

Western Renewable Energy Zones



Composite photo created by NREL

**Meeting Transmission
Challenges in the Rocky
Mountain Region**

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Presentation Outline

- WREZ Vision;
- Chronology;
- WREZ Initiative Overview;
- Generation and Transmission Model;
- Lessons Learned;
- Future Activities.

WREZ Vision

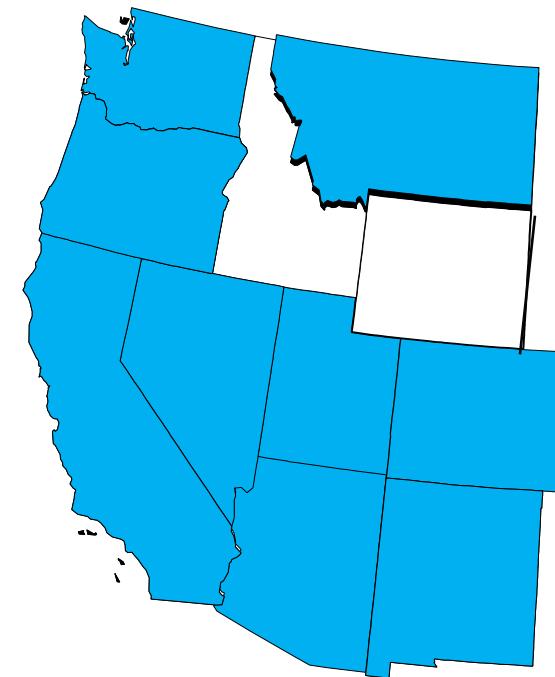
- Western Governors' Association and U.S. Department of Energy initiated effort to develop renewable energy resources and reduce GHG emissions.
- Develop a high level “screening tool” to identify potential projects that allows industry stakeholders to analyze and compare economics of multiple projects.
- Find the high quality, developable renewable resource zones (based on NREL data).
- Assume incremental transmission expansion to bring generation to load.
- Identify the areas where there are impediments.

WREZ: Why was it developed?

- **U. S. Utilities Must Install More Renewable Energy Generation**

Nine western states have adopted targets for the percent of all electricity generation that must come from renewable energy:

- | | | |
|----|------------|-------------|
| 1. | Arizona | 15% by 2025 |
| 2. | California | 33% by 2020 |
| 3. | Colorado | 30% by 2020 |
| 4. | Montana | 15% by 2015 |
| 5. | Nevada | 20% by 2015 |
| 6. | New Mexico | 20% by 2020 |
| 7. | Oregon | 25% by 2025 |
| 8. | Utah | 20% by 2025 |
| 9. | Washington | 15% by 2020 |



- **Western states work together to develop most economical resources**

*Note: British Columbia is seeking renewables for all new generation.

WREZ Chronology of Events

- 2005-2006 Western Governors' Association Clean and Diversified Energy Initiative;
- 2007 - WREZ Concept Emerges (based largely on TX Competitive Renewable Energy Zones effort);
- 2008 – DOE WREZ Grant to WGA;
- 2009 – Transmission Planning FOA funds;
- 2010 – WREZ findings incorporated into interconnection-wide transmission planning (WECC).

