

Clean Line Transmission Initiatives in the West

ACC Biennial Transmission Assessment Workshop



National Grid is a key investor in Clean Line Energy

nationalgrid

CLEAN LINE
ENERGY PARTNERS



National Grid brings extensive experience in building, owning, and operating large transmission projects in the United States and overseas



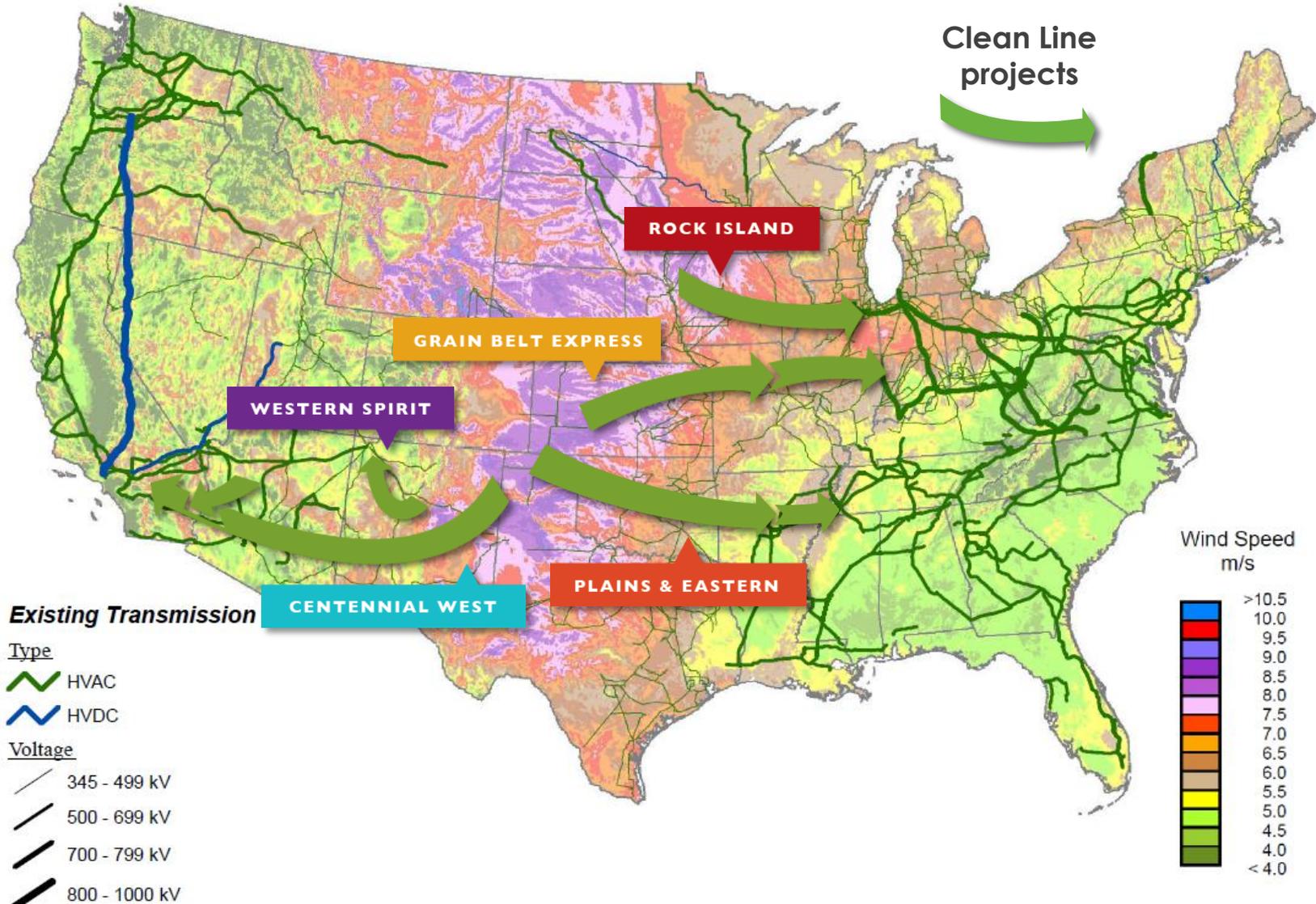
National Grid in the United States

- Owns and operates more than 8,600 miles of transmission
- Serves more than 7 million electricity and natural gas customers

