

North American Renewable Integration Study: Wind and Solar Datasets

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ESIG 2018 Forecasting Workshop



The North American Renewable Integration Study

State-of-the-art analysis of the U.S., Canada, and Mexico power systems, from planning through operations



Canada



WHAT WE'RE STUDYING

- Long-term pathways to a modern power system in North America
- Operational feasibility of very high-penetration scenarios
- Weather variability and uncertainty
- Value of enabling technologies: flexible hydro, thermal generation, demand response, storage, transmission
- Value of operating practices: interchange, enhanced scheduling, local generation, reserve provisions

Accelerating Grid Modernization in North America



INFORMING

grid planners, operators, market participants, and regulators of challenges and opportunities for the grid

- Is it **reliable** and **affordable**?
- What operating **practices** and **technologies** help the most?
- Are the “solutions” **robust**?
- What is the benefit of **inter-regional** and **cross-border** cooperation?



ENABLING

stakeholders to deepen and extend their understanding of renewables and modern power systems

- Creating and disseminating new **data**
- Pioneering and deploying new **methods** and computational **tools**

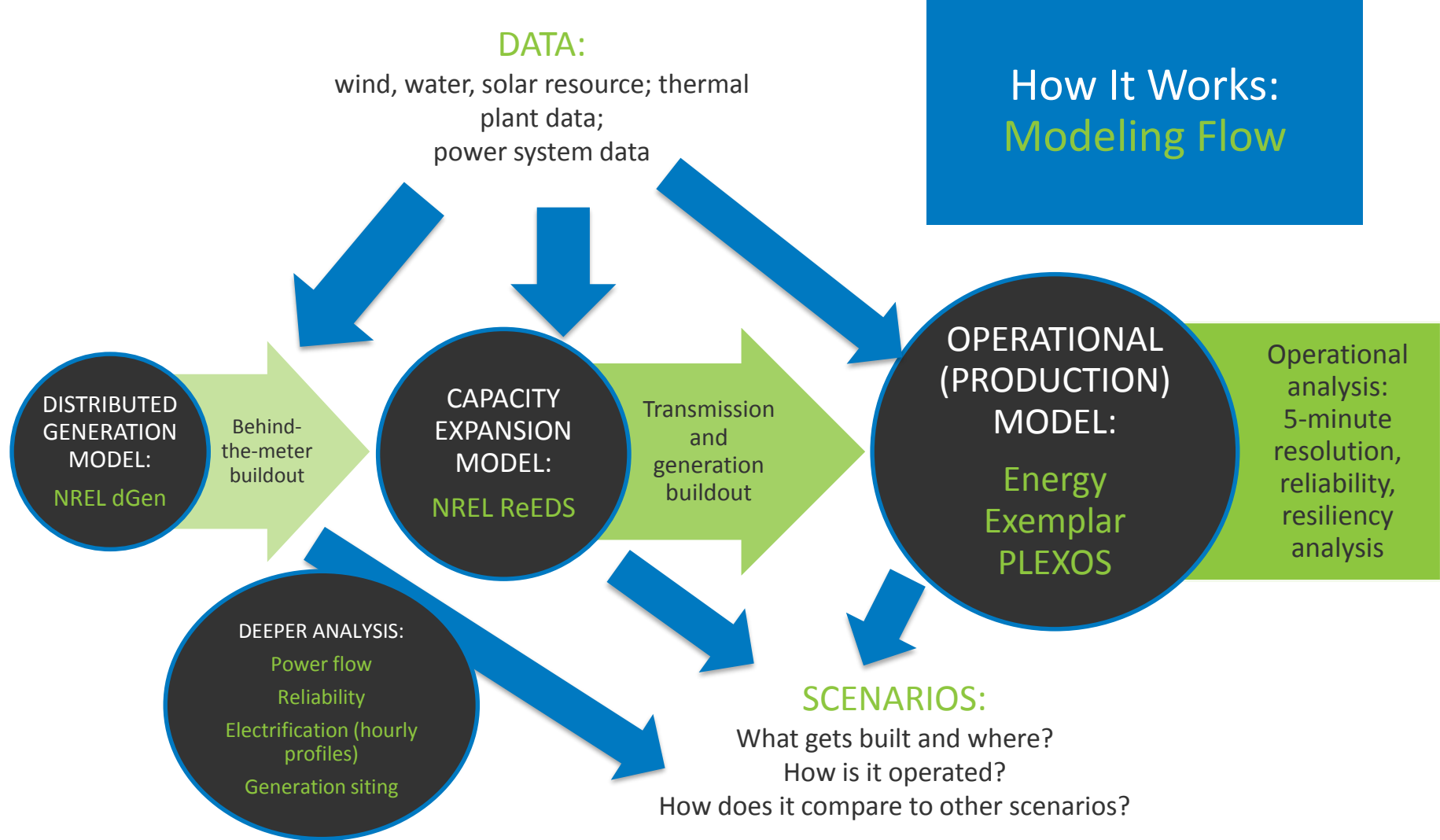


CREATING

a framework for future analysis

- **Stability** (i.e., frequency, transient, voltage)
- **Resilience** to extreme events (e.g., weather)