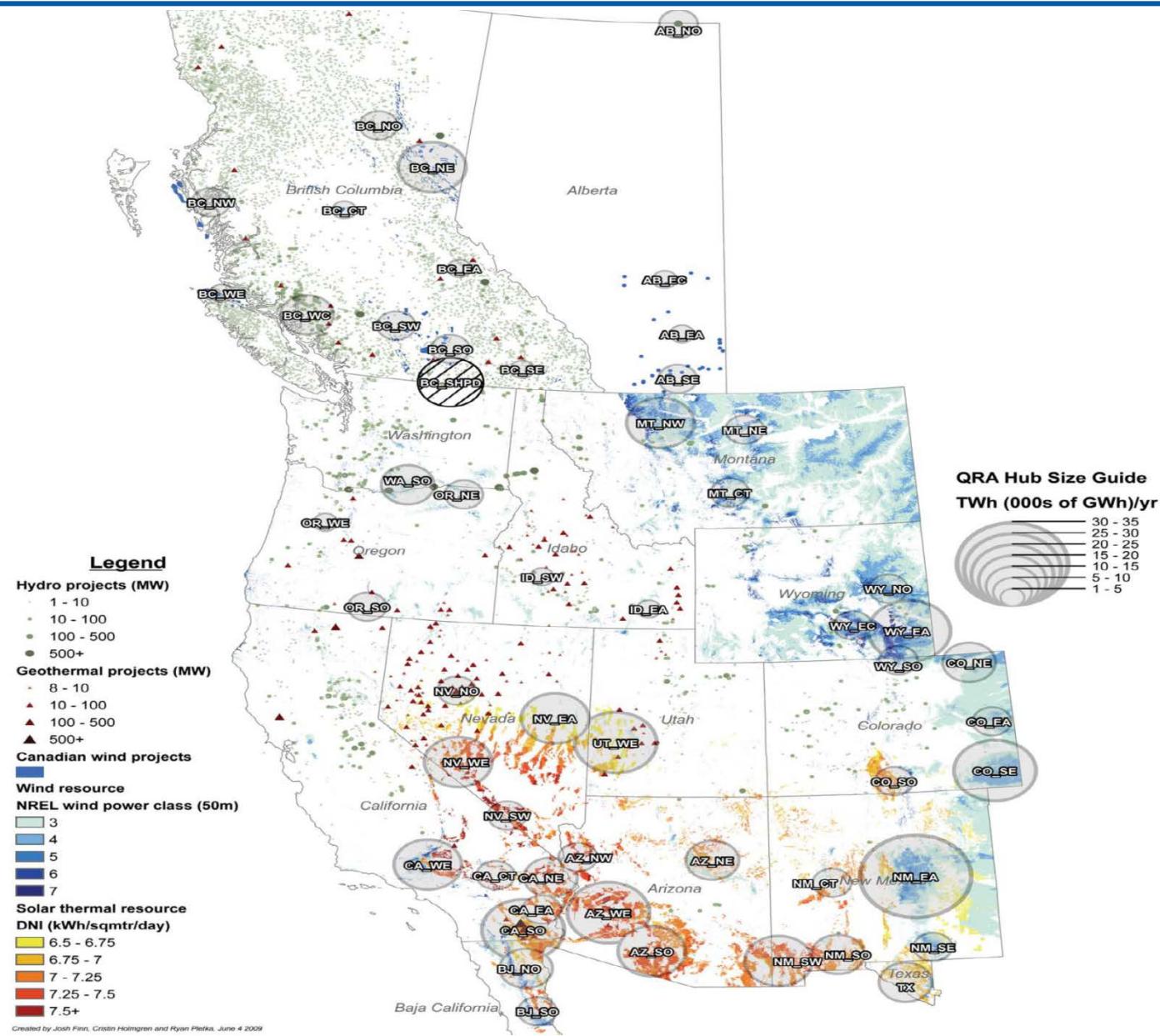
WREZ Four Phases

- **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:** Identify zones of common interest to multiple LSEs (foster regional renewable generation and transmission projects);
- **Phase 4:** Institution-building, address transmission siting and cost allocation issues.

WREZ Phase 1

- Include all states and provinces in the Western Interconnection
- “Filters” applied to eliminate certain land types (national parks, urban areas, etc.)
- Areas identified represented large resources, smaller areas still show potential for smaller local loads.
 - Wind Class Threshold
 - Solar DNI Threshold
- Standard economic assumptions
 - Capital cost of each technology
 - Capacity factor
 - Operation and maintenance costs
- Estimate typical annual production (MWh) - each technology at each quality level.

Western Renewable Energy Zones Initiative (WREZ)



Renewable Energy Zones

- A zone has no real boundary. Grid lines do not limit development. They are for the analytical purpose of estimating resources and deciding how large to build the transmission system.
- A hub is the center of a zone. It represents a transmission substation where the zone's resources are collected and get onto the grid.
- All of the resources in the vicinity of the hub that passed screening are used to estimate the capacity available at the hub.