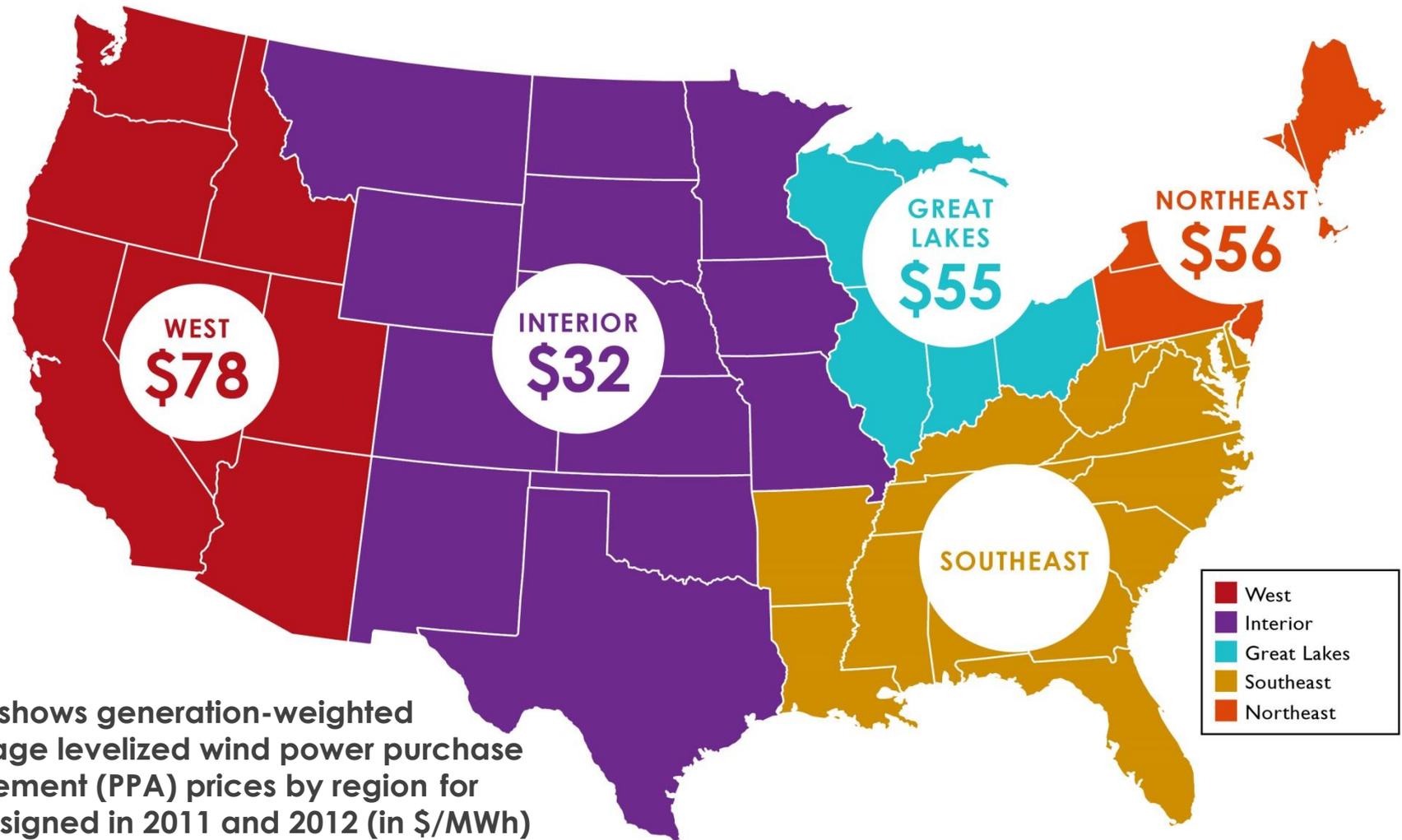


National Grid joins Clean Line's existing investors that include private equity firm ZBI Ventures

Clean Line's projects connect the lowest-cost wind resources to major demand centers



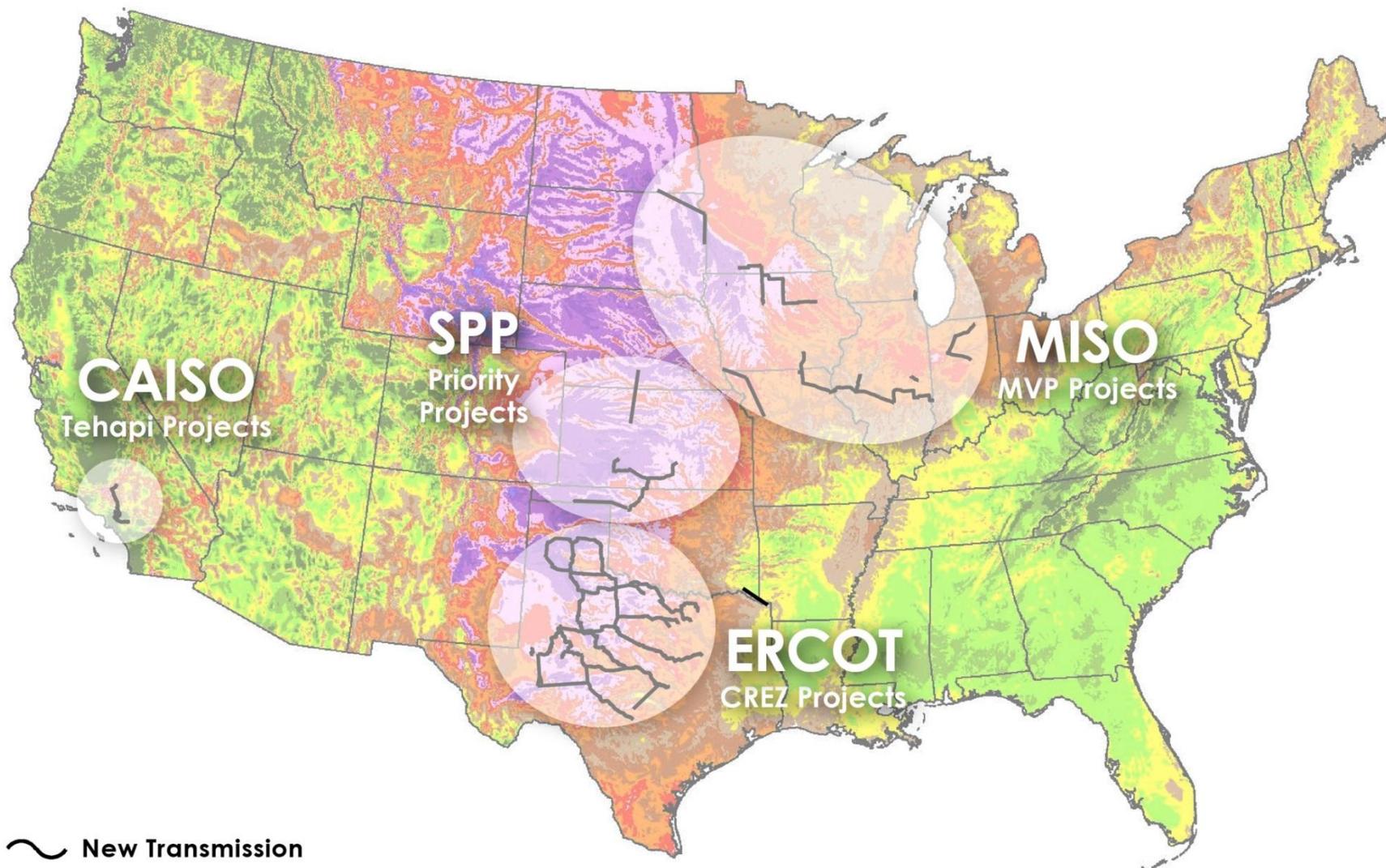
Clean Line's projects source power from the country's lowest cost wind resources