How It Works: Modeling Flow



Input Data

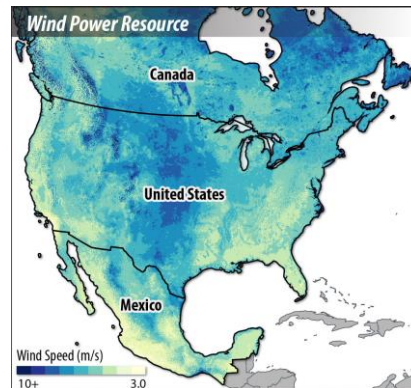
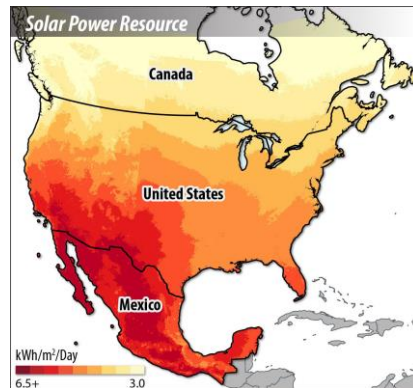
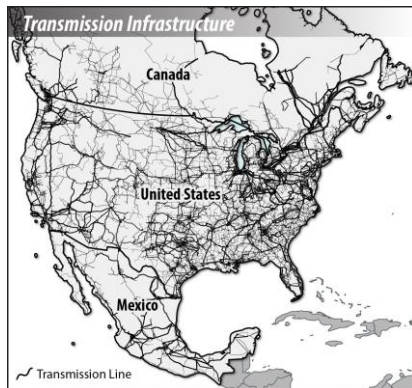
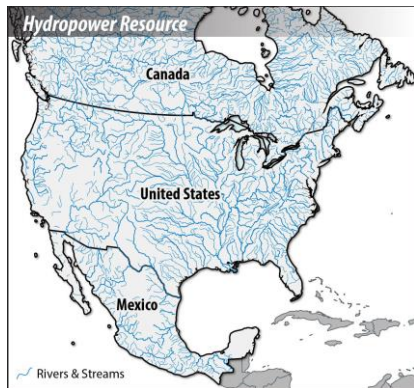
DATA
DEVELOPMENT

ReEDS

dGen

PLEXOS

Data sets are developed almost entirely based on public data, processed using novel, replicable methods



The Scenarios


Four overarching pathways for
North American electric power
system evolution **through 2050**

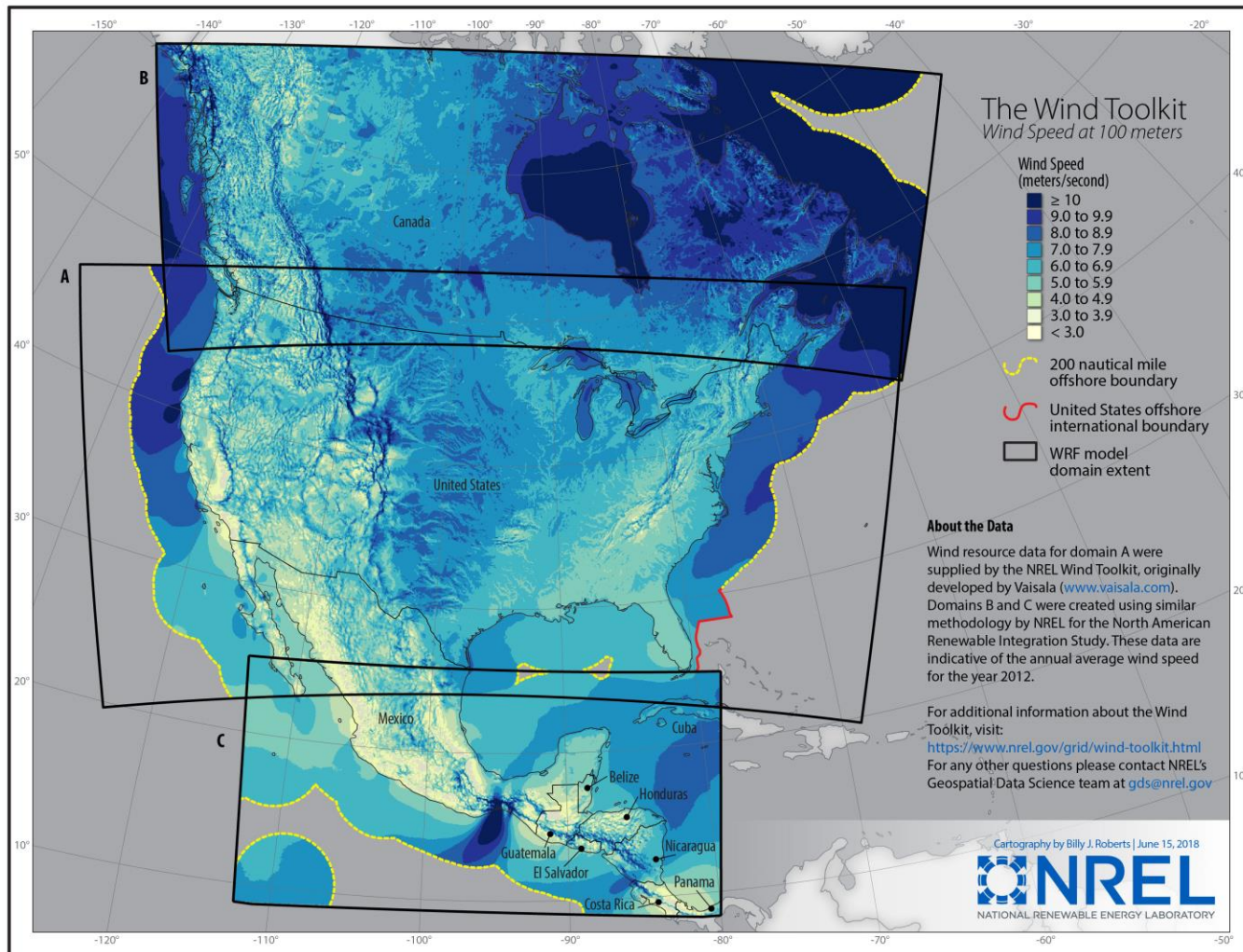
The Scenarios

Four overarching pathways for
North American power
system 2050

CONFIDENTIAL

Wind Resource Dataset

A photograph of a white wind turbine nacelle with two technicians in blue uniforms and white hard hats working on top. The nacelle has several horizontal ventilation grilles and the 'ALSTOM' logo is partially visible. The background features a range of rugged mountains with significant snow cover under a clear blue sky. A semi-transparent dark banner is overlaid across the middle of the image, containing the text 'Wind Resource Dataset'.