WREZ Phase 2

- Create Generation and Transmission Model (GTM)
- Calculates cost of delivered energy from 54 zones to 20 load centers in WECC.
- High level “screening tool” that performs a simplified economic analysis for quick project comparison.
- Easy-to-use spreadsheet downloadable from web.
- Anybody can download and use – LSEs, PUCs, Industry Stakeholders – and yes your dog.

Resource Selection

- Build resource portfolio
 - Unlimited resources from 5 Zones or less
 - Resource energy profile exists and can be viewed (as shown)
 - Select zone, then resource

File Edit View Insert Format Tools Data Window Help Adobe PDF

W29 ▾ fx

A B C D E F G H I J K L M N V W X Z

CA_WE ▾
Delivery Node:

California West
8 ANTELOPE

ID	Tech	Capacity Left (MW)	Capacity Factor (%)	Busbar Cost (\$/MWh)	Select
CA_VWE_B_5	Biomass	76	85%	\$132	<input type="checkbox"/>
CA_VWE_S_1	Solar	Thermal Dry Thermal Wet Thermal Stor Dry Thermal Stor Wet Tracking PV Fixed PV	26% 26% 26% 26% 26% 26%	\$171 \$171 \$171 \$171 \$171 \$171	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
		Total Capacity	2019		
CA_VWE_W_1	Wind	68	47%	\$47	<input type="checkbox"/>
CA_VWE_W_2	Wind	437	38%	\$65	<input type="checkbox"/>
CA_VWE_W_3	Wind	1235	31%	\$87	<input type="checkbox"/>
CA_VWE_W_4	Wind	1311	26%	\$110	<input type="checkbox"/>
CA_VWE_W_5	Wind	345	23%	\$128	<input type="checkbox"/>

Details

CA_CT_S_6

Technology: SolarThermal Zone: CA
Capacity: 1,628 MW Price: \$160.71
Capacity Factor: 27%
Annual Generation: 3,888 GWh

1.2
1
0.8
0.6
0.4
0.2
0.0
1 3 5 7 9 11 13 15 17 19 21 23

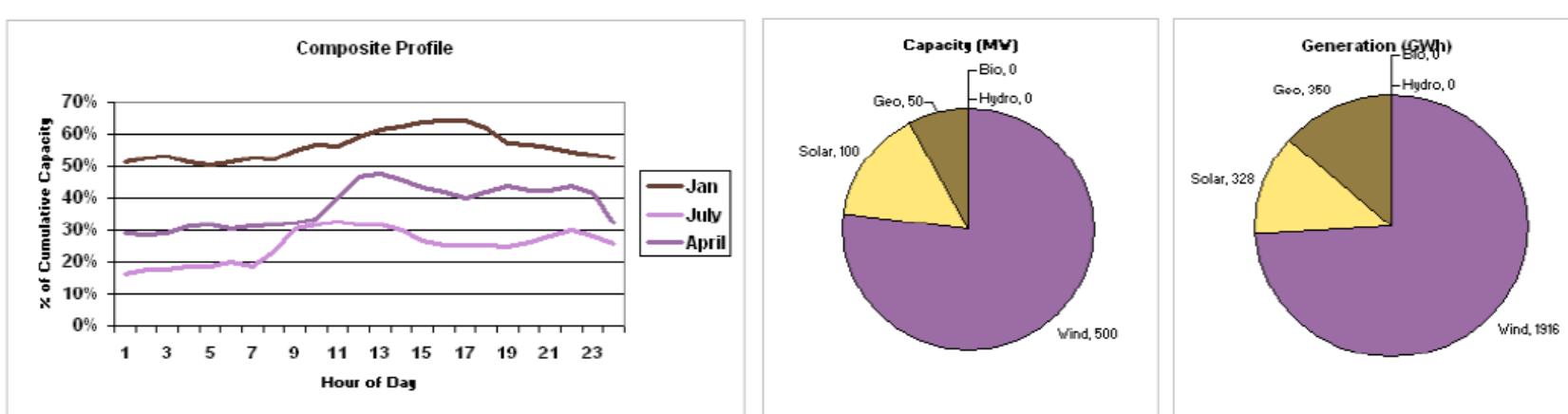
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Okay

Resource Portfolio

- Shows specifics of resource portfolio.
- Graphic representation of energy profile, capacity, and annual energy.
- Specific resources can be removed from portfolio (enter 0 for Cap (MW)).