Map shows generation-weighted average levelized wind power purchase agreement (PPA) prices by region for PPAs signed in 2011 and 2012 (in \$/MWh)

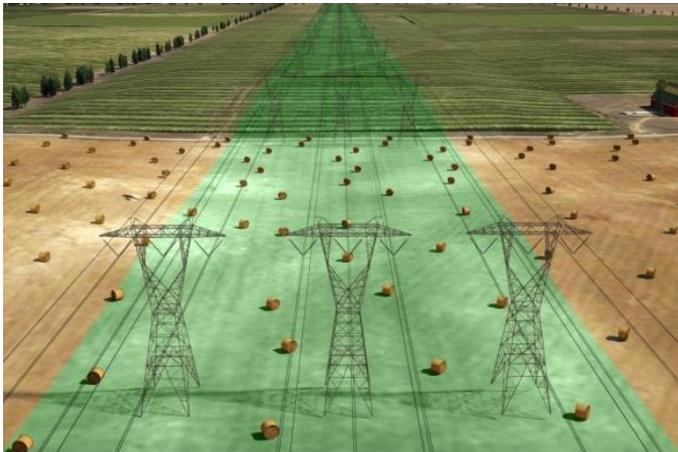
Source: DOE 2012 Wind Technologies Market Report published August 2013

Transmission is being built to meet state and regional needs, but need for interregional transmission remains

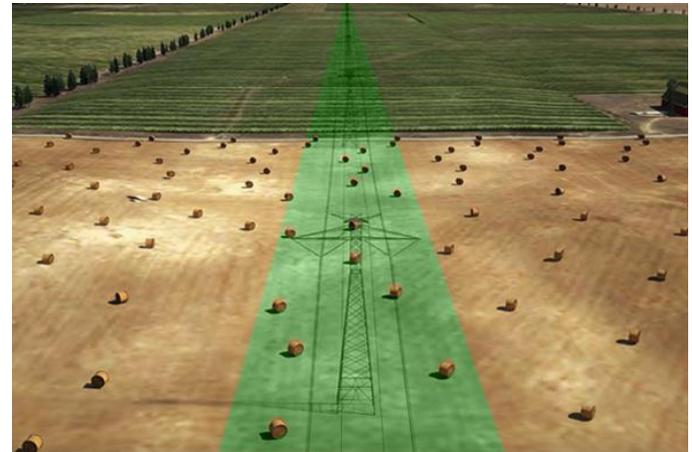


HVDC is the most efficient method to transmit large amounts of electricity over long distances

- **More efficient** — Lower line losses
- **Lower cost** — Requires less infrastructure, results in lower costs and lower prices for delivered renewable energy
- **Improved reliability** — Control of power flow enhances system stability and lowers cost of integrating wind
- **Smaller footprint** — Uses a narrower right-of-way than equivalent Alternating Current (AC)

