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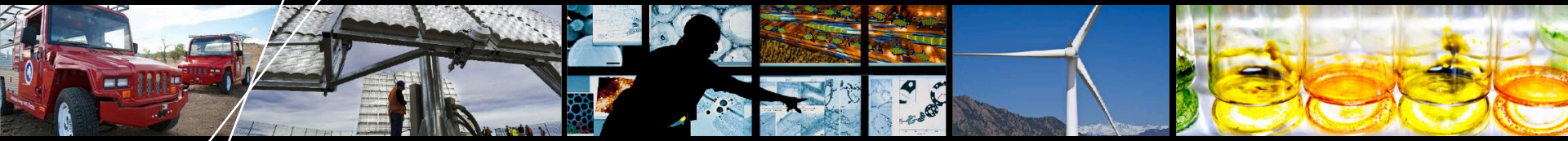
Capacity Value: Evaluation of WECC Rule of Thumb



WECC Data Working Group

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Western Electricity Coordinating Council Webinar
June 9, 2015

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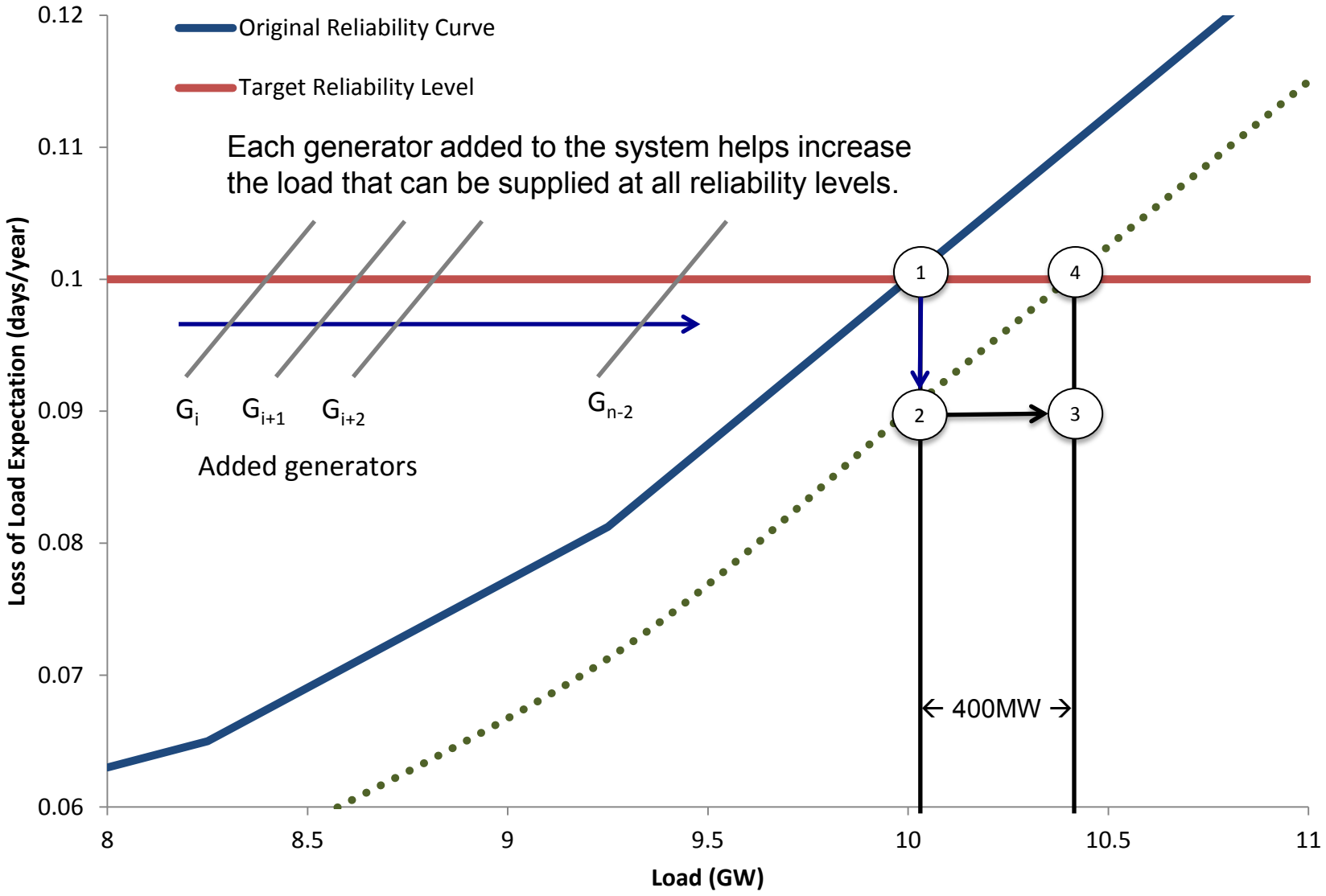
NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

