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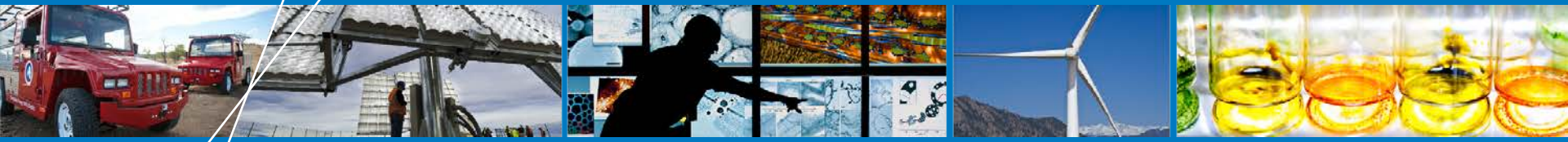
Overview of Western Renewable Energy Markets and Transmission Planning



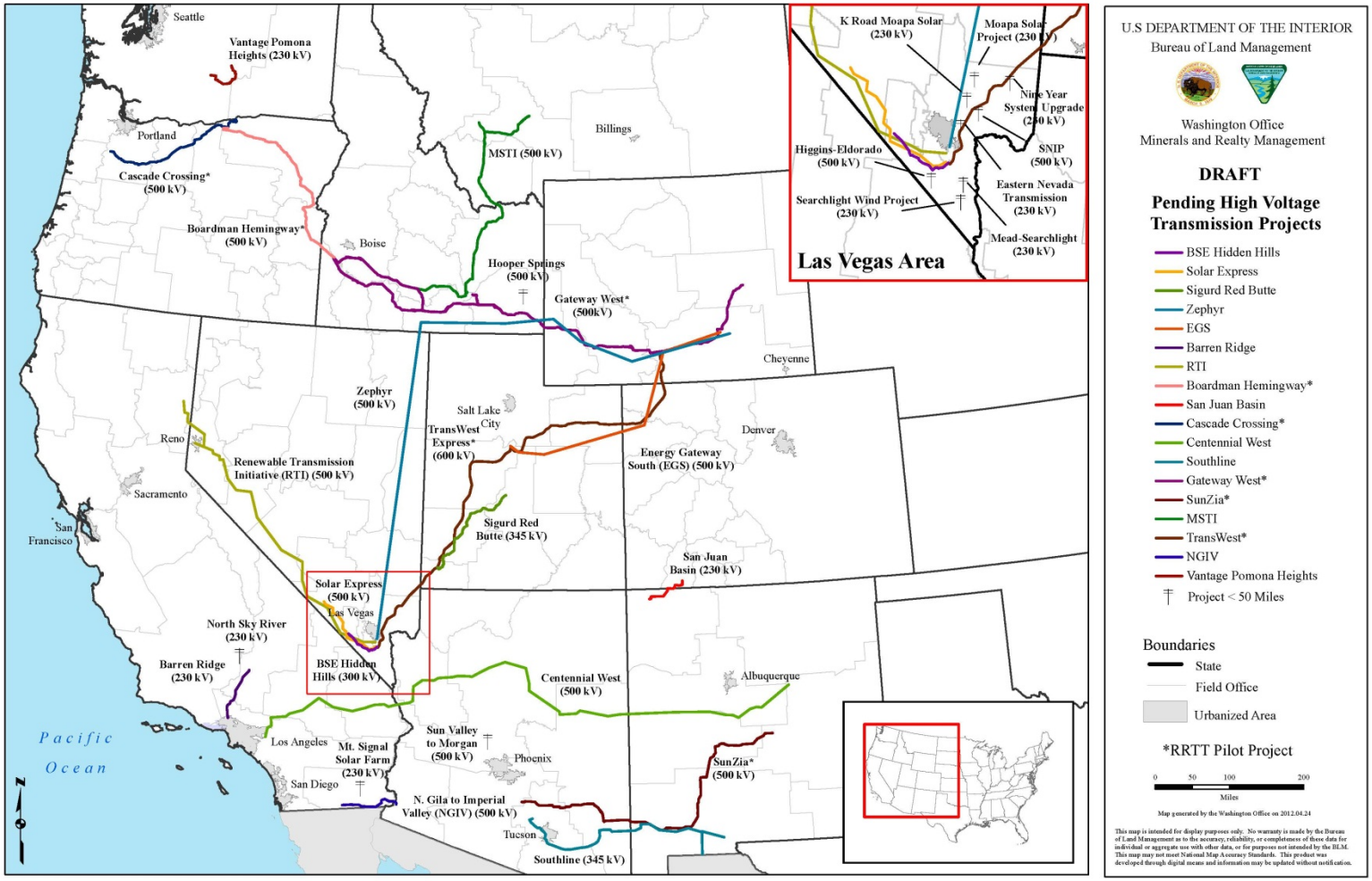
Scott Haase
David Hurlbut

BLM Transmission Training Webinar Series

Webinar 1

October 23, 2012

MAP Pending High Voltage Tlines



Webinar 1 Objectives

- Provide an overview of renewable energy markets and development activities within the western United States (2010-2020 timeframe)
