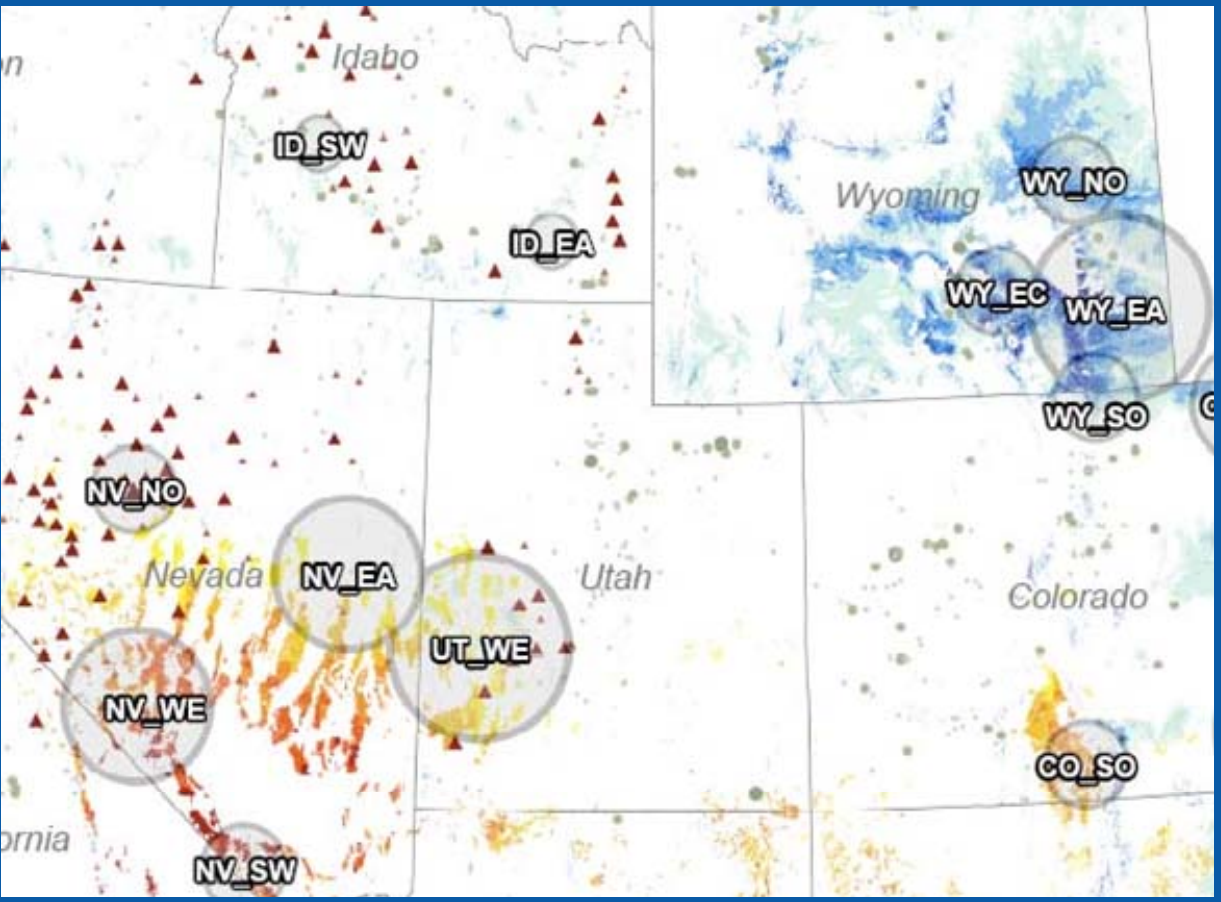
National Renewable Energy Laboratory
Innovation for Our Energy Future

The Western Renewable Energy Zone Initiative



American Council of Engineering Companies

Summer Business Meeting in Golden, Colorado

Dr. David Hurlbut

Senior Analyst

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Zone initiatives in western states

Texas: Competitive Renewable Energy Zones (CREZ)