Domain A

- Vaisala Wind Toolkit
- 2007-2013
- Continuous United States

Domain B

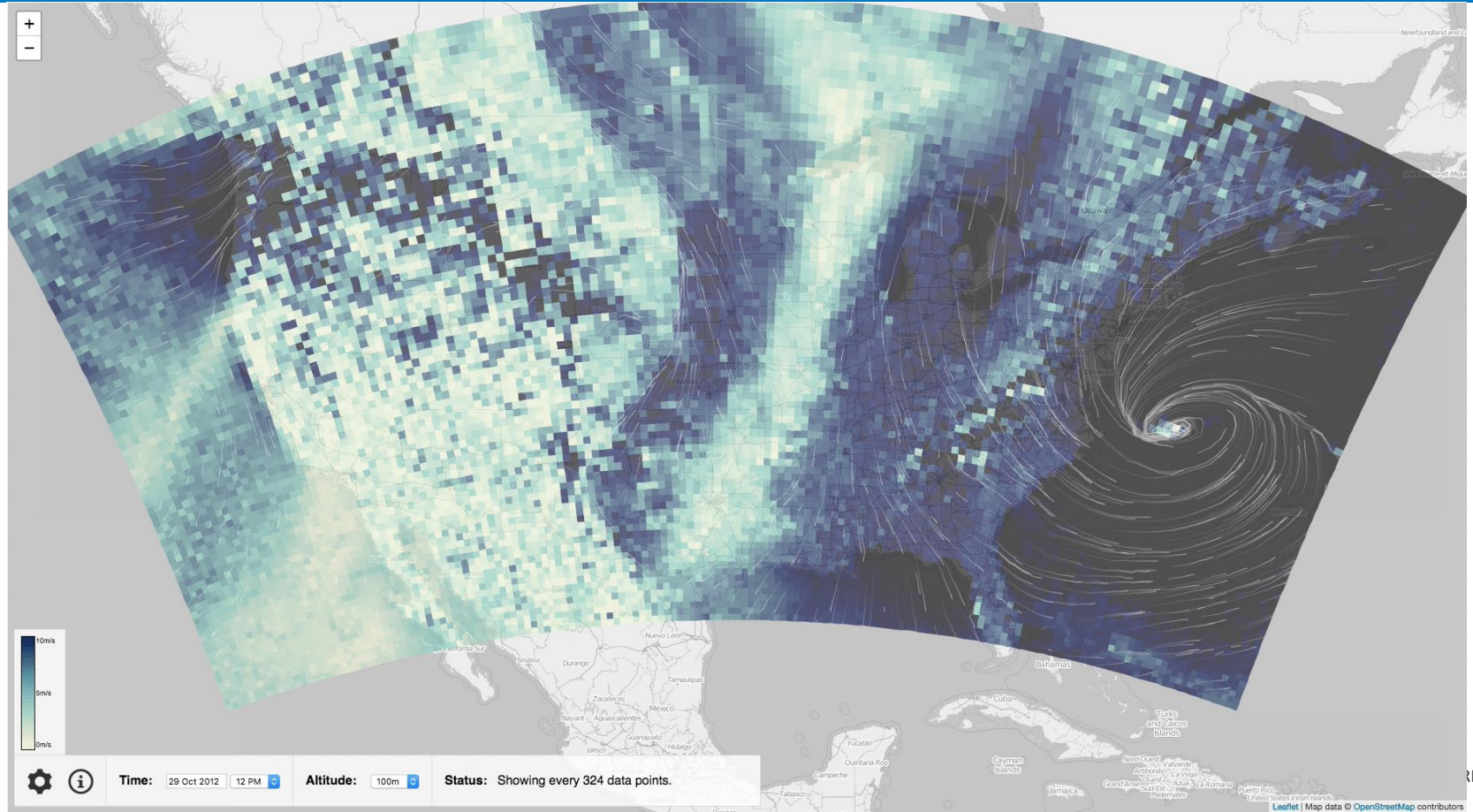
- NREL Created using similar method
- 2010-2013
- Canada