- Understand the transmission planning process in the western U.S.: key players, policies, regulations and drivers
- Within the context of these drivers, understand the current and future potential of BLM's renewable energy and transmission projects

Presenters

- **Scott Haase, Senior Engineer/DOI Liaison**
- **David Hurlbut, Ph.D., Senior Economist**

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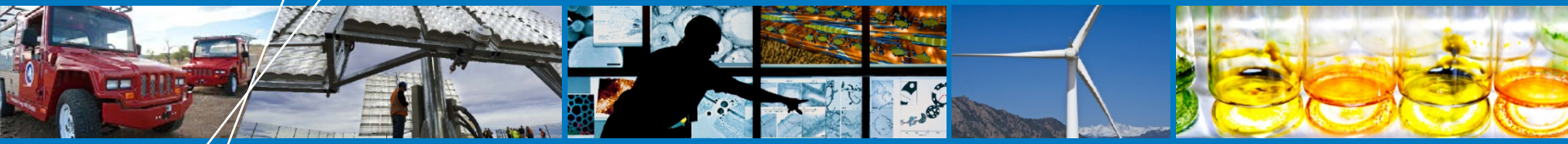
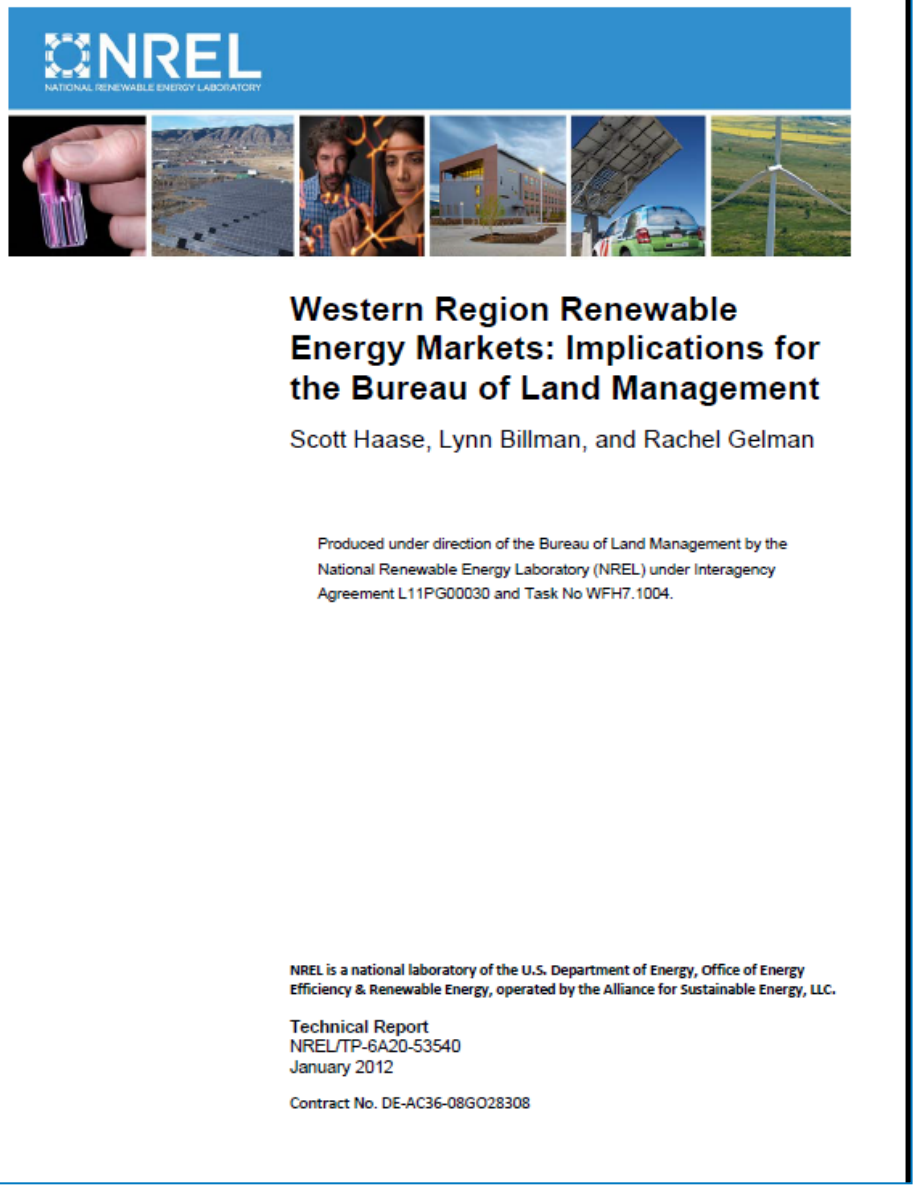