California: Renewable Energy Transmission Initiative (RETI)

Colorado: renewable resource mapping, expedited transmission planning

Nevada: Renewable Energy Transmission Access Advisory Committee (RETAAC)

Utah: Finished resource assessment, identifying zones and transmission needs

Arizona: biennial transmission assessment ordered by ACC seeks top 3 renewable energy zone options

WREZ objectives

- Evaluate ***regional*** transmission options for renewable energy, on the assumption that in-state evaluations can be done by states themselves
  - Purpose is ***not*** to identify all developable renewable resources
- Identify the highest concentrations of the least-cost renewable resources, in sufficient quantity to sustain competition among potential developers
- Identify in advance the environmental and other land use issues that may limit development

WREZ work phases

- Phase 1: Identify renewable energy zones (REZs), estimate quantity of REZ resources, estimate busbar cost of REZ resources
- Phase 2: Develop conceptual transmission modeling tool to estimate delivered cost of energy from any REZ to any major load center in the West; submit scenarios to WECC for detailed study
- Phase 3: Assist load-serving entities (LSEs) in coordinating renewable energy procurement plans and new transmission needs
- Phase 4: Institution-building

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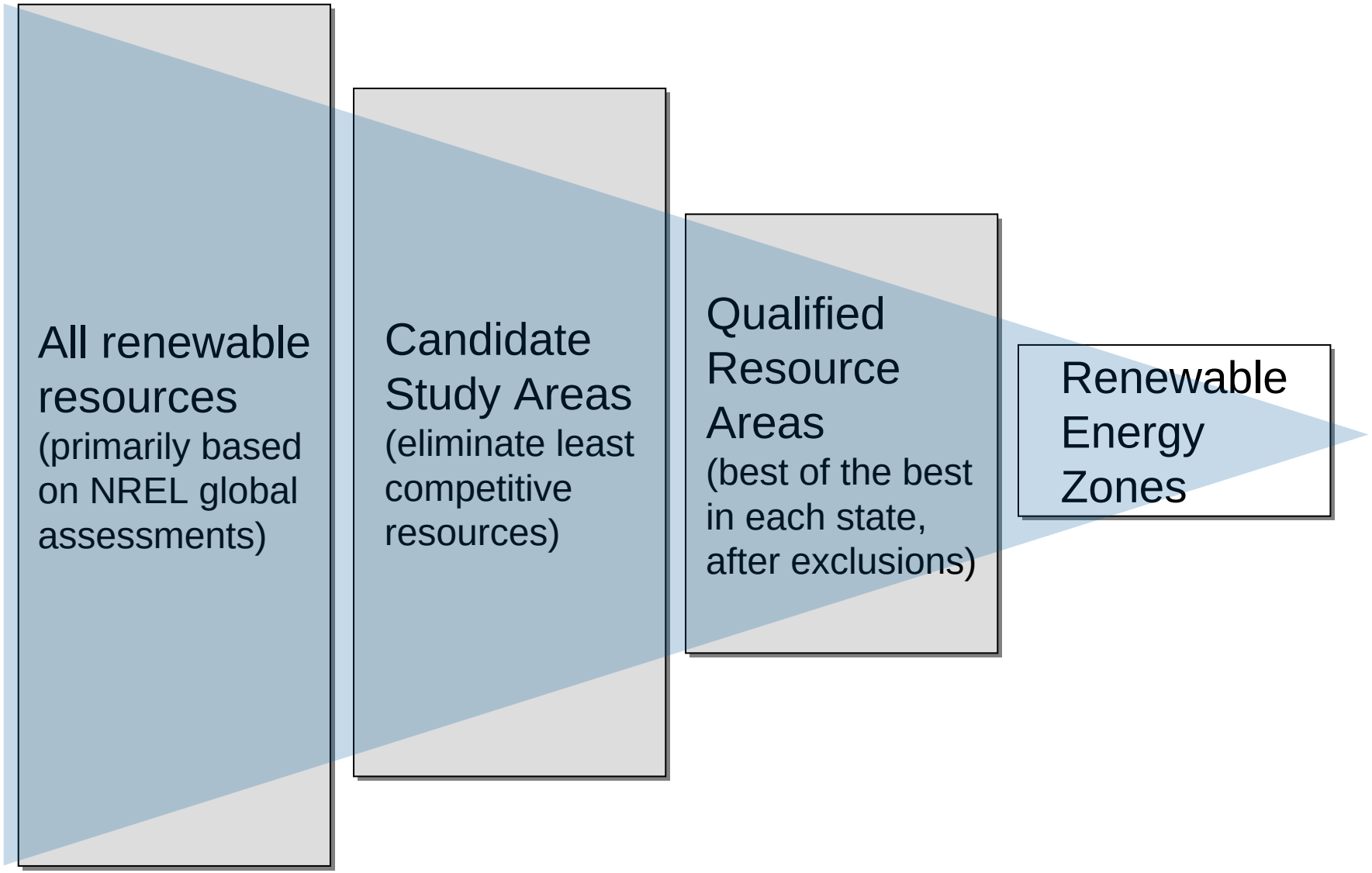
Progression toward REZs