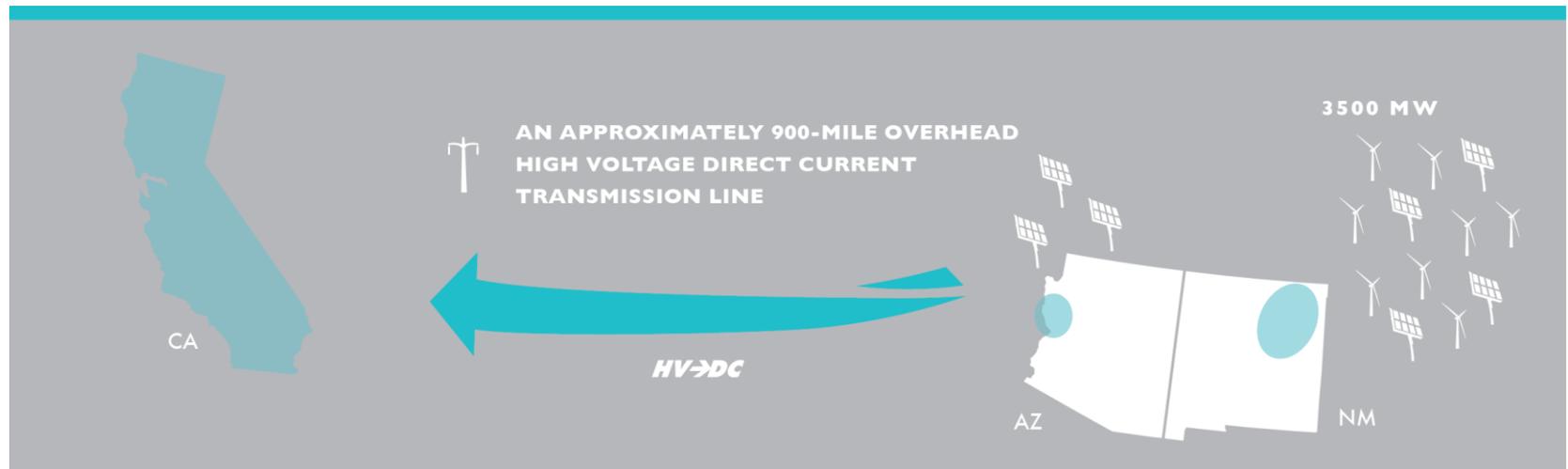


AC footprint



DC footprint

Centennial West Clean Line will deliver renewable energy from New Mexico and Arizona to California



KEY MILESTONES

STATUS

Interconnection

- CAISO interconnection request pending; WECC Project Coordination Review completed

Regulatory

- Development agreement with Western Area Power Administration

Environmental & Routing

- SF – 299 Right of Way application filed with BLM in 2010
- BLM National Project Manager coordinating NEPA process with Western, USFS

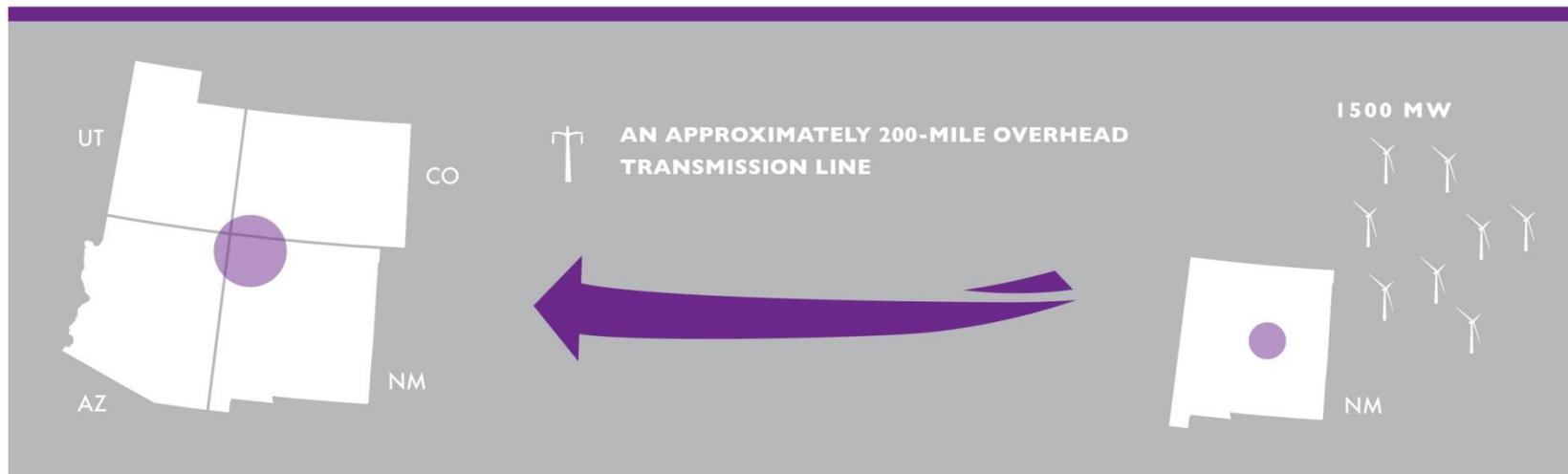
Agreements & Alliances

- MOU with New Mexico Renewable Energy Transmission Authority

Public Outreach

- Held 18 community leader workshops in four states and two tribal nations to gather information about local routing opportunities and constraints

Western Spirit will increase transfer capacity from New Mexico's best wind resources to Four Corners



KEY MILESTONES	STATUS
Interconnection	<ul style="list-style-type: none"> • Queue position with Public Service of New Mexico for service to Four Corners • Requested Arizona Public Service transmission service from Four Corners to CAISO
Environment & Routing	<ul style="list-style-type: none"> • Preliminary routes developed • Right-of-way acquisition initiative commenced
Agreements & Alliances	<ul style="list-style-type: none"> • Lease Agreement with New Mexico Renewable Energy Transmission Authority (RETA) • RETA is authorized by statute acquire land for the project and own transmission facilities • No additional route approval is required

As California increases its renewables penetration, resource selection becomes more important