Section 1:
Renewable Energy Markets and Drivers: 2020 Crystal Ball

General Background of BLM Drivers

- **Energy Policy Act of 2005 established BLM goal to permit 10,000 MW of renewable energy on public lands by 2015**
- **Secretary Salazar has elevated the priority of renewable energy and transmission planning within DOI**
- **BLM has instituted activities to help meet these objectives:**
  - Renewable Energy Coordination Offices, Solar PEIS, high priority projects
  - Interagency coordination and weekly strike team meetings
  - Rapid Response Transmission Team
- **State based actions**
  - California: Renewable Energy Action Team; Desert Renewable Energy Conservation Plan
  - Arizona: Restoration Design Project
- **Fundamental question: How do all of these BLM activities fit within the broader context of energy markets and transmission planning efforts in the western U.S., and how can we optimize the value of the BLM assets?**



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Western Region Renewable Energy Markets: Implications for the Bureau of Land Management

Scott Haase, Lynn Billman, and Rachel Gelman

Produced under direction of the Bureau of Land Management by the National Renewable Energy Laboratory (NREL) under Interagency Agreement L11PG00030 and Task No WFH7.1004.

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Technical Report
NREL/TP-6A20-53540
January 2012

Contract No. DE-AC36-08GO28308

http://www.nrel.gov/docs/fy12osti/53540.pdf

Study Overview

- **Develop current electricity supply and demand profiles for 11 western states in the territory of the Western Electricity Coordinating Council (WECC)***
- **Estimate 2020 demand for renewable energy**
  - based only on existing renewable portfolio standards (RPS)
  - estimate 2020 projected load
- **Estimate new renewable generation under construction or advanced development in WECC**
- **Evaluate balance between planned supply and projected demand**
- **Assist BLM with understanding how its projects fit within this broader market context**

* Throughout this document, "WECC" refers to only the 11 U.S. states in WECC, not British Columbia or Mexico