Domain C

- 2009-2013
- Southern Mexico

5-minute resolution
2km x 2km spatial
resolution

Extreme Weather Event Analysis

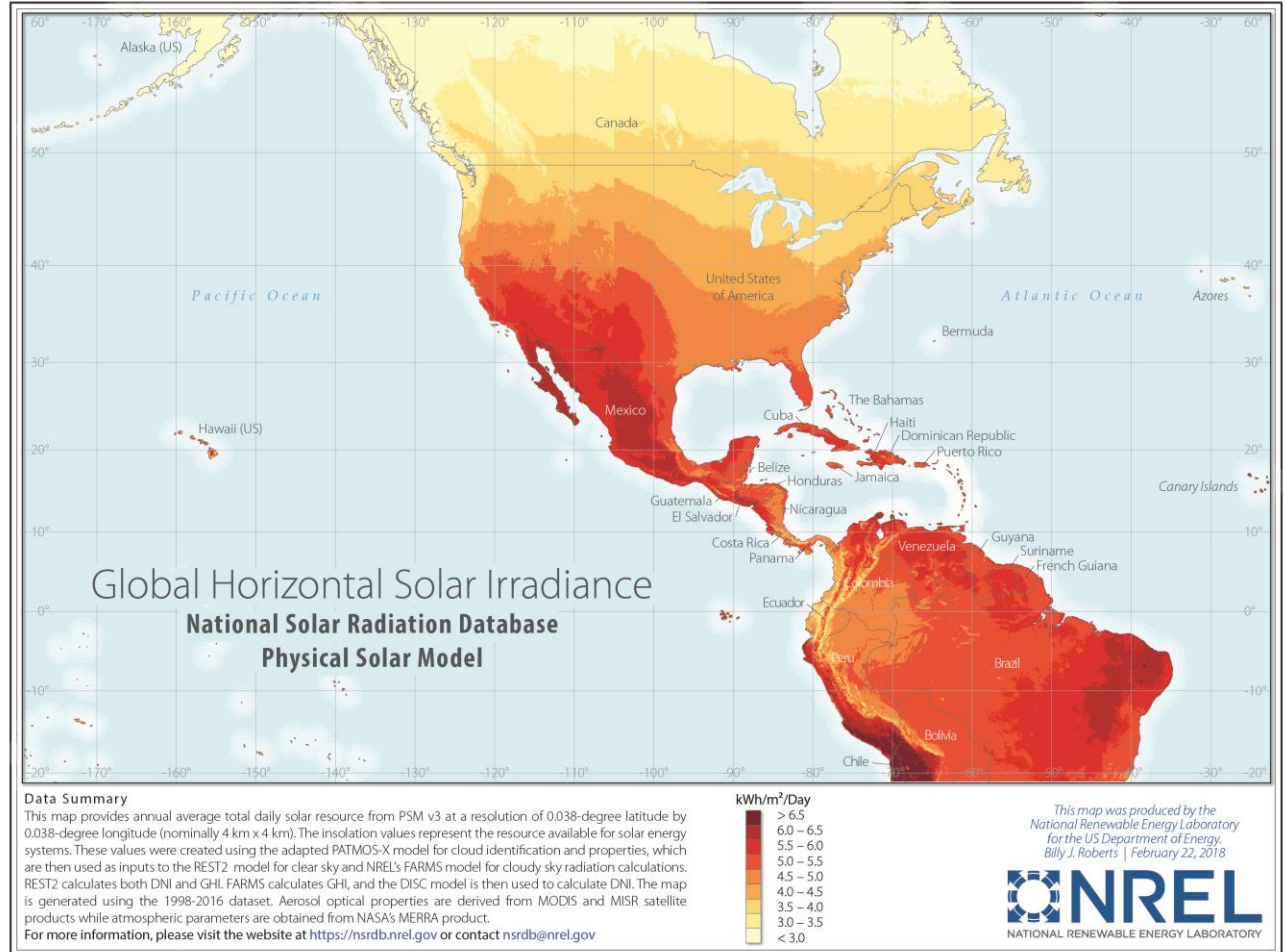


A photograph of a large-scale solar farm. The image shows rows of photovoltaic solar panels tilted at an angle, stretching into the distance. The panels are dark blue with a grid of silver lines. The background is a clear, bright blue sky. The ground is dry and sandy with some sparse, low-lying desert vegetation. A semi-transparent black banner is overlaid across the middle of the image, containing the text "Solar Resource Dataset" in white.