Geographic Diversity

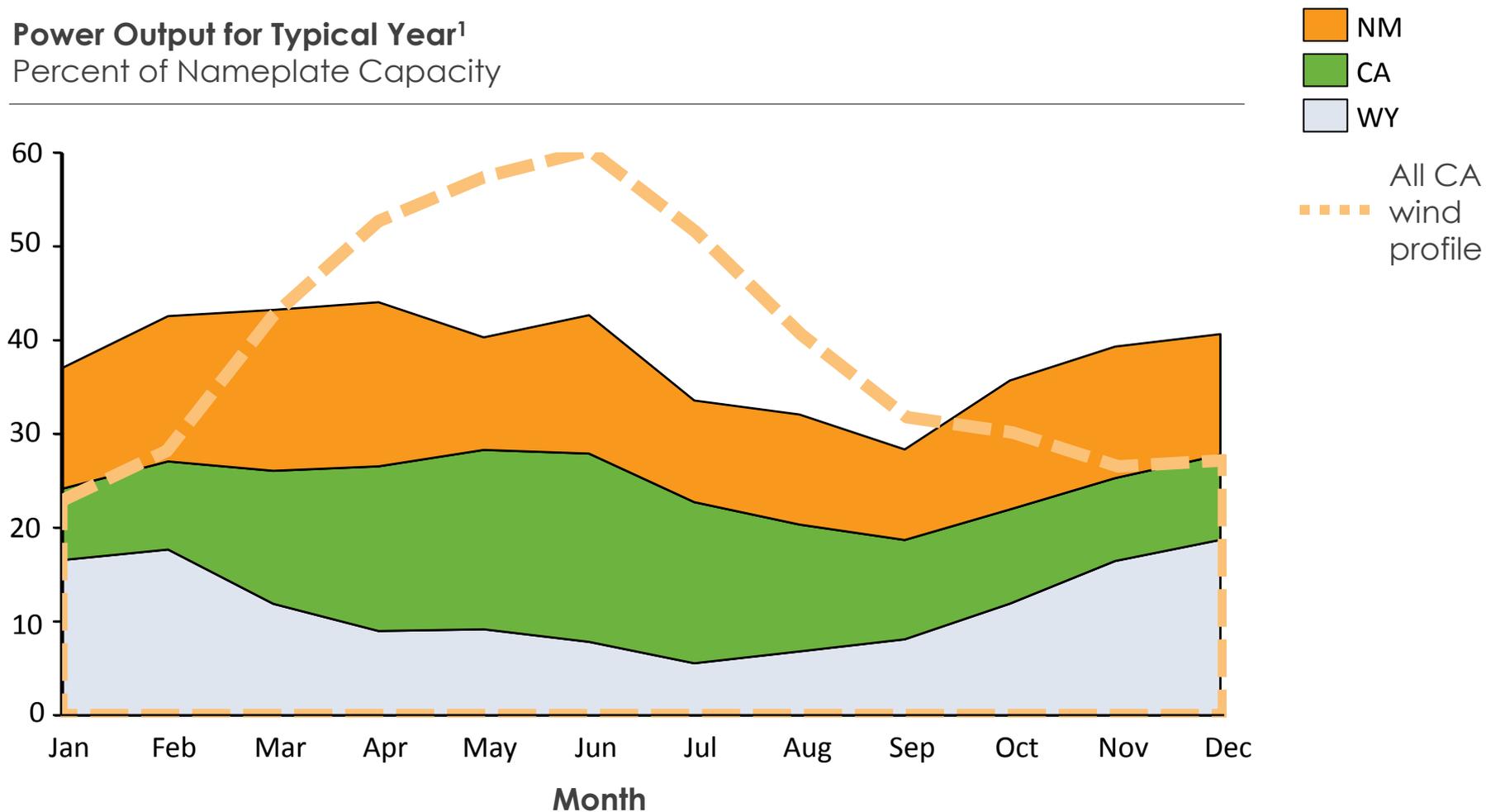
A geographically diversified portfolio reduces the occurrence of extreme changes in power output and smoothens out seasonal effects across locations

Resource Diversity

Different renewables technologies complement each other in terms of their power output profile

A geographically diversified portfolio can mitigate seasonal variability...