Caveats

- **Data herein represent a snapshot in time from the summer and fall of 2011**
  - Estimate of current and expected future development
- **Gathering the data is difficult – no central repository**
- **Renewable demand forecasts based on current RPS requirements:**
  - Some would like to expand these
  - Some would like to roll back RPS (e.g. NM HB 546)
- **Utilities scaling back future load expectations due to poor economy, which impacts 2020 RPS needs**
  - (e.g. Xcel Energy PUC filing on 10/31/11 stating it only needs 292 MW of new generation by 2018, not 1,000)
- **As cost of renewable energy decreases, utilities may go beyond RPS limits**
- **Low natural gas prices are impacting renewable development**

BLM Projects
Overview

BLM Project Sites
Nameplate Capacity (MW)

Proposed	Priority	
		Unknown
		0 - 500
		500 - 800
		800 - 1,500
		1,500 - 2,000

WREZ Size (TWh)

> 20
15 - 20
10 - 15
5 - 10
< 5

SEZ Size (TWh)

> 20
15 - 20
10 - 15
5 - 10
< 5

Transmission Lines

DC Line
AC Line

WECC		BLM	
Foundational		Authorized	
	<= 345 kV		<= 345 kV
	> 345 kV		> 345 kV
Proposed		Pending	
	<= 345 kV		<= 345 kV
	> 345 kV		> 345 kV
Existing		Pilot Lines	
	<= 345 kV		<= 345 kV
	> 345 kV		> 345 kV

Data Source: Homeland Security Infrastructure Database (HSIP) 2011; Bureau of Land Management. This map was produced by the National Renewable Energy Laboratory for the U.S. Department of Energy by Dylan Hettinger, November 2011.

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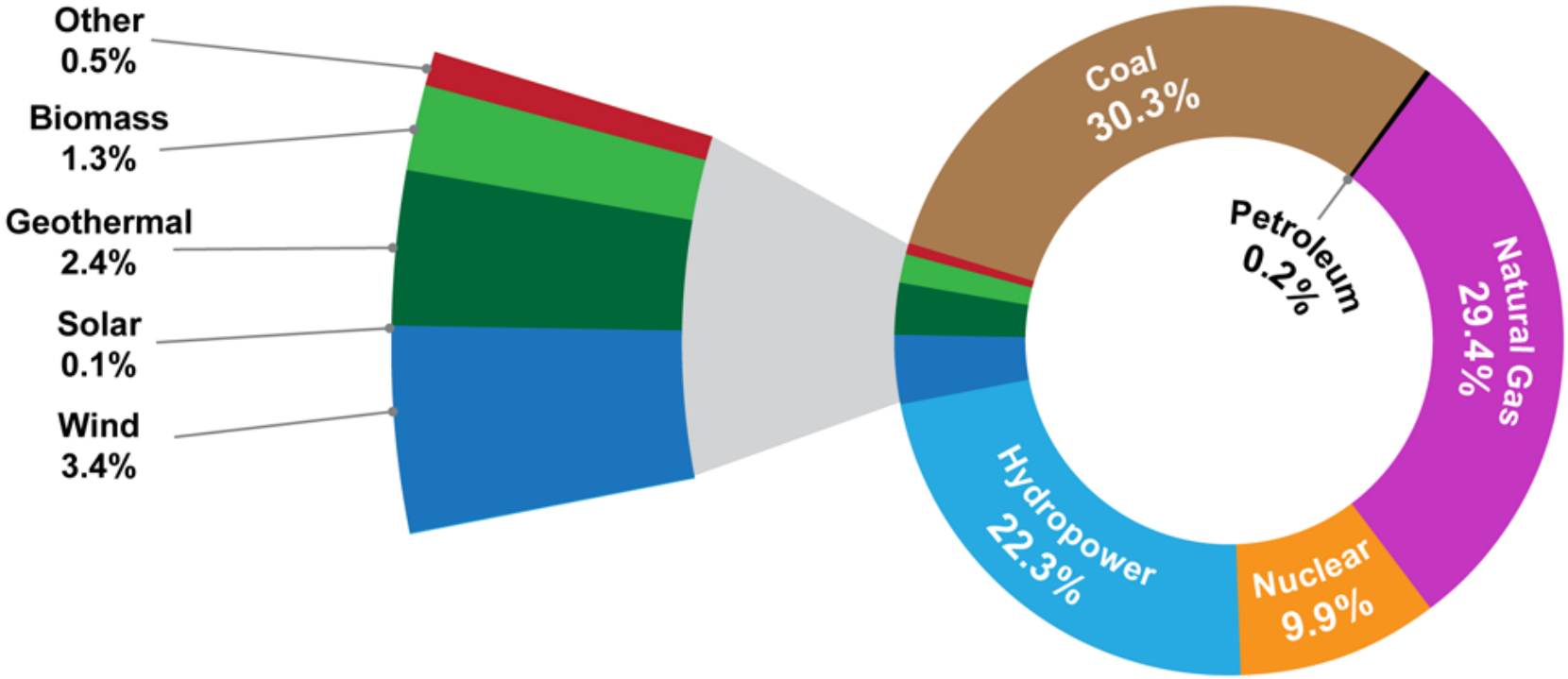
Nicola - Meridian
BC-US Intertie
East HVDC
I-5 Corridor
Big Eddy - Knight
Little Goose Area Reinforcement
West McNary
Cascade Crossing
Hemingway - Boardman
Chinook
Gateway West Phase 1
Gateway Central Phase 1
Zephyr
Transwest-Express
Gateway South Phase 1
Pawnee - Smoky Hill
SWIP South
TCP Northwest - Amargosa
Gateway South Phase 1
Waterton - Midway
Lamar Front Range
Tehachapi Upgrade
TCP Harry Allen Northwest
San Luis Valley
Blythe - Devers
PV - Blythe
PV - Morgan
Sunrise
Southeast Valley (SEV)
PV - NG
Pinal Central - Tortolita
SunZia