Objective

- **Compare LOLE, wind/solar capacity values with ‘rules of thumb’ used in Western Interconnection Planning**
- **Provide alternative recommendations to WECC’s TEPPC modeling efforts**

ELCC: Measure Contribution of Generator to Resource Adequacy



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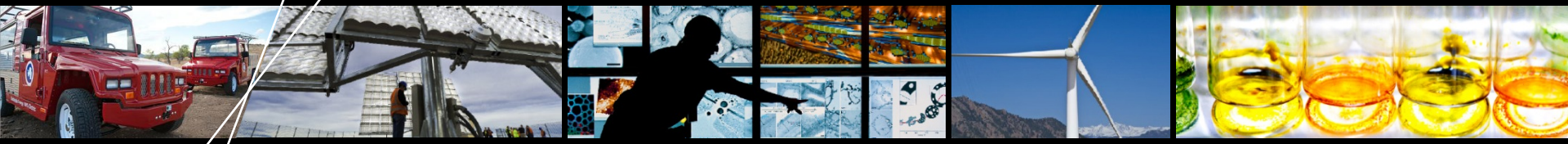


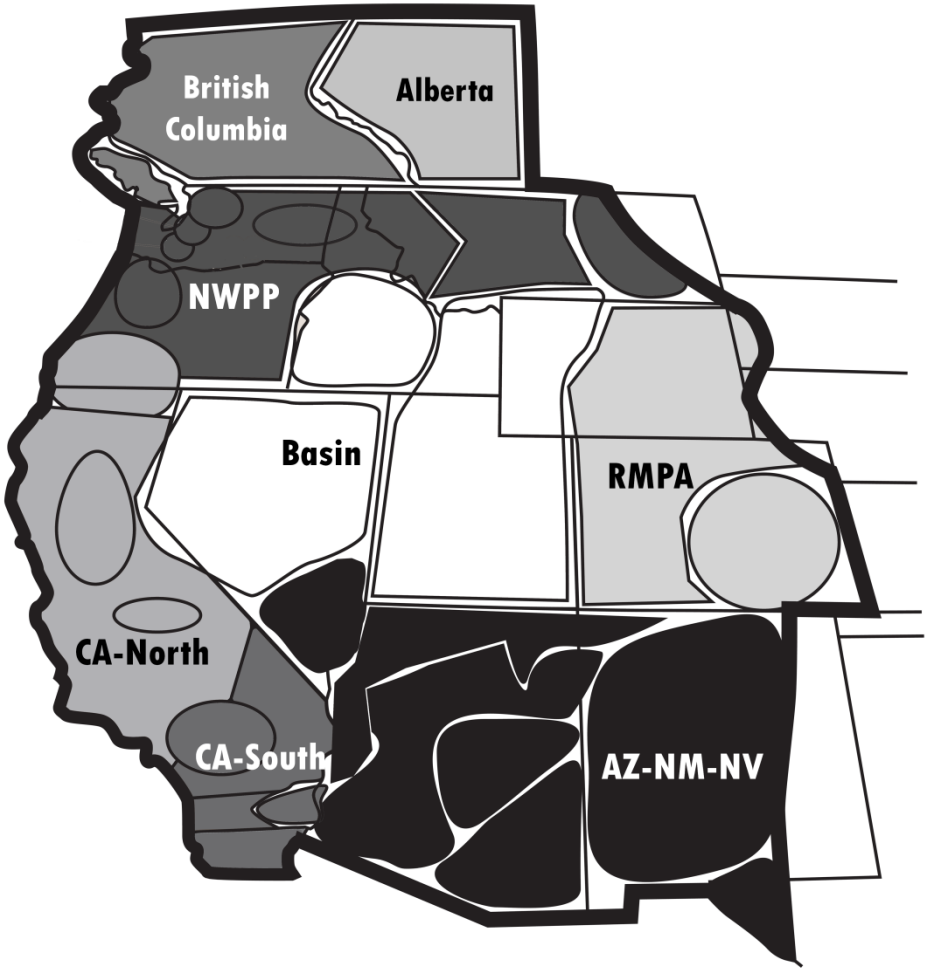
Evaluation of WECC Rules of Thumb for Resource Adequacy for Wind and Solar

Numerical Example

- **Comparison of metrics and effect on capacity value**

- **Using WECC's Transmission Expansion Planning Policy Committee (TEPPC) 2024**
  - Long-term transmission study for the U.S. Western Interconnection

Footprint and pools



Tool: REPRA

- **Renewable Energy Probabilistic Resource Assessment tool (REPRA)**
  - Include variable generation in traditional probabilistic-based methods
  - Allow comparison of alternative targets, metrics (LOLE, ENS, LOLH, etc.)
  - Answer questions from the IVGTF report http://www.nerc.com/files/IVGTF1-2.pdf
  - Available as open-source package for R statistical software
- **More information:**
  - Ibanez, Milligan, "Impact of Transmission on Resource Adequacy in Systems with Wind and Solar Power," www.nrel.gov/docs/fy12osti/53482.pdf
  - –, "Probabilistic Approach to Quantifying the Contribution of Variable Generation and Transmission to System Reliability," http://www.nrel.gov/docs/fy12osti/56219.pdf

Definition of pools and reserve margins

Pool	Includes	Summer Margin	Winter Margin
AZ-NM-NV	Arizona, New Mexico, Southern Nevada	13.6%	14.0%
Basin	Idaho, Northern Nevada, Utah	13.7%	13.7%
Alberta	Alberta	12.6%	13.9%
BC	British Columbia	12.6%	13.9%
CA-North	Northern California, San Francisco, SMUD	15.0%	12.1%
CA-South	Southern California Edison, San Diego Gas & Electric, LADWP, Imperial Irrigation District	15.2%	11.0%
NWPP	Pacific Northwest, Montana	17.5%	19.2%
RMPA	Colorado, Wyoming	15%	15.9%

Contribution to Resource Adequacy

Capacity credit by technology and pool that TEPPC uses to meet the reserve margin criteria

Generation Type	AZ-NM-NV	Basin	Alberta	BC	CA-North	CA-South	NWPP	RMPA
Biomass RPS	100%	100%	100%	100%	66%	65%	100%	100%
Geothermal	100%	100%	100%	100%	72%	70%	100%	100%
Small Hydro RPS	35%	35%	35%	35%	35%	35%	35%	35%
Solar PV	**60%**	**60%**	**60%**	**60%**	**60%**	**60%**	**60%**	**60%**
Solar CSP0	90%	95%	95%	95%	72%	72%	95%	95%
Solar CSP6	95%	95%	95%	95%	100%	100%	95%	95%
Wind	**10%**	**10%**	**10%**	**10%**	**16%**	**16%**	**5%**	**10%**
Hydro	70%	70%	90%	90%	70%	95%	70%	70%
Pumped Storage	100%	100%	100%	100%	100%	100%	100%	100%
Coal	100%	100%	100%	100%	100%	100%	100%	100%
Nuclear	100%	100%	100%	100%	100%	100%	100%	100%
Combined Cycle	95%	95%	100%	95%	95%	95%	95%	95%
Combustion Turbine	95%	95%	100%	95%	95%	95%	95%	95%
Other Steam	100%	100%	100%	100%	100%	100%	100%	100%
Other	100%	100%	100%	100%	100%	100%	100%	100%
Negative Bus Load	100%	100%	100%	100%	100%	100%	100%	100%
Dispatchable DSM	100%	100%	100%	100%	100%	100%	100%	100%

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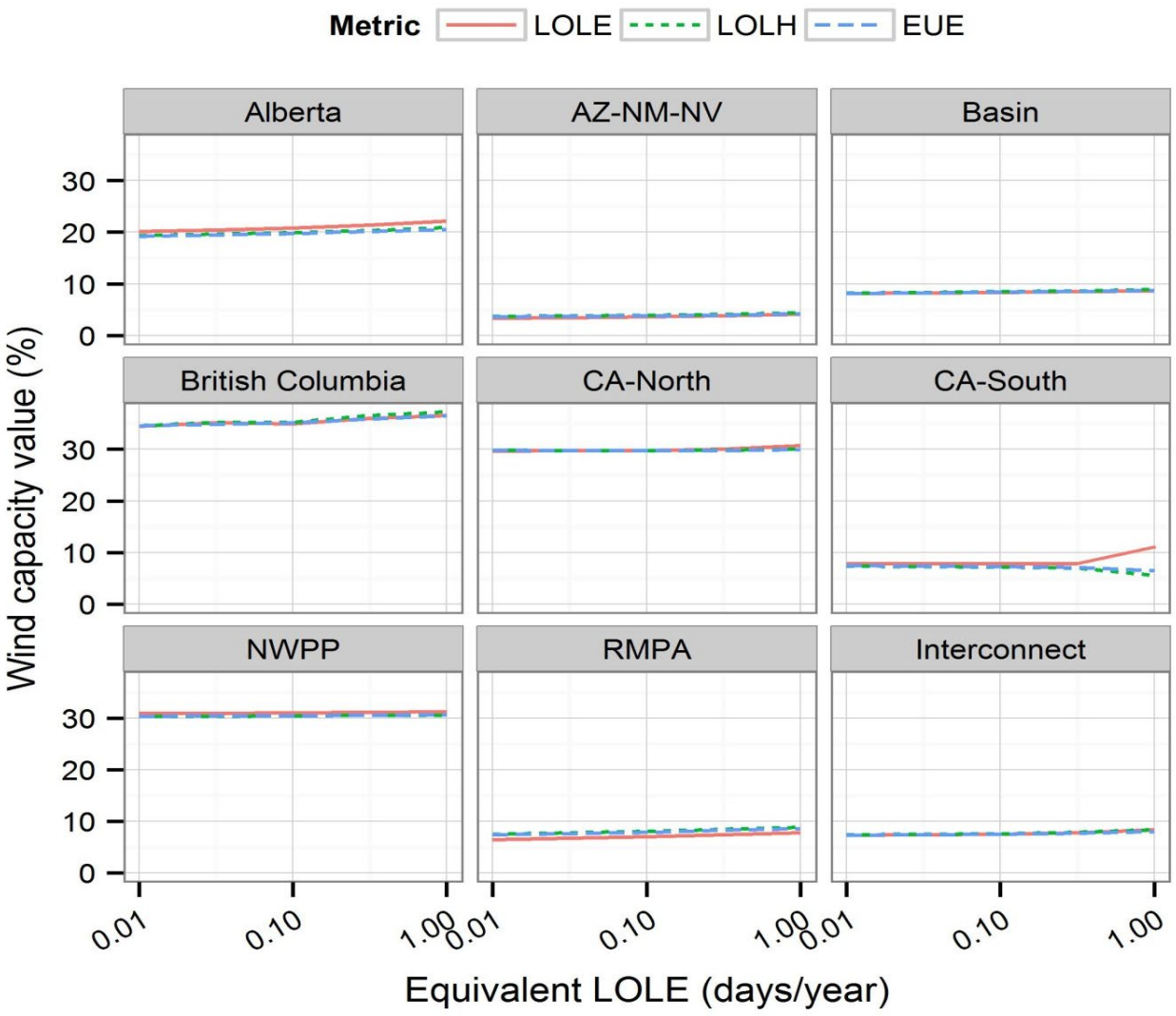
Solar CSP6	95%	95%	95%	95%	100%	100%	95%	95%
Wind	**10%**	**10%**	**10%**	**10%**	**16%**	**16%**	**5%**	**10%**
Hydro	70%	70%	90%	90%	70%	95%	70%	70%
Pumped Storage	100%							100%
Coal	100%							100%
Nuclear	100%							100%
Combined Cycle	95%							95%
Combustion Turbine	95%							95%
Other Steam	100%							100%
Other	100%							100%
Negative Bus Load	100%	100%	100%	100%	100%	100%	100%	100%
Dispatchable DSM	100%	100%	100%	100%	100%	100%	100%	100%

Solar PV = 60% everywhere

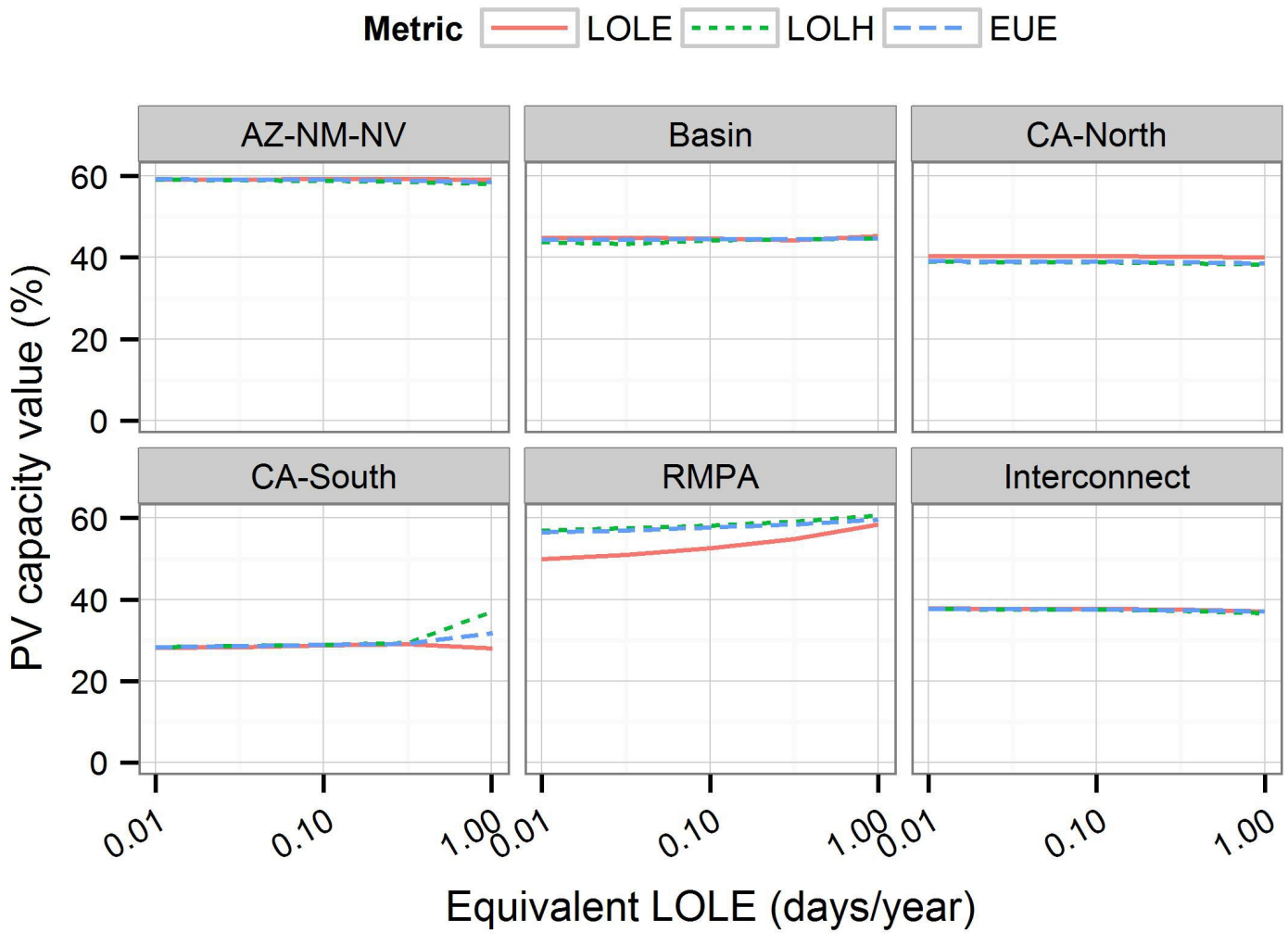
Wind varies from 5-16%

Wind capacity value for different metrics



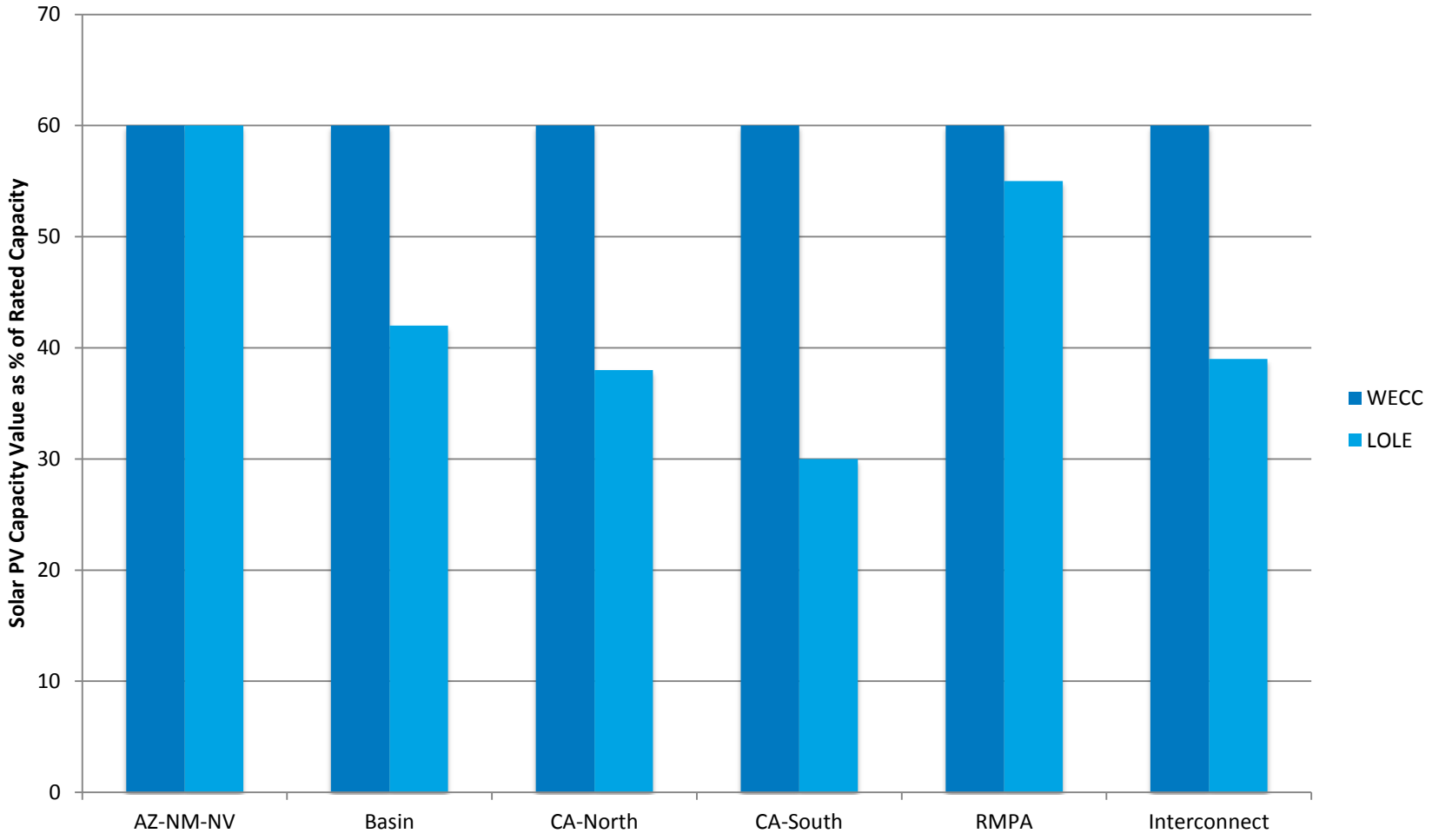
TEPPC assumed 10% capacity value (except 16% In CA and 5% NWPP)

PV capacity value for different metrics

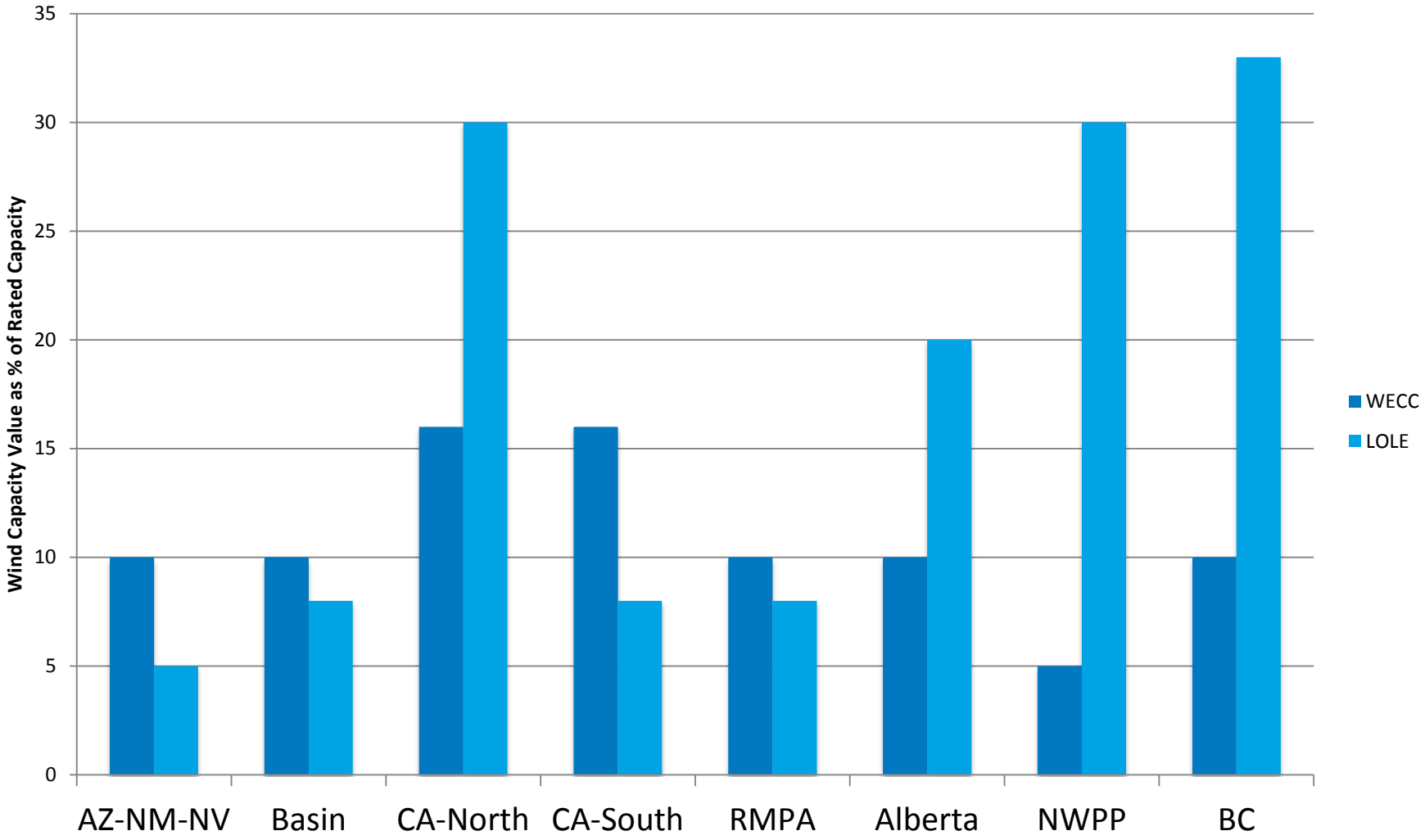


TEPPC assumed 60% capacity value at all locations

PV: Comparison of WECC Rules of Thumb and ELCC



Wind: Comparison of WECC Rules of Thumb and ELCC



Conclusions – Resource Adequacy Metrics

- **Estimating resource adequacy levels in the presence or renewables is an open area of research**
- **Capacity values are not very sensitive to metric or adequacy level selection**
- **Calculated CV were smaller than TEPPC assumptions; TEPPC cases might be slightly underbuilt**

WECC may want to consider:

- **Adopting these capacity values by type of resource and zone as new rules of thumb**
  - Subject to periodic revision
- **Utilizing NREL's REPRA (open source) model to complement existing modeling resources in TEPPC process**
- **Utilizing an alternative approach to incorporate capacity valuation into the TEPPC process**