Power Output for Typical Year¹
Percent of Nameplate Capacity



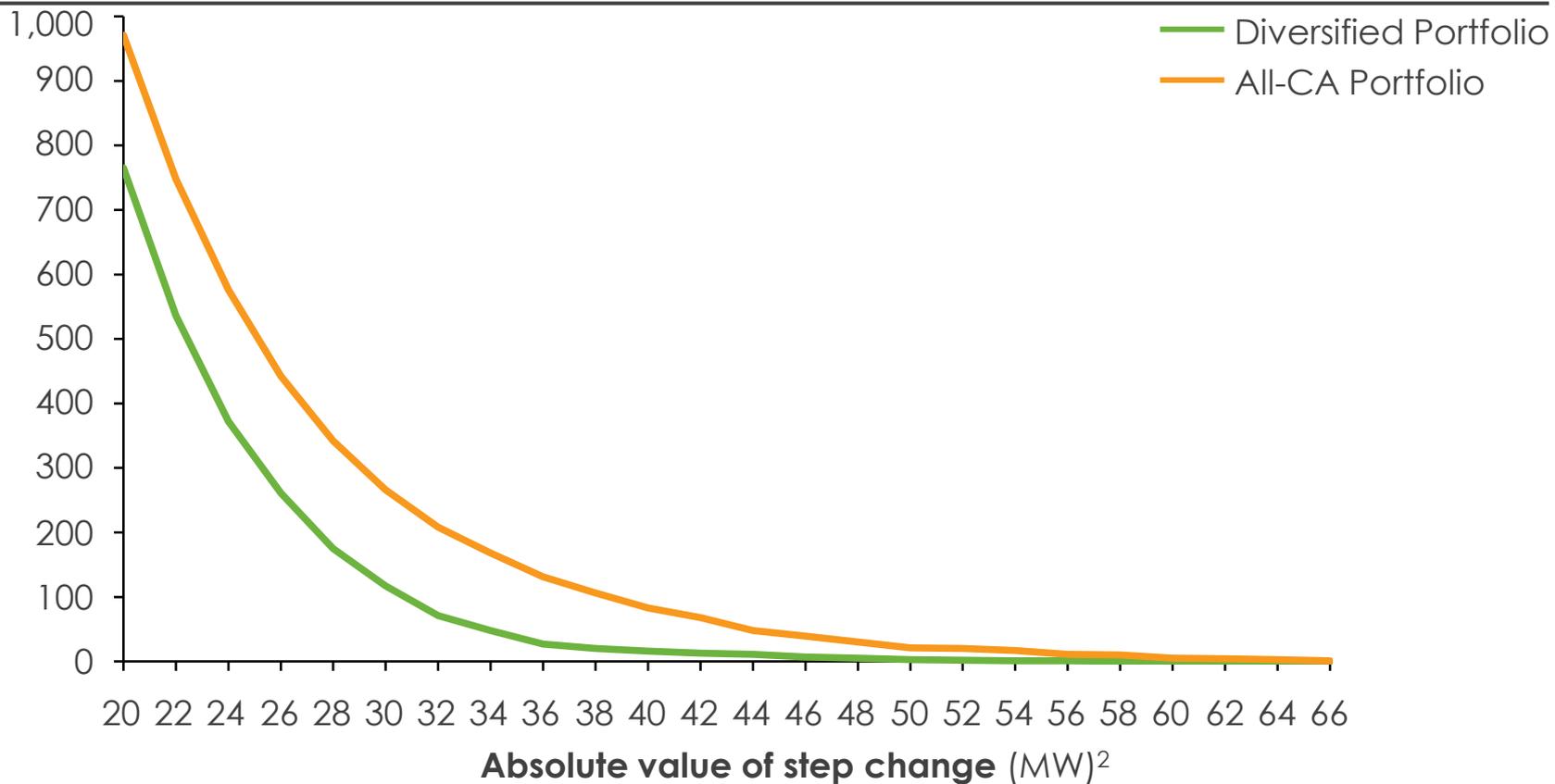
1. Assuming equal nameplate capacity for each location shown

Source: V-BAR, NREL

...and lead to fewer major ramping events

Frequency of Hourly Step Changes¹

Number of hours



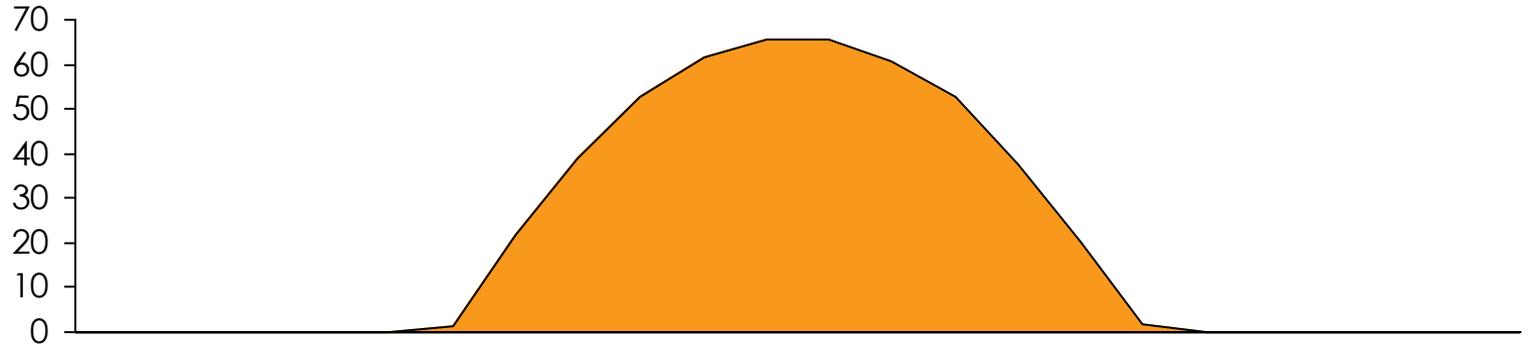
1. Comparison of generation output (for the years 2004-2006) of a portfolio of 3 wind farms all located in California versus a portfolio of 3 wind farms, with one wind farm each in California, Wyoming and New Mexico
2. For a total capacity of 90 MW (30 MW per wind farm)