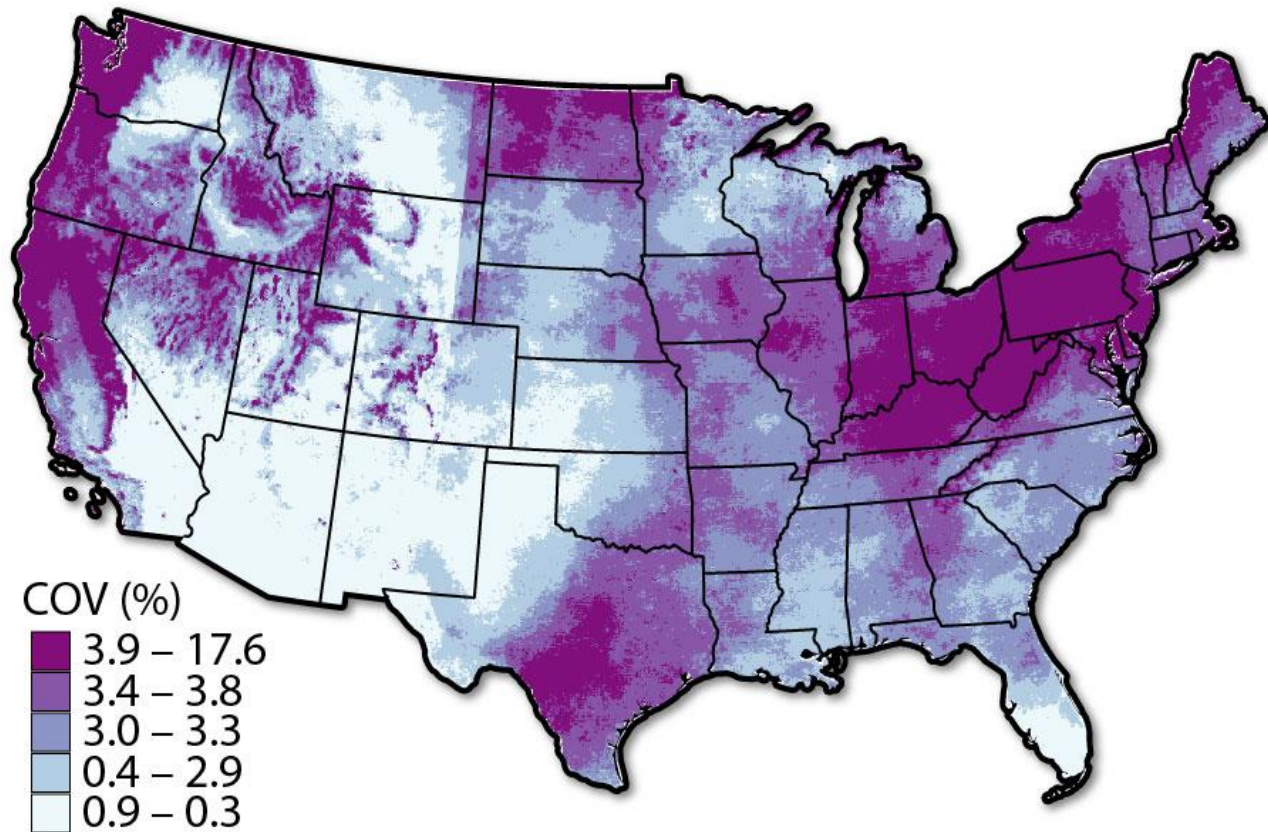
Solar Resource Dataset

National Solar Radiation Database

- 1998 – 2014
- 30-minute resolution
- 4km x 4km spatial resolution



Inter-Annual Variability of Potential Generation



- Multiple years of weather data to be used for Production Cost Modeling

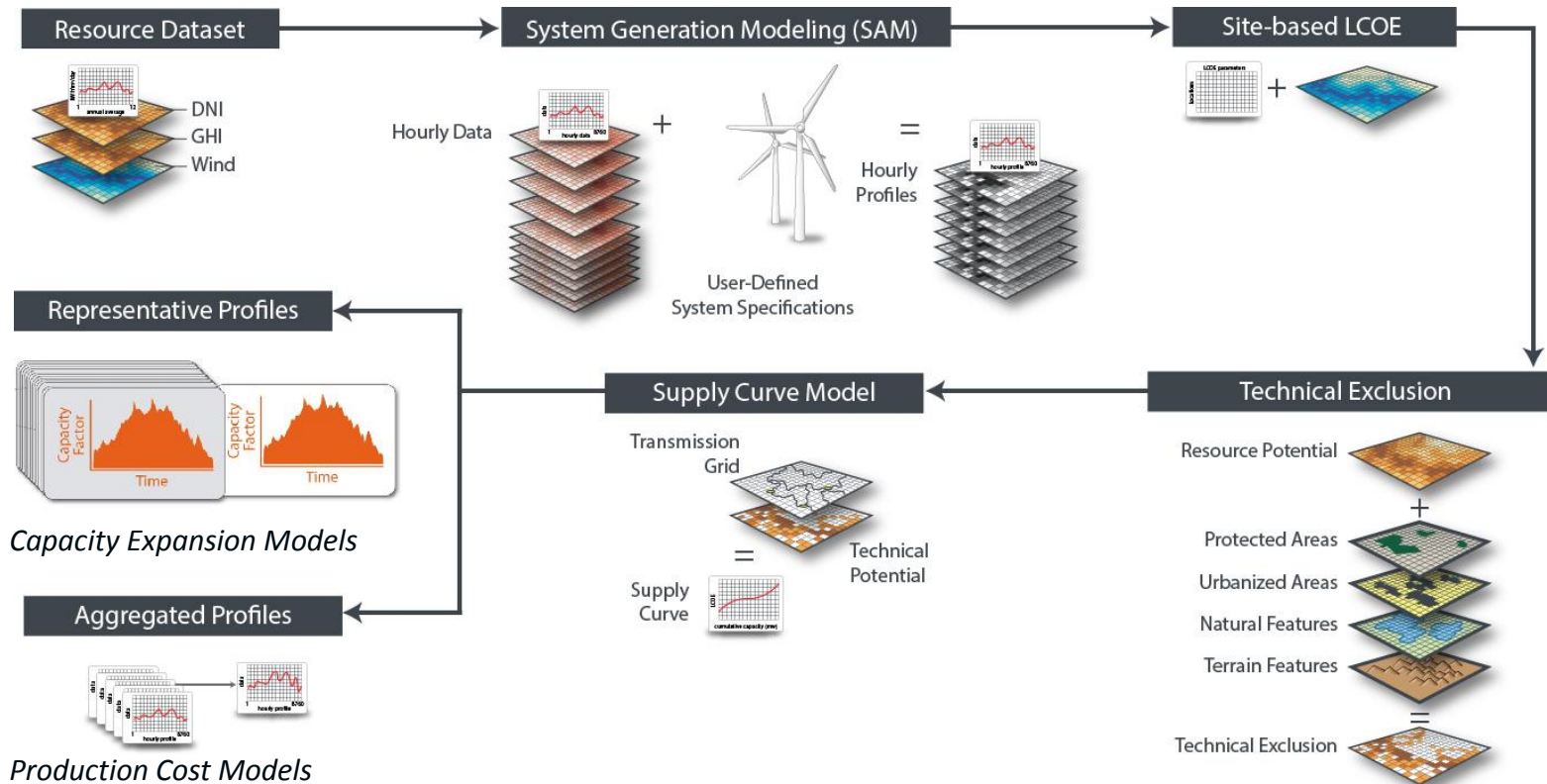
A map of Central America and the Caribbean region. Countries shown include Mexico, Guatemala, El Salvador, Honduras, Nicaragua, Panama, Cuba, Jamaica, Dominican Republic, and Haiti. Major cities like Mexico City, Cancun, Guatemala City, and Panama are labeled. The map is light gray with black text labels.

How Do We Make Sense of Petabytes of Data?