Project Applications on BLM Land (MW, as of November 2011)

	Arizona	California	Colorado	Idaho	Montana	Nevada	New Mexico	Oregon	Utah	Washington	Wyoming	Total
Geothermal Approved (MW)	–	150	–	–	–	128	–	–	–	–	–	**278**
Solar Authorized (MW)	–	3,588	–	–	–	654	–	–	–	–	–	**4,242**
Wind Authorized (MW)	30	296	–	139	–	150	–	–	80	–	21	**716**
Total Approved or Authorized (MW)	30	4,034	–	139	–	932	–	–	80	–	21	**5,236**
Geothermal Pending (MW)	–	298	–	13	–	584	15	23	37	–	–	**970**
Solar Pending (MW)	18,308	11,618	–	–	–	16,437	2,200	–	–	–	–	**48,563**
Wind Pending (MW)	500	2,272	–	465	–	1,780	–	604	593	90	2,073	**8,377**
Total Pending (MW)	18,808	14,188	–	478	–	18,801	2,215	627	630	90	2,073	**57,910**
Total Approved and Pending (MW)	**18,838**	**18,222**	–	**617**	–	**19,733**	**2,215**	**627**	**710**	**90**	**2,094**	**63,146**

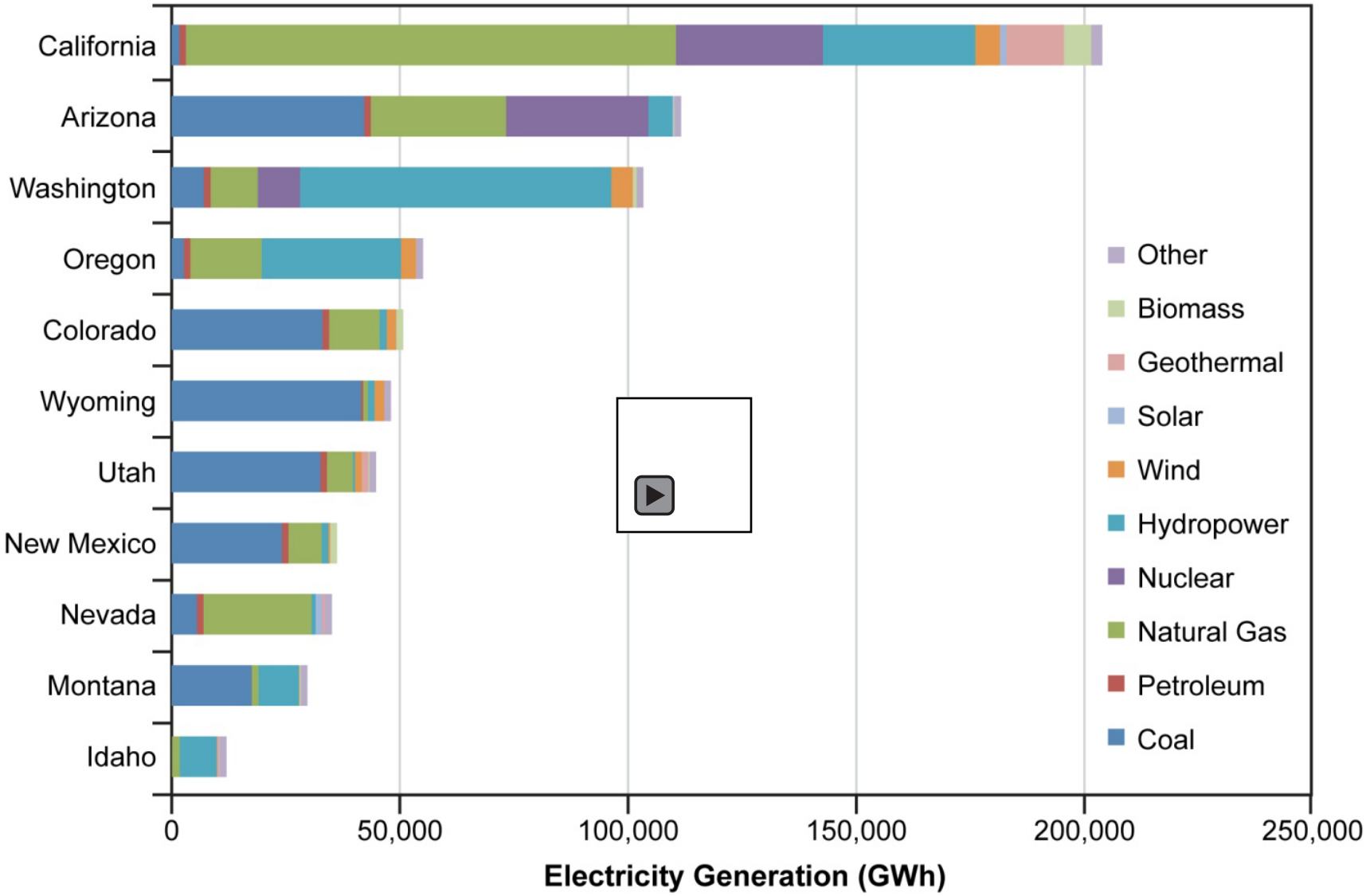
WECC Generation Mix (2010)

Total WECC generation: 731,000 GWh (18% of US)