Source: NREL WWSIS study

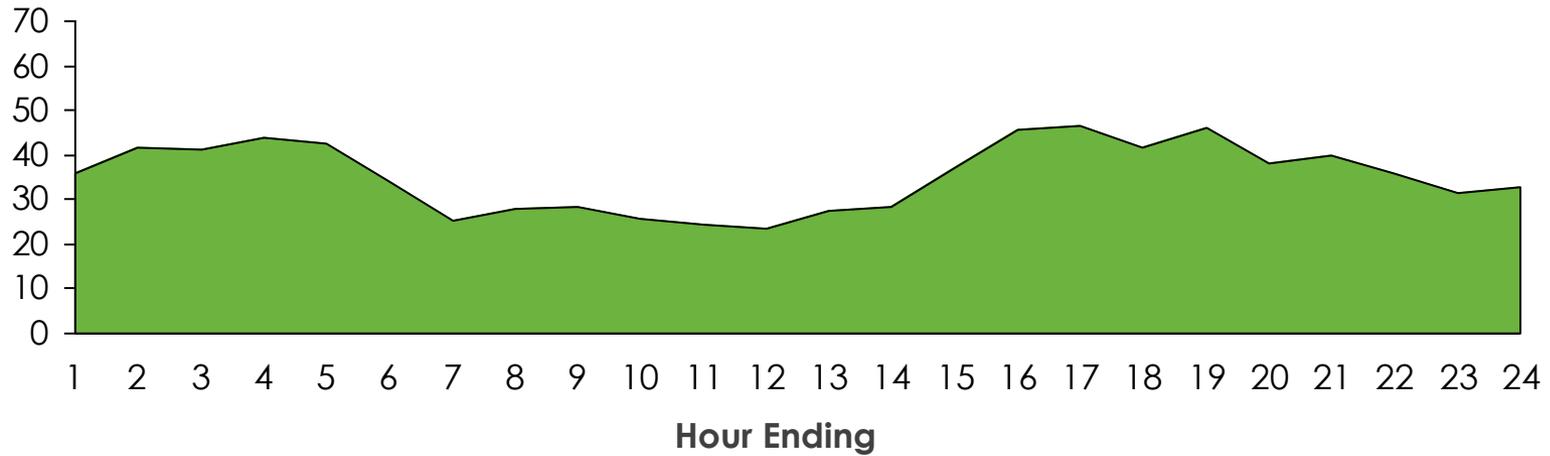
Solar and wind technologies generate power at different times of the day...

Power Output for Typical California August Day¹
Percent of nameplate capacity

CA Solar PV



NM Wind

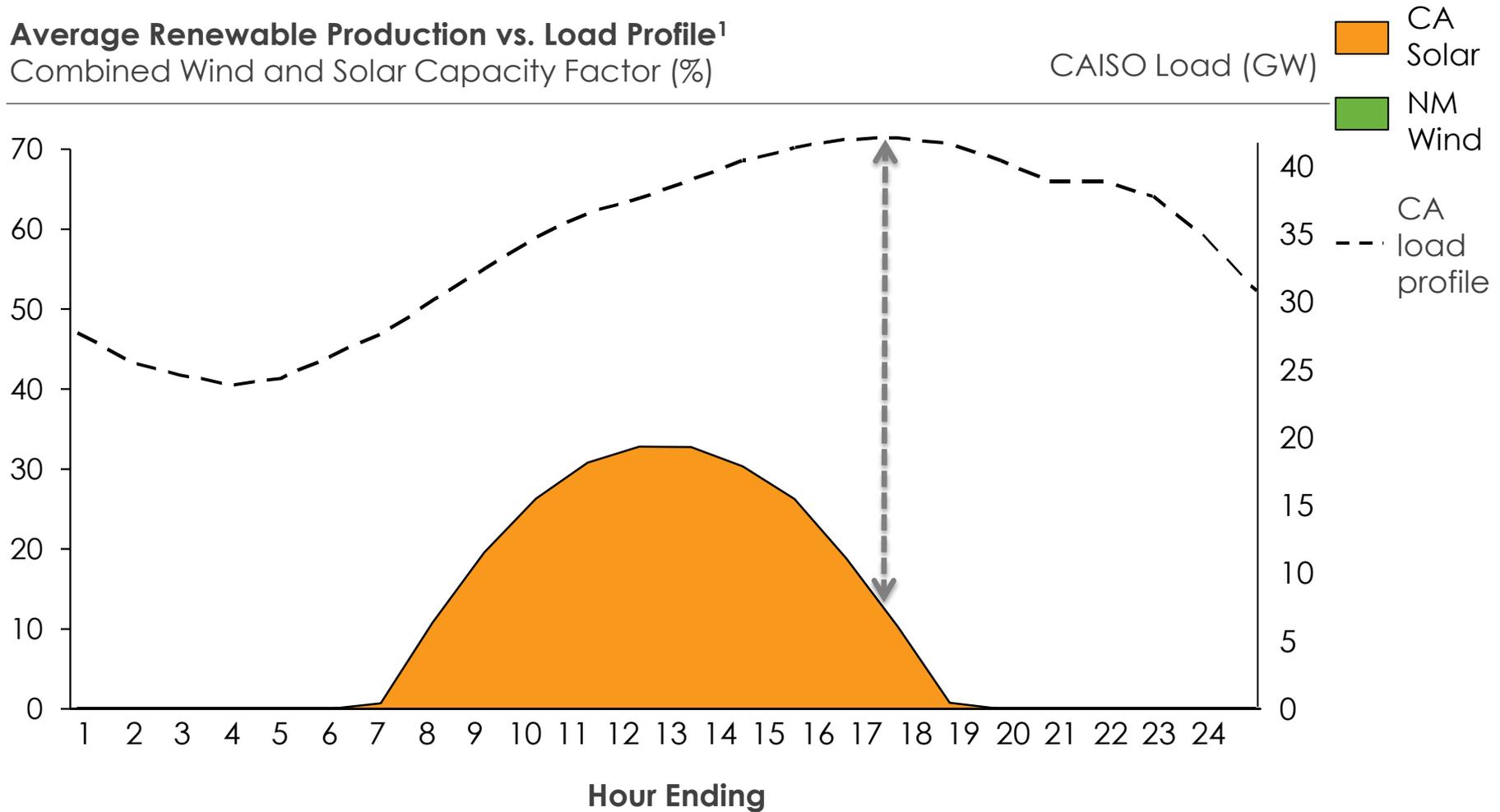


1. Eastern NM wind. Solar output based on Typical Meteorological Year data; Wind output based on 2009 data derived from V-Bar models.