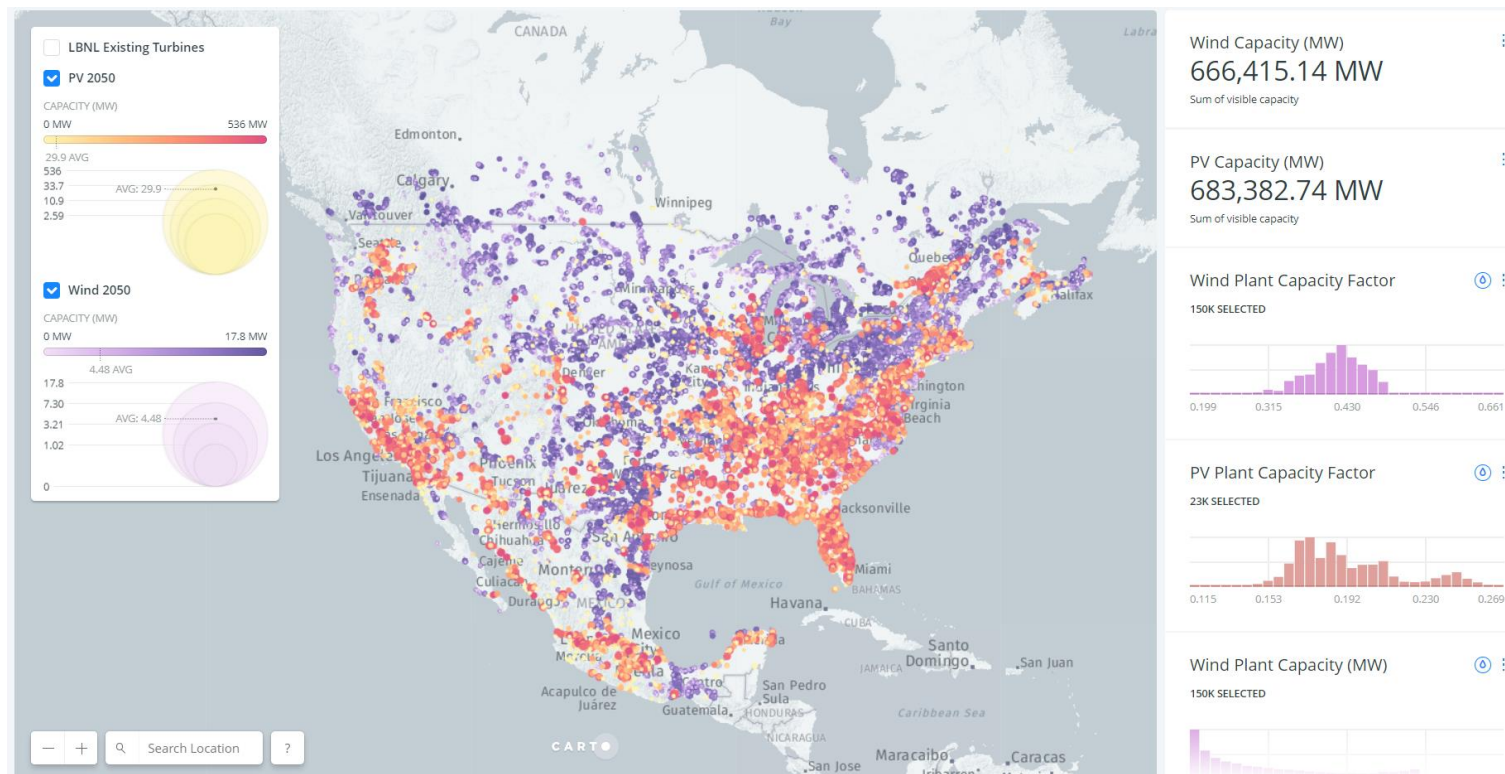
reV: Renewable Energy Potential Model

- Runs on NREL's Peregrine supercomputer
- Serves as a pipeline for coupling energy models (e.g., ReEDS and PCM)—boiling down immense amounts of data into the precise scenarios each model requires
- Enables detailed techno-economic assessment of renewable energy resources under a variety of regulatory, sociopolitical, and environmental factors

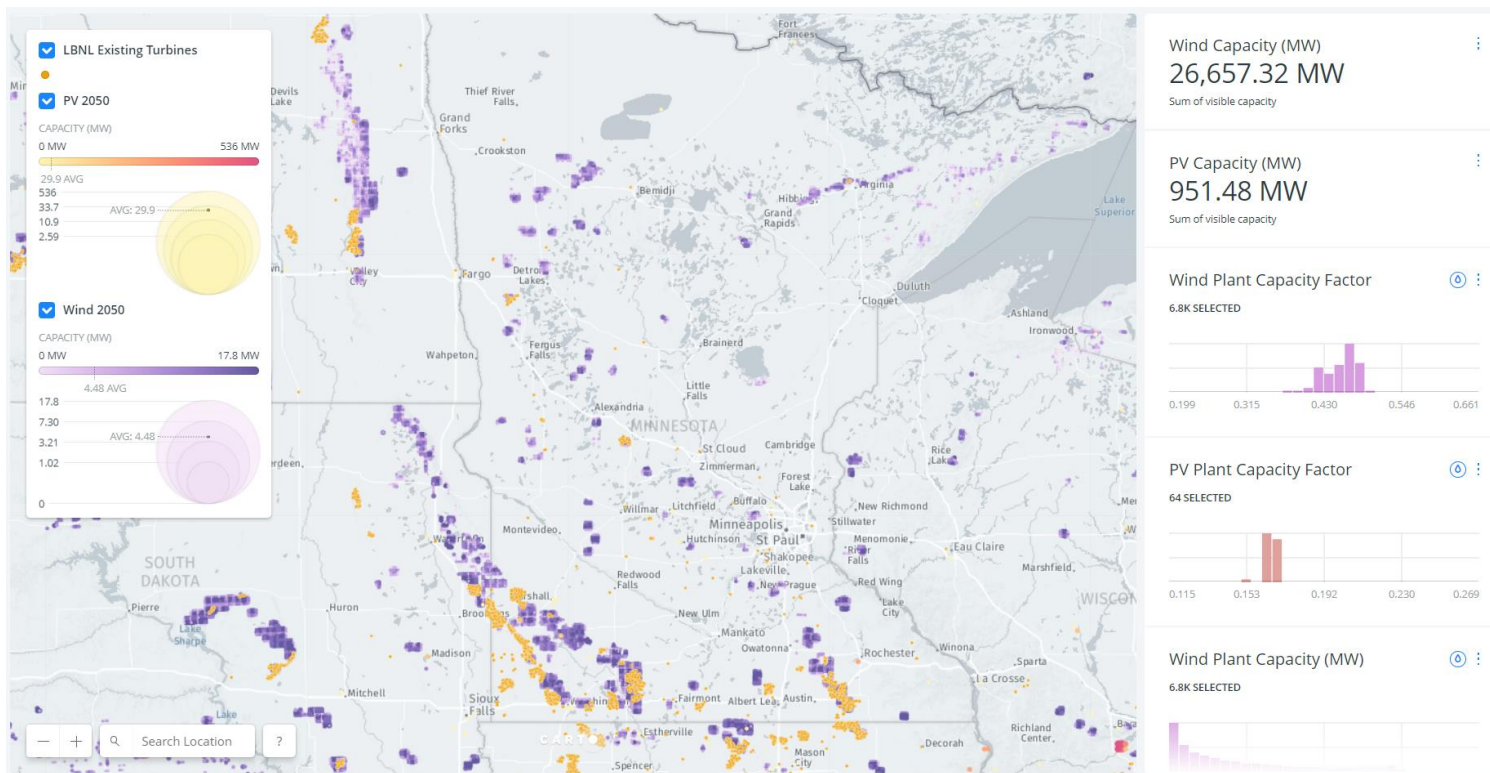
The Renewable Energy Potential (reV) model