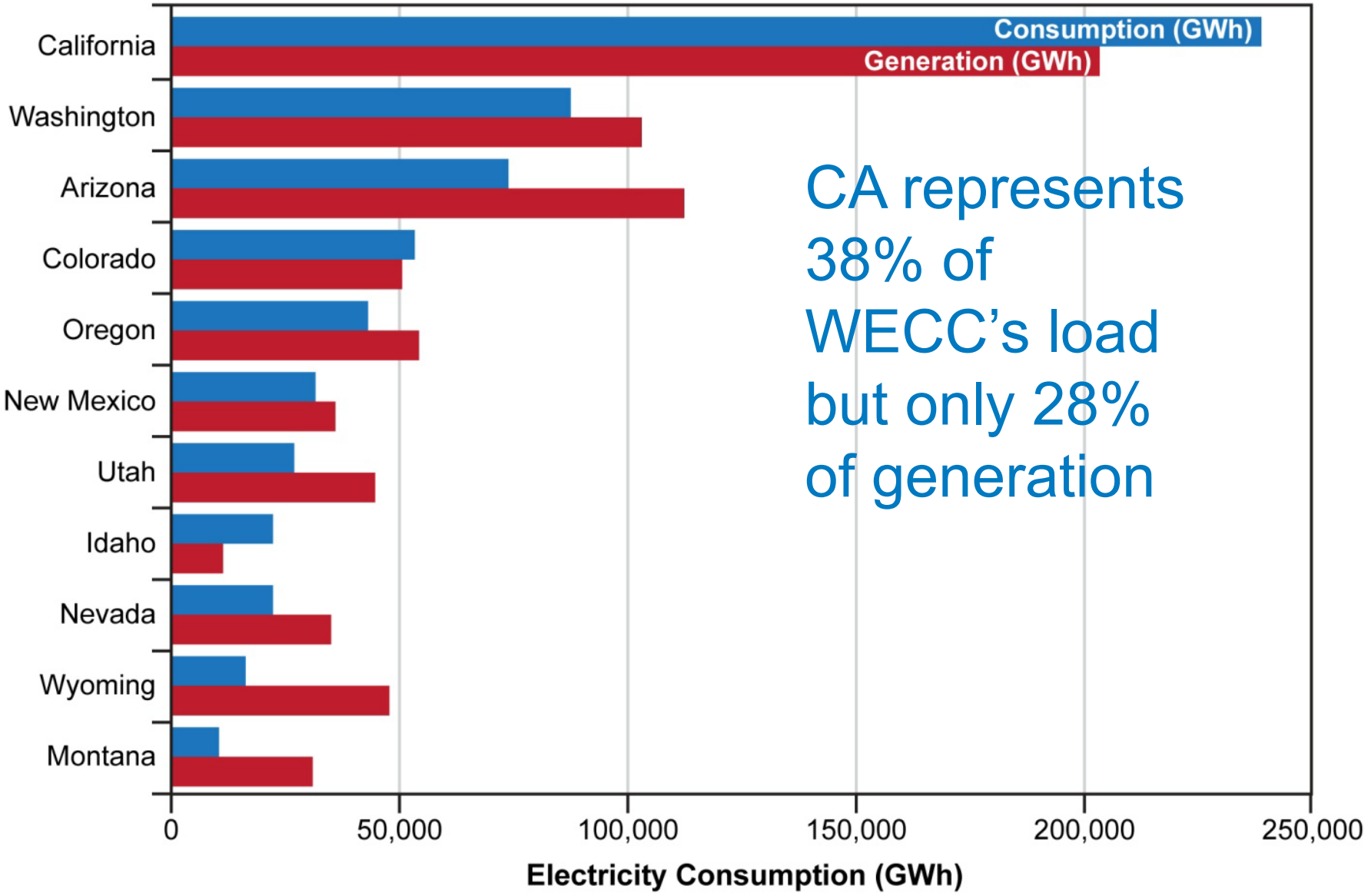
- 7.7% non-hydro renewable (~ 54,000 GWh)
- 30% renewable w/hydro
- 60% coal and gas
- 40% CO_2 neutral or zero (nuclear, hydro, RE)

2010 Generation Mix, by State (GWh)



Source US DOE, EIA: http://www.eia.doe.gov/cneaf/electricity/page/eia906_920.html

WECC 2010 Electricity Consumption and Generation, by State (GWh/yr)



CA represents 38% of WECC's load but only 28% of generation

Summary of Western Renewable Portfolio Standards

			Capacity Factor for Non-specified RE Generation[1]	Arizona	California	Colorado	Idaho	Montana	Nevada	New Mexico	Oregon	Utah	Washington	Wyoming	Total WECC
				10%	33%	30% IOU Total, 3% IOU DG,10