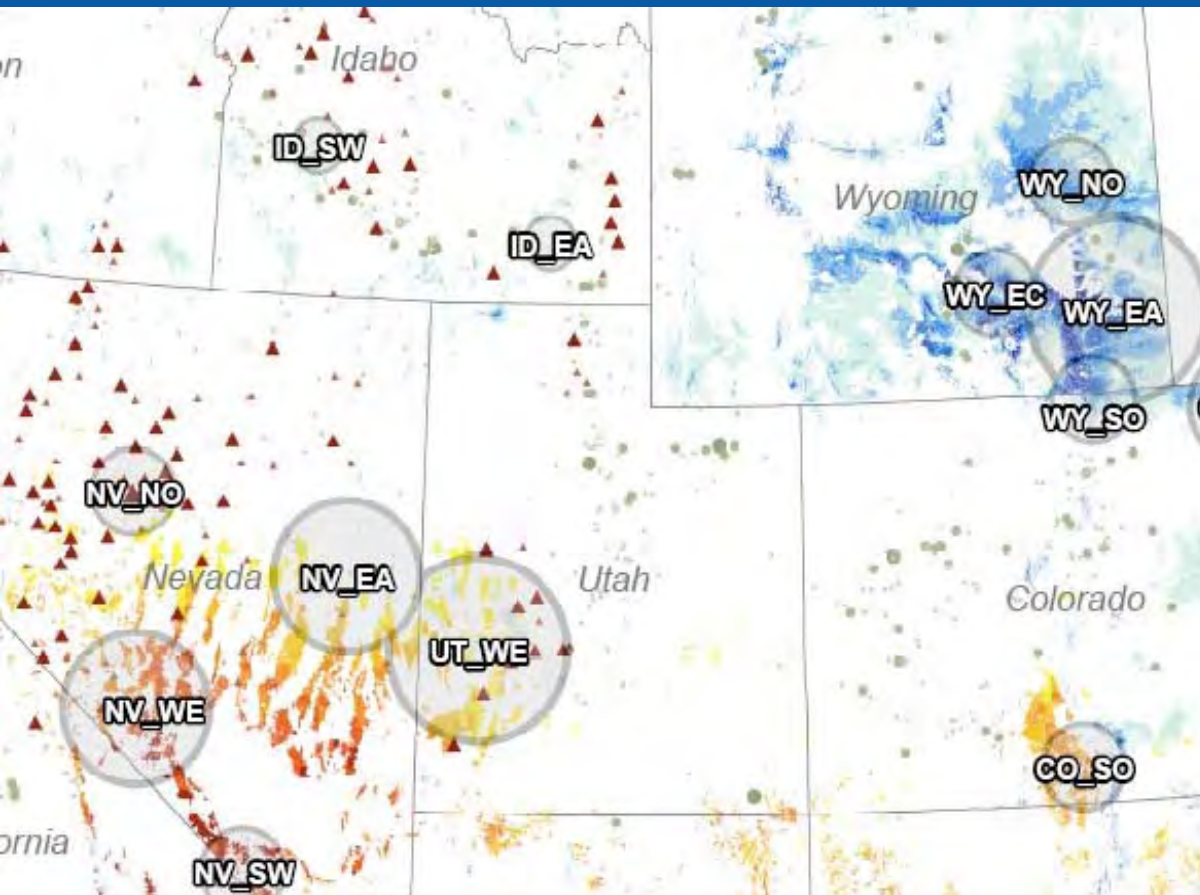


Renewable Energy Strategy in the West



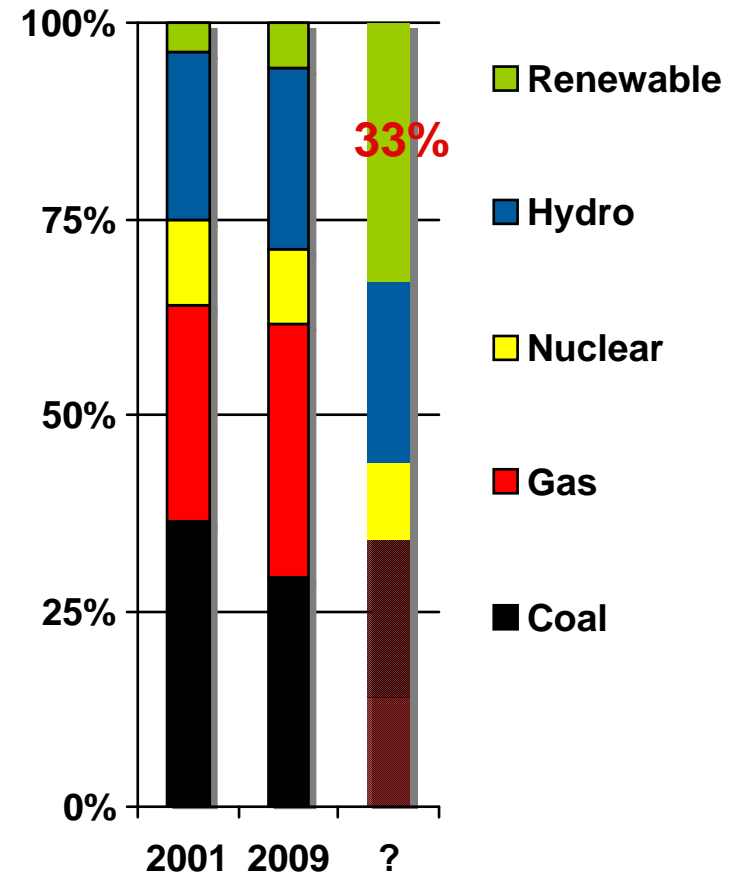
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Utility Energy Forum

Tahoe City, CA
May 5, 2010

How the West generates power

- In 2001, coal was the predominant source (35%)
 - Above 90% in CO, UT, WY
 - Transfers to West Coast were primarily coal base load
- Today coal is less, wind and natural gas are more
- Long-term planning includes renewable energy scenarios of up to 33% for the Western Interconnection as a whole