NARIS Siting Visualization Tool



Minnesota Zoom-In

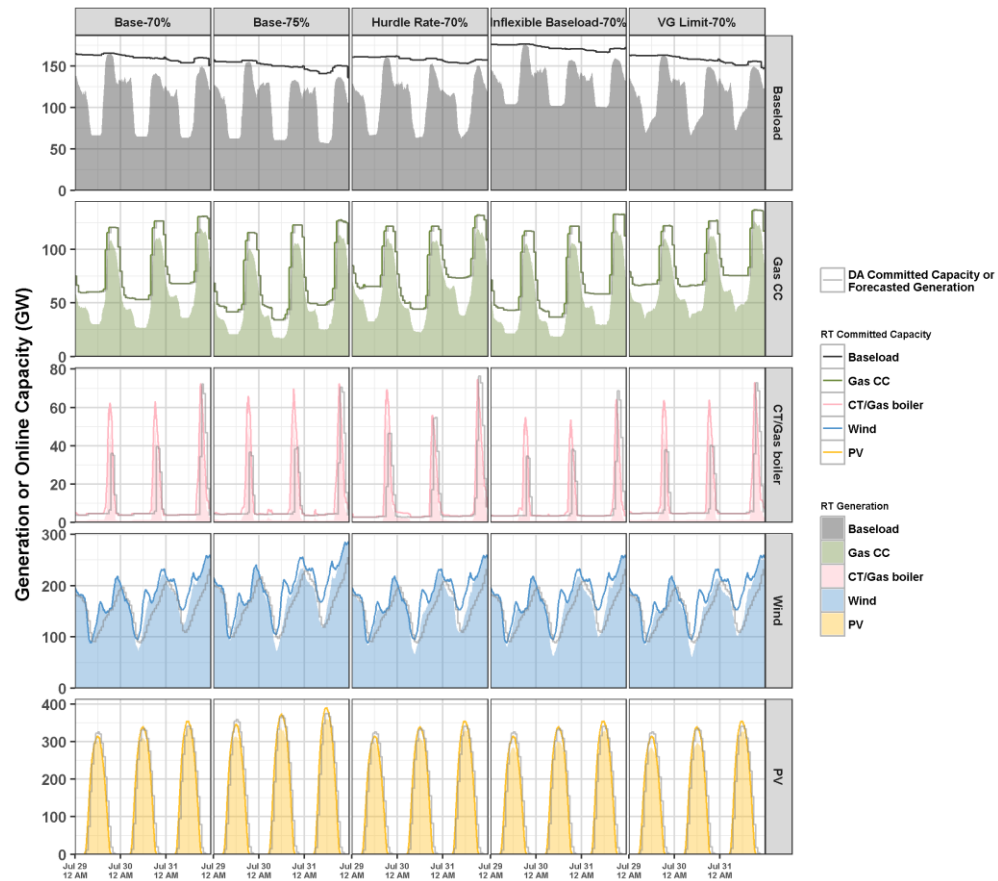
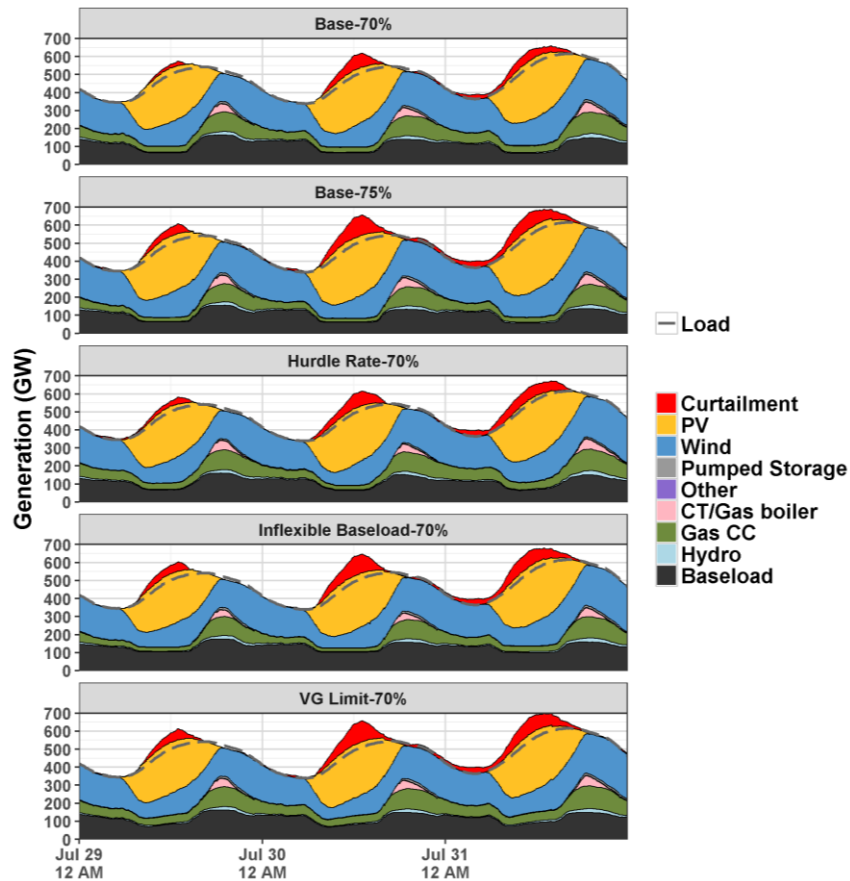




