. The scenarios represent current-day levels, future levels dictated by current state renewable portfolio standards (RPS), and high (30%) penetrations of solar and wind. The National 30% Scenario requires the U.S. portion of the EI to serve 30% of its annual load with solar and wind, using the best solar and wind resources in the EI. The Regional 30% Scenario requires each individual region to serve 30% of its annual load with solar and wind within its geographic boundaries, with the exception of SERC, which is allowed to import part of its requirement from SPP.*

| | Energy Penetration (%) | | Solar PV Capacity (GW) | | Wind Capacity (GW) | | Conventional Capacity (GW) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Scenario | Solar | Wind | Rooftop | Utility | Onshore | Offshore | Nuclear | Coal | CC | CT & Boiler |
| Low Renewables | 0 | 3 | 1 | 0 | 30 | 0 | 88 | 231 | 147 | 194 |
| State RPS | 0.2 | 12 | 3 | 2 | 91 | 15 | 88 | 230 | 144 | 197 |
| Regional 30% | 10 | 20 | 96 | 123 | 168 | 46 | 88 | 212 | 133 | 173 |
| National 30% | 5 | 25 | 50 | 123 | 237 | 27 | 88 | 216 | 137 | 178 |

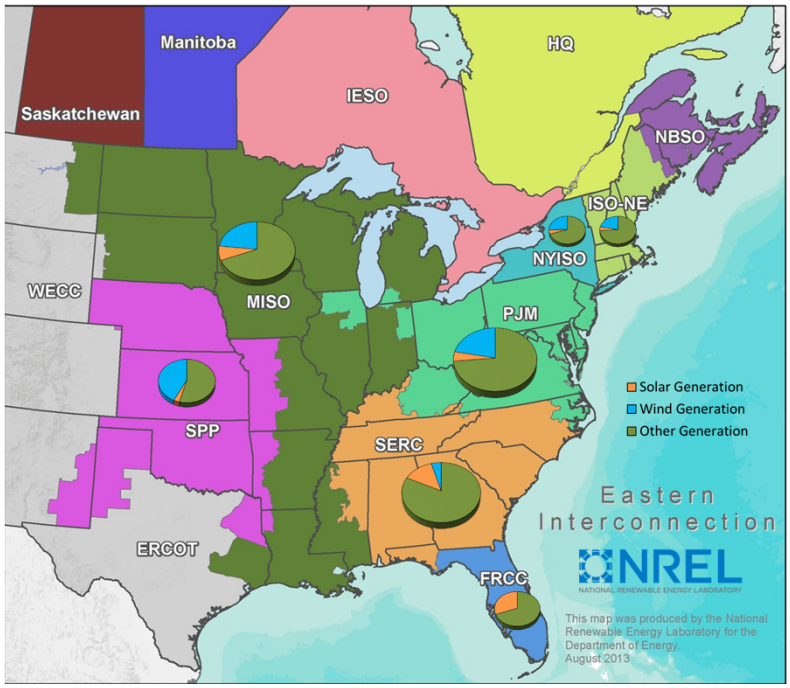


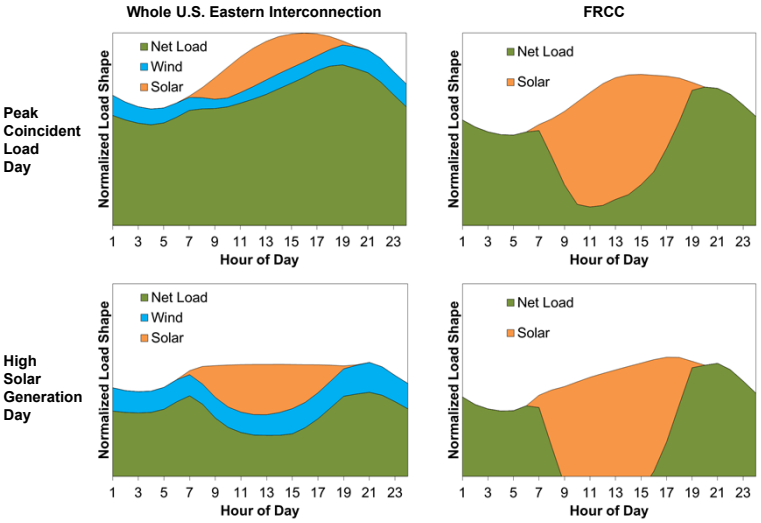

***Figure 1: This map shows the assumed structure of the EI in the study year. The pie chart slices indicate the relative amount of solar, wind, and other generation in each region, and the relative size of the pie charts indicates the amount of generation in each region for the Regional 30% Scenario.***

## Operational Impacts

*ERGIS will evaluate the effectiveness of different operational strategies that could be used to minimize the cost of integrating high penetrations of solar and wind, such as:*

- *New or modified ancillary services products*
- *Increased sharing of ancillary services between regions*
- *Faster unit commitment and dispatch cycles*
- *More frequent interchange scheduling*

***Figure 3: These graphs show normalized solar and wind generation and net load shapes for (left) the entire U.S. EI and (right) FRCC for (top) the peak coincident load day and (bottom) a high solar generation day. Operating the conventional generators to meet the net load for the whole EI appears reasonable, but certain regions could have challenging issues that would likely require operational changes from current practices, as illustrated by the large ramps in the FRCC net load.***

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