Modeling for System Integration Studies

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Kirsten D. Orwig

Solar Resource and Forecasting Workshop

June 21, 2011

NREL/PR-5500-52110

Overview

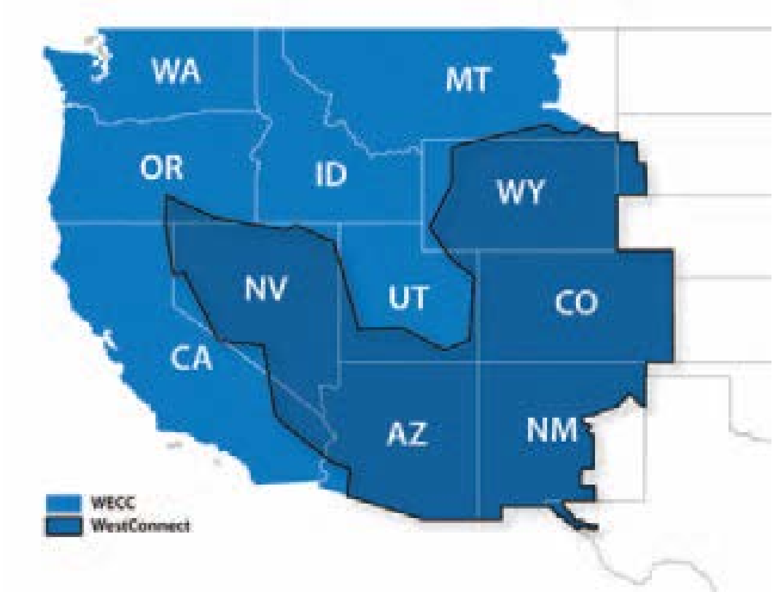
- Renewable energy integration studies evaluate the operational impacts of variable generation.
- Transmission planning studies investigate where new transmission is needed to transfer energy from generation sources to load centers.
- Both use time-synchronized wind and solar energy production and load as inputs.
- Both examine high renewable energy penetration scenarios in the future.

WWSIS

Western Wind and Solar Integration Study

What are the technical barriers to achieving 20% wind energy penetration by 2030?

- Does geographic diversity of renewable energy resource help mitigate variability?
- How do local resources compare to out-of-state resources?
- Can balancing area cooperation help mitigate variability?
- What is the role and value of energy storage?
- Should reserve requirements be modified?
- What is the benefit of forecasting?
- How can hydropower help with integration of renewables?



Wind and Solar Energy Penetrations

Case Name	In Footprint			Rest of WECC	
Name	Wind + Solar	Wind	Solar	Wind	Solar
Pre-selected case	3%	3%	*	2%	*
10% Case	11%	10%	1%	10%	1%
20% Case	23%	20%	3%	10%	1%
20/20% Case	23%	20%	3%	20%	3%
30% Case	35%	30%	5%	20%	3%

*Existing solar embedded in load

WWSIS Solar Inputs

- Satellite cloud cover model data (SUNY) used to represent irradiance over the US at a 10-km, hourly resolution;
- PV was modeled in 100-MW blocks as distributed generation on rooftops;
- CSP was modeled as 100-MW blocks of parabolic trough plants with six hours of thermal storage;
- 10 minute data derived from hourly production;
- Day-ahead hourly solar forecasts were also developed.