Resource Portfolio

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My Resources

[Clear](#)

Project ID	State	Node	Technology	Cap (MW)	Cap Factor	Cost (\$/kW)	Debt Term (yrs)	Econ Life (yrs)	Tax life (yrs)	% Depr	FOM (\$/kw-yr)	VOM (\$/Mwh)	PTC (%)	PTC Term (yrs)	ITC (%)	Fuel (\$/MMB TU)	Rate (BTU/kWh)	Disc Rate (%)	Debt %	Debt Rate (%)	Tax Rate (%)	Cost Equity (%)	Busbar Cost (\$/MWh)	GWh
WY_EA_W_2	WY	70	Wind	500	44%	\$2,400	15	20	5	100%	\$60	\$0	21	10	0%	\$0	0	11%	60%	8%	40%	15%	\$62	1916
NV_NO_G_3	NV	13	Geothermal	50	80%	\$4,648	15	20	5	100%	\$0	\$35	21	10	0%	\$0	0	11%	60%	8%	40%	15%	\$90	350
NV_WE_S_6	NV	12	SolarThermal	100	37%	\$7,575	15	20	5	85%	\$66	\$0	0	0	30%	\$0	0	11%	60%	8%	40%	15%	\$163	328

Identify Incremental Transmission Path(s): REZ(s) to Load

- Select Point-to-Point or Multi-Area Transmission Path(s).
- User may define the route for each resource(s)

User defined Route: Select "Click" on Segments

Point-to-Point

Multiple-Area

Select Resource(s)

Save Route

Transmission Route

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Transmission System Nodes/Substations

Number	Name
Load Area Node:	83 SERRANO
Resource Node:	7 PISGAH
Resource Node:	5 BLYTHE
Resource Node:	6 MOUNTAIN
Resource Node:	32 STERLING
Resource Node:	31 NEW SUB 31

Point to Point Routing Solution
This tool will select the shortest route through the grid from the load area node to each resource node independently.

ProP

Multi - Point Routing Solution
This tool will attempt to find a shorter route by considering routes that better serve combinations of resource nodes.

Multi

User Defined Routing Solution
Use these tools to edit the routing solution.

1) Examine the route between the load area node to each resource node by itself. Display the one you wish to edit.

Resource Node 1: PISGAH
 Resource Node 2: BLYTHE
 Resource Node 3: MOUNTAIN
 Resource Node 4: STERLING
 Resource Node 5: NEW SUB 31
 All Resource Nodes

2) Modify the route by clicking on the line segments to toggle them on and off. This will only work if you have selected an individual resource node above.

3) When you have modified the route to an individual resource node, save it and the total routing solution will be modified.