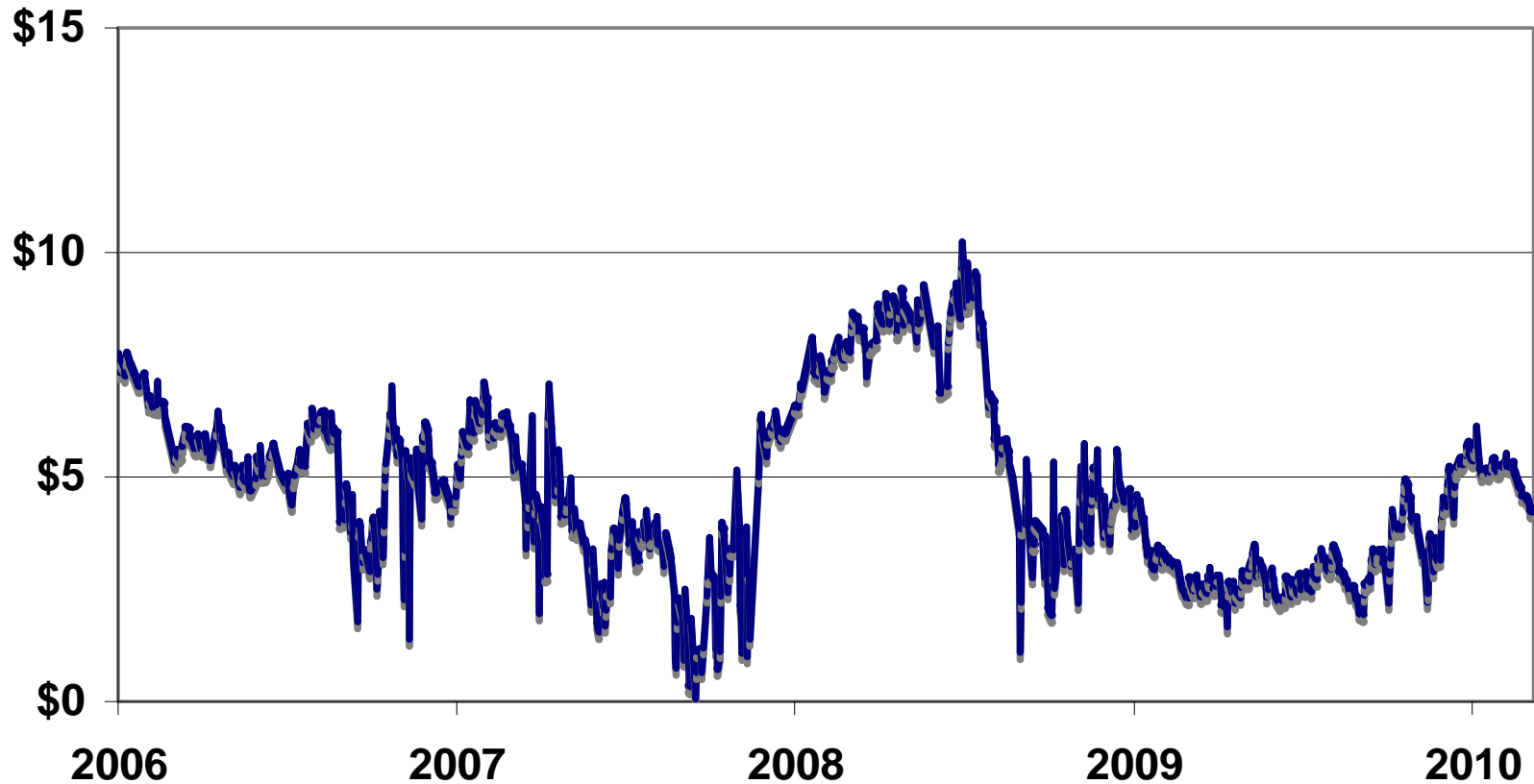


Path of future cost is uncertain

- What will be the price of carbon?
 - Coal has twice the carbon emissions of natural gas, so the price effect on coal will be double
 - Moderate carbon price alone will not cause an economic shift in the fuel mix
- Where will natural gas prices go?
- Where will the cost of renewable alternatives be?
 - Today, levelized \$/MWh for a well-sited wind farm is equivalent to that of a new combined cycle gas turbine with natural gas at \$7/mmBtu
 - Well-sited solar thermal in AZ is equivalent to a peaker with natural gas at \$10/mmBtu

Path of future cost is uncertain

CIG - Rocky Mountain Spot Natural Gas Index



Path of future cost is uncertain

- How will the western grid be managed?
 - Currently managed within many small areas
 - Small areas make variable resources such as wind and solar harder and more expensive to manage

QuickTime™ and a decompressor are needed to see this picture.

What's being done?

- Western Governors' Association
 - Western Renewable Energy Zone Initiative
- Western Electricity Coordinating Council
 - Modeling long-term renewable energy penetration scenarios to evaluate reliability issues and solutions
 - Sub-regional planning groups identifying preferred transmission options
- US Department of Energy and national labs
 - In addition to on-going research and analytical support, providing \$26.5 million in ARRA funding to WGA and WECC for interconnection-wide transmission planning
 - Western Wind and Solar Integration Study

Wind and Solar Integration Study

- Modeled renewable energy expansion of up to 35% (30% wind, 5% solar), using three scenarios
 - In-state renewables for in-state demand
 - “Mega-project” transmission overlay
 - Hybrid: local priority, some new transmission
- Objective was to look at variability and effect on reliability and reserve requirements
- Geographic focus was on WestConnect footprint
 - NV, AZ, NM, CO, WY
 - Modeled remainder of WECC as a single out-of-footprint resource area

Study findings

- 35% is achievable, but —
 - not without more transmission
 - not without more balancing area coordination
- Forecasting reduces integration costs significantly
- Subhourly scheduling is critical
- 35% does not justify additional storage
 - Arbitrage value (generate off-peak, dispatch on-peak) would not offset cost of new storage
- Among the in-state, mega-project and local priority scenarios,
 - little operational difference
 - Mega-project scenario required 25% less wind capacity than did the in-state scenario

Western Renewable Energy Zones

- ✓ *Phase 1: Identify renewable energy zones (REZs), estimate quantity of REZ resources, estimate busbar cost of REZ resources*
- ✓ *Phase 2: Develop 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 utilities in coordinating renewable energy procurement plans and new transmission needs
- Phase 4: Institution-building