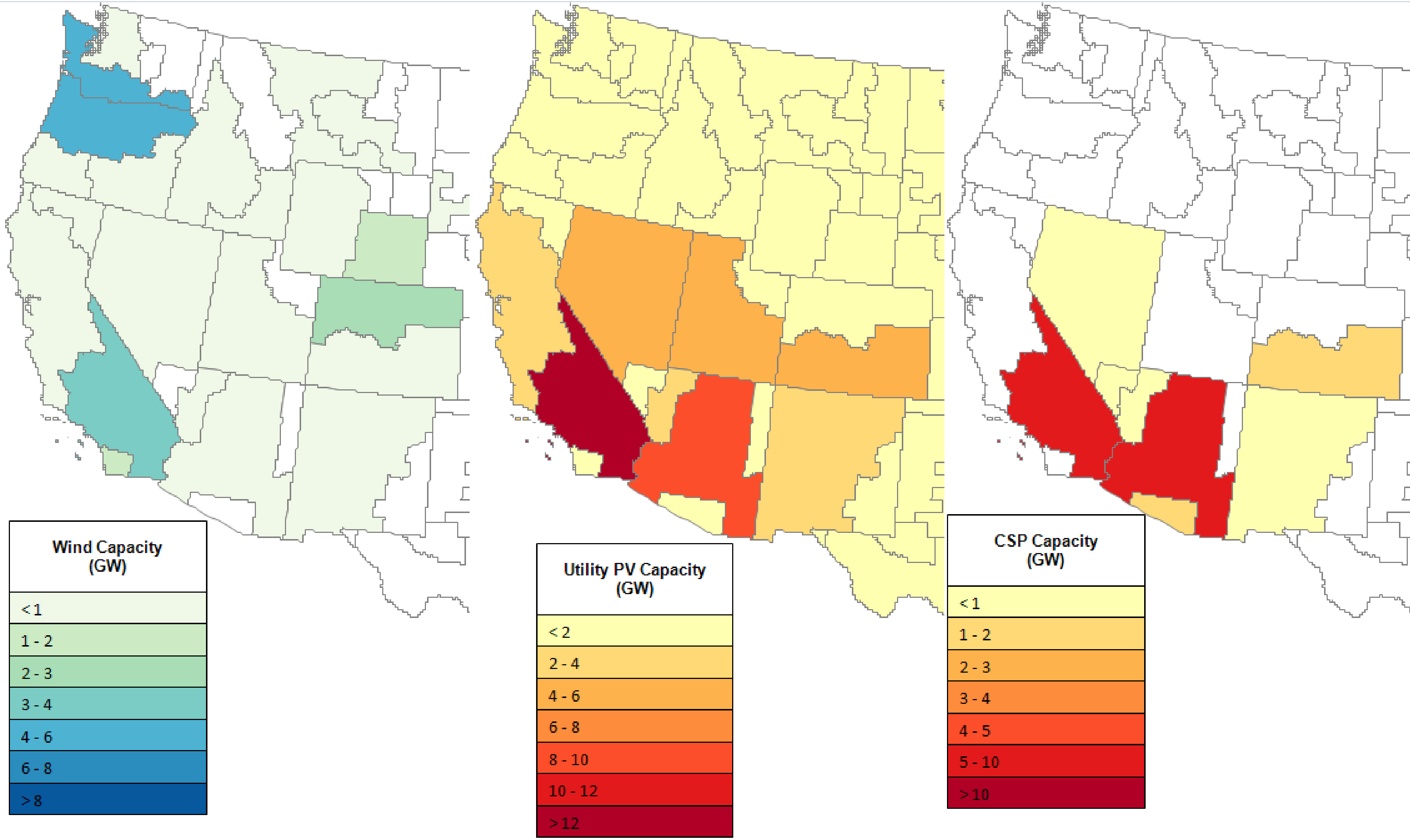
WWSIS Phase 2

Penetration by Energy	High Wind	Intermediate	High Solar
11%	WECC TEPPC 2020 8% wind 3% solar		
22%			
33%	25% wind 8% solar	16.5% wind 16.5% solar	8% wind 25% solar

- Solar consists of 40% CSP w/6-hour storage and 60% PV
- 40% of PV is rooftop for each scenario

*note that sensitivity analyses may include runs of various penetrations of solar with various PV/CSP ratios

High Solar ~(8% wind, 15% PV, 10% CSP)



Solar "Actuals" Dataset

- Utility-scale PV:
  - Use existing WECC PV dataset which has 50-MW plants on 10-km grid at 1-minute, 10-minute, and hourly resolution;
  - Filter function under development to model PV plants up to 500 MW.
- Distributed PV:
  - Use rooftop PV data from WWSIS, Phase 1;
  - Distribute generation identical to load in each load bubble.
- CSP:
  - Rerun WECC CSP dataset using a variety of plant sizes up to 200 MW;
  - Revise sites as needed.

Topics

- Algorithm for downscaling hourly irradiance data;
- Modeling various time scales of interest;
- Using NWP for modeling PV production;
- Solar input data needed from an electrical perspective;
- PV forecast data requirements.