Restore Default Calcs

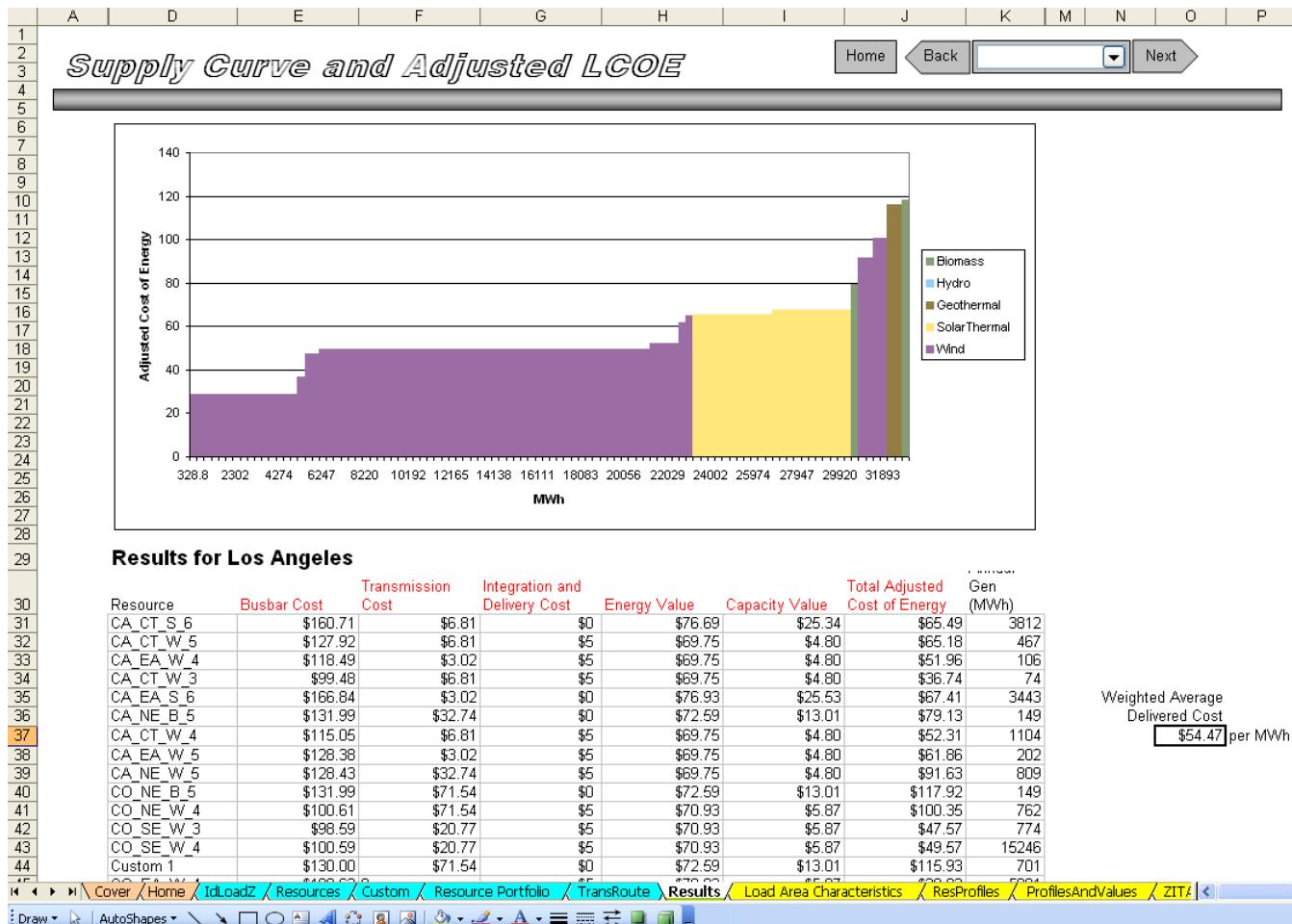
Save Change

2270.76

National Renewable Energy Laboratory

Project Results – Generation Resource & Transmission

- Supply curve shows leveledized cost of electricity to load from portfolio (\$/MWh):
 - Detailed resource cost;
 - Detailed transmission cost.



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.