Western Renewable Energy Zones

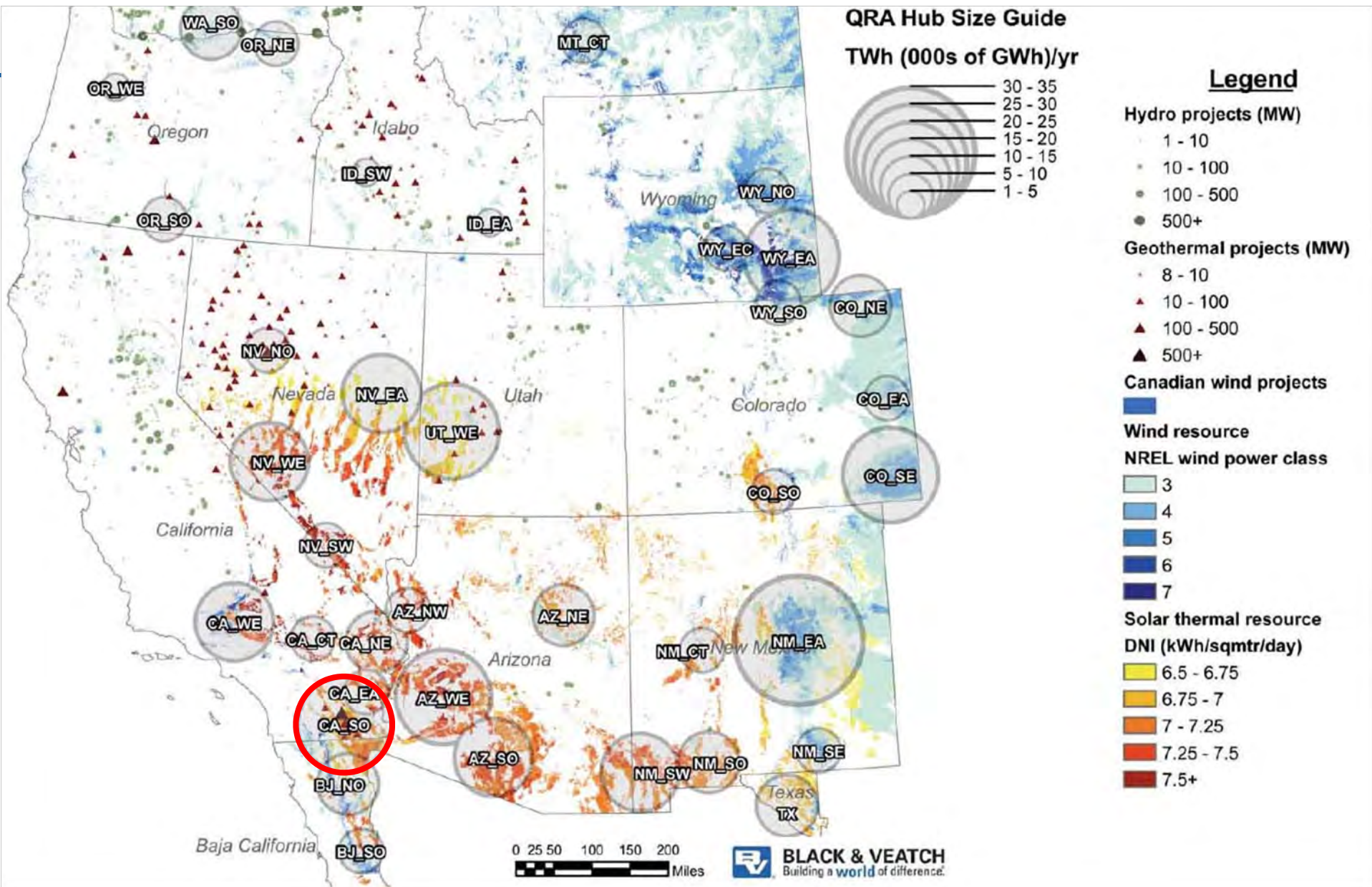
- REZ resources
 - Connected to load via large regional transmission lines crossing several states
 - Multijurisdictional, in that the entire transmission project would require approvals in more than one state
- Non-REZ resources
 - Economical for serving in-state demand
 - Not necessarily in a REZ

Qualifying resources

1. Select wind class threshold, eliminate resources below threshold
2. Identify exclusion areas
 - Technical (land slope is too steep)
 - Existing land use (urban centers, airports)
 - Policy (parks, preservation areas, cultural sites)
3. Apply exclusion filter

Renewable Energy Zones

- A REZ is an area with renewable resources of sufficient quality and sufficient concentration to warrant consideration of interstate transmission
- A REZ **hub** represents a hypothetical transmission substation where the zone's resources are collected
- Estimates of available resources take into account land limitations (environmental, technical) to the extent known
- Discounts applied to remaining screened potential
 - Wind capacity reduced to 25%
 - Solar capacity reduced to 3.5%



Regional transmission scenarios

- Zone hubs and their supply curves went into a conceptual delivered cost model
 - Excel-based
 - Populated with busbar costs from Phase 1, but may be customized to capture user-defined projects or scenarios
 - Delivered costs estimated on the basis of user-selected load hub and user-selected REZ hub
 - Available to load-serving entities and regulators to test scenarios

Next steps

- Engage load-serving entities, transmission planners and regulators in analysis of high-interest renewable energy zones
- Identify institutional barriers to regional planning for transmission to renewable energy zones

Questions?