Source: NREL PVWatts; V-BAR

...and their combination better follows load

Average Renewable Production vs. Load Profile¹
 Combined Wind and Solar Capacity Factor (%)

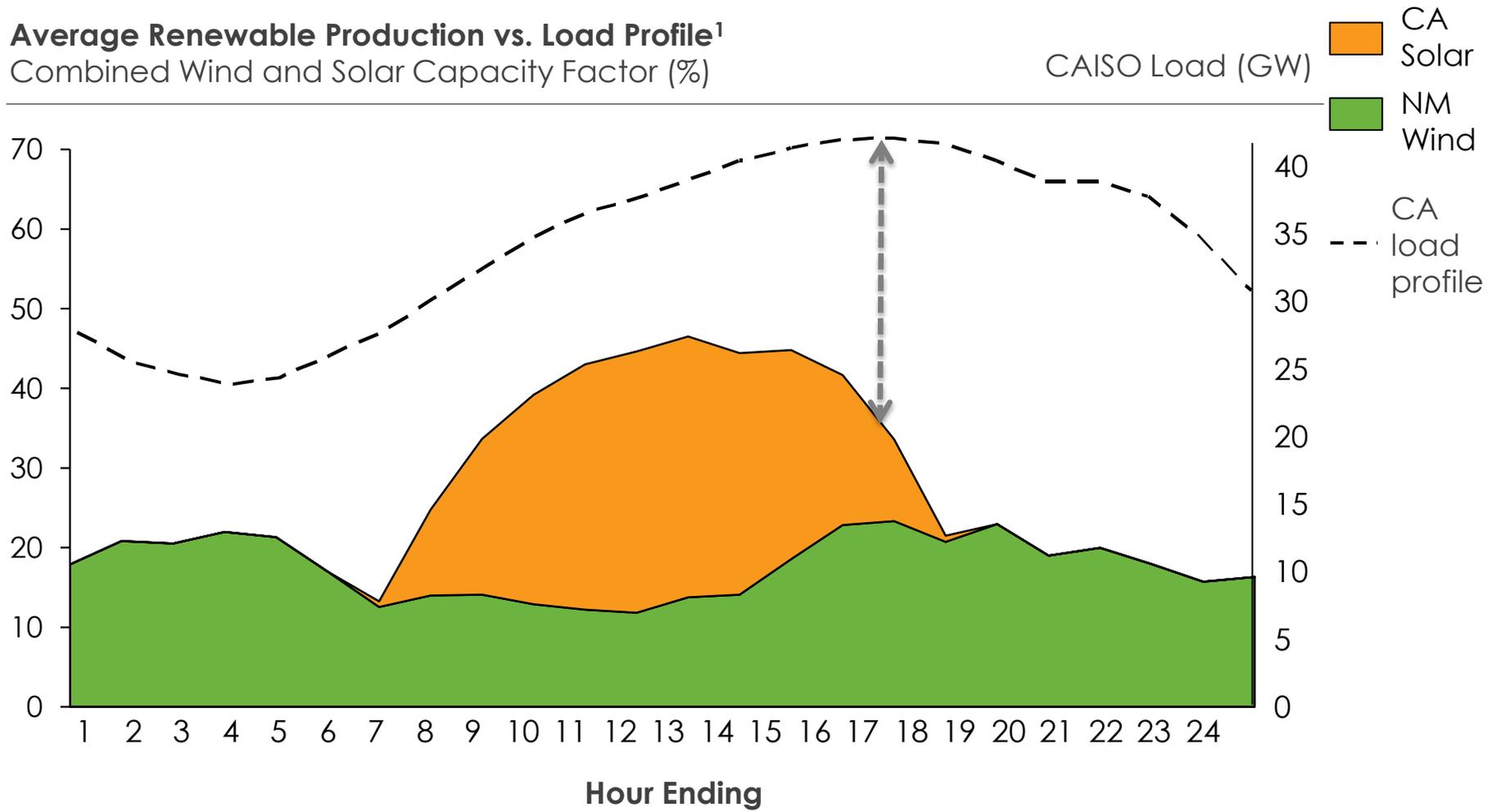


1. Assuming equal nameplate capacity for solar and wind

Source: NREL PVWatts; V-BAR

...and their combination better follows load

Average Renewable Production vs. Load Profile¹
 Combined Wind and Solar Capacity Factor (%)



1. Assuming equal nameplate capacity for solar and wind

Source: NREL PVWatts; V-BAR

New transmission for wind brings numerous benefits to the Western grid

-  Access to the most cost effective renewable resource
-  Lowest cost, most efficient transmission solution
-  RPS eligibility
-  Diversity in renewable resources

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