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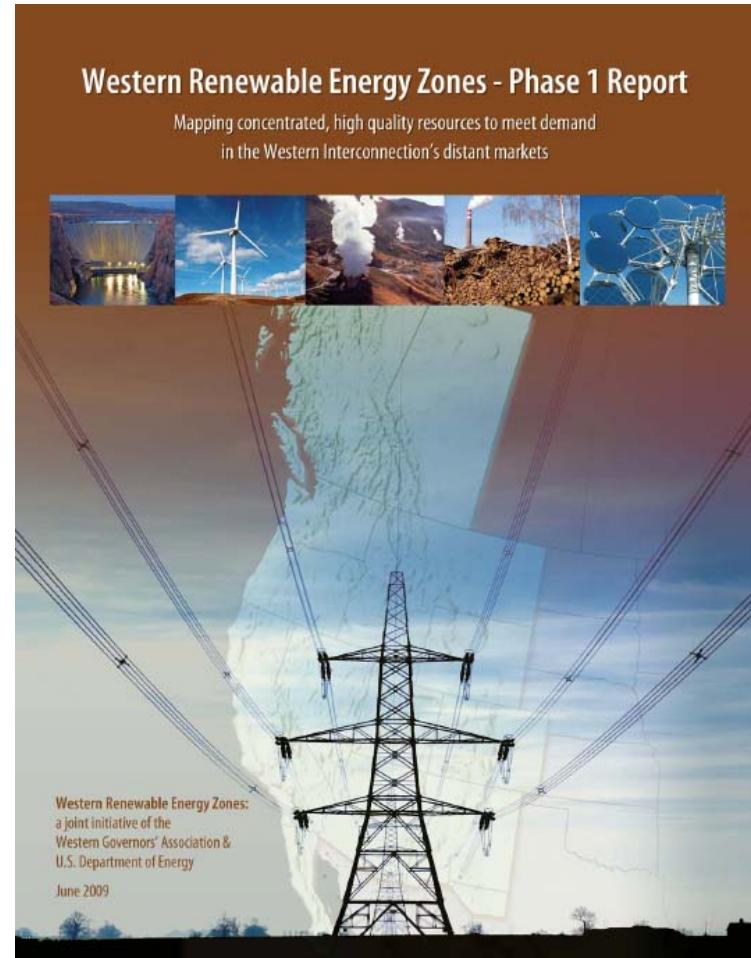
- WREZ on the Western Governors' web site:

[http://www.westgov.org/wga/
initiatives/wrez/](http://www.westgov.org/wga/initiatives/wrez/)

- GIS portal for WREZ maintained by NREL:

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

- Login “wrez”
- Password “guest”



WREZ Phases 1 & 2 Lessons Learned / Impediments

- Transmission is the biggest obstacle to installing large amounts of new renewable energy generation.
- Wildlife sensitivity analysis did not get developed adequately, and is an impediment. Accordingly, this issue is not in the Phase 1 report.
- Wildlife issues can overwhelm renewable energy potential.
- The WREZ took on significant importance to developers and others.
- In the end, the policies of the individual states can drive project outcomes.

WREZ Phase 3 – Identify Zones of Common Interest

- Multiple LSEs may benefit from the same regional transmission and REZ(s) project.
- LSE and PUC interviews are completed:
 - Regulatory Assistance Project;
 - NREL/LBNL.
- Initial finding – local resources sufficient to meet RPS requirements.
- Funding under FOA 68, Area of Interest 2, 2010.

WREZ Phase 4 – Fostering Interstate Cooperation

- Develop environment for regional interstate transmission and REZ(s) projects.
- Address policy and regulatory obstacles to interstate transmission projects, such as:
 - Siting
 - Federal lands, protected lands, sensitive lands, etc.
 - Cost allocation
 - Energy recipient(s)
 - Reliability beneficiary(s)

WREZ General Lessons Learned:

- Most LSEs and states prefer to use in-state/local renewable resources due to transmission timing and state economic benefits.
- States with energy export potential want to see G&T projects developed in order to bring the resource to market.
- Disturbed lands with valuable renewable resources should be a priority.
- Renewable resources will increase if:
 - They are economical or required:
 - Greenhouse gas emissions;
 - Renewable portfolio standards;
 - Price signals;
 - Technology breakthrough.

WREZ Continuing Efforts:

- Update wildlife and water issues into the generation data.
- Improve the WREZ model:
 - Improved GTM functionality;
 - Improved annotation;
 - Updated/Improved data (e.g., replacing 50-m wind data w/ 80 m).
- Improved DG integration.
- Outreach to LSEs and states.

WREZ Additional Information:

- Data, Presentations, and Reports
 - Website at:
<http://www.westgov.org/wga/initiatives/wrez/index.htm>
- Questions?
 - Email: jeff.hein@nrel.gov
 - 303-384-7090

Questions / Comments