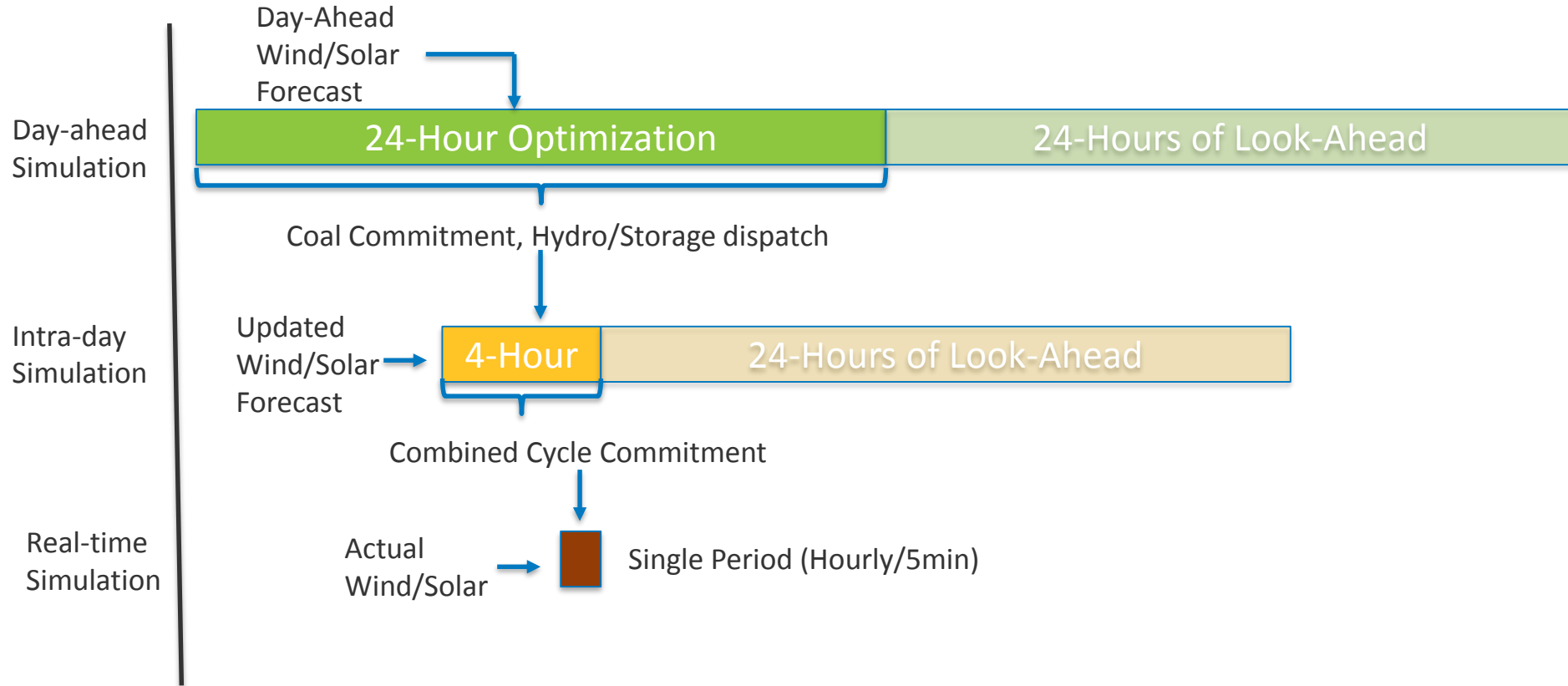
But What About Forecasts?

Production Cost Modeling

Unit Commitment and Economic Dispatch



PCM Simulation Phases



NARIS Data Summary

- NARIS built on highly resolved spatial and temporal resource data
- Multi-year analysis allows for more robust understanding of power system operations under high variable generation
- Enable deeper understanding of operations during specific weather events (not just hurricanes)
- The datasets are public



Natural Resources
Canada

Ressources naturelles
Canada

Canada

SENER
SECRETARÍA DE ENERGÍA



Acknowledgment and Contact

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Geospatial Data Science and Computational
Science Team:

- Michael Rossol
- Anthony Lopez
- Billy Roberts
- Galen MacClaurin
- Caleb Phillips
- Jordan Perr-Sauer

Dataset access:

Wind Toolkit:

<https://www.nrel.gov/grid/wind-toolkit.html>

NSRDB:

<https://nsrdb.nrel.gov/>

Wind Toolkit Viewer:

<https://nrel.github.io/hsds-viz/>