Filtering Qualified Resource Areas

- Develop and apply land exclusions
  - Technical exclusions
    - No development in urban areas, near airports, on wetlands
    - For wind: exclude slopes greater than 20%
    - For solar thermal (CSP): exclude slopes greater than 2%, minimum square contiguous area of 640 acres
  - Lands off limits by statute or policy (national parks, wildlife refuges, wilderness areas, etc.)

Filtering Qualified Resource Areas

- State-specific resource thresholds
  - For wind,
    - Best resources, highest threshold: Montana, Wyoming
    - Good resources: Baja California, Colorado, New Mexico, Texas
    - All other states/provinces
  - For solar,
    - Best resources, highest threshold: Arizona
    - Good resources: Baja California, California, Colorado, Nevada, New Mexico
    - Lower threshold: Utah, Texas

Filtering Qualified Resource Areas

- Geothermal was a qualifying resource
  - Existing projects used to identify potential, with USGS maps providing additional information on possible underground heat flows
  - Points rather than areas
- Biomass and small hydro (US) were not qualifying resources
  - Applied conclusion from Colorado study that these were local resources; zones were inapplicable
  - Would be quantified in a zone that was determined by wind, solar or geothermal potential

Filtering Qualified Resource Areas

- Apply reduction factors to estimate developability
  - For wind, 25% of qualifying technical potential
  - For solar, 3.5% of qualifying technical potential
- Applied density screen to remaining qualified resources
  - Uniform grid overlay over entire Western Interconnection, each grid cell 50 km^2
  - Calculate the total MW of qualifying potential in each grid
- Eliminate cells with relatively low MW
- Eliminate high-MW grid cells that were isolated
- Eliminate clusters with aggregate qualifying potential less than 1,500 MW

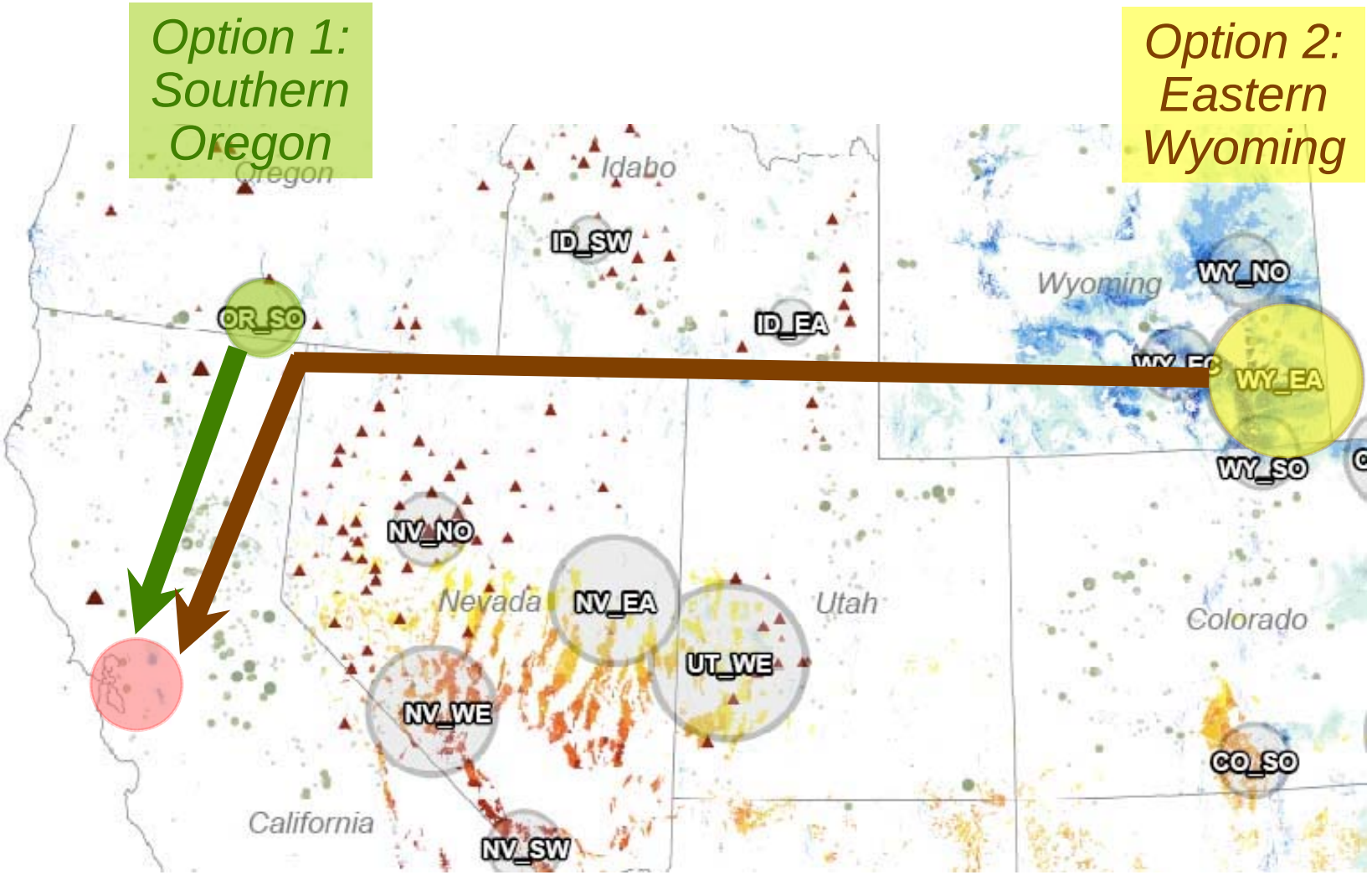
Once areas were filtered,

- Eliminated, consolidated QRAs
- Implemented guidance from governors with respect to treatment of sensitive wildlife habitat
  - Option 1: Eliminate QRA entirely
  - Option 2: Apply additional screen
  - Option 3: Add cautionary notes to state QRAs
- “Erased” the lines but used the screened quantities as resources feeding into a central hub
- Calculated supply curves based on busbar cost of energy (levelized $/MWh)
  - Long-distance transmission costs to be added in next phase

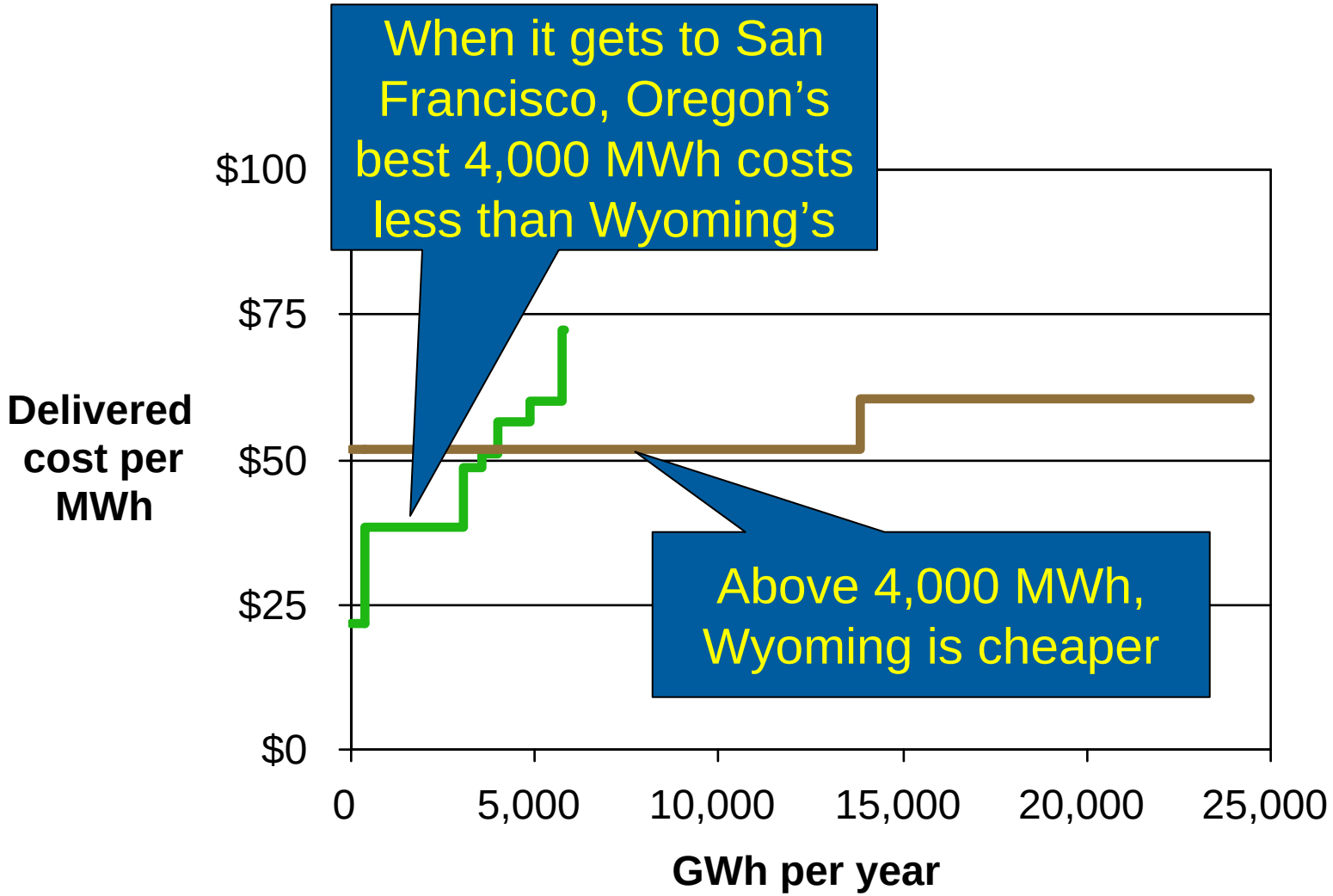
Zones to regional transmission

- Zone hubs and their supply curves went into a high-level conceptual transmission model to estimate delivered cost from zones to major load centers
  - Assumes all new transmission, no ATC on existing lines
  - Line distances based on existing transmission paths
  - Delivered cost vary based on the path modeled
- Excel-based transmission model, populated with busbar costs from Phase 1, are available to load-serving entities and regulators to test scenarios
- WECC is conducting more detailed studies on WREZ scenarios

Example: Delivery to San Francisco



Cost curves for Oregon, Wyoming



Western Renewable Energy Zones

WREZ on the Western Governors' web site:

http://www.westgov.org/wga/initiatives/wrez/

GIS portal for WREZ maintained by NREL:

http://mercator.nrel.gov/wrez/

- Login "wrez"
- Password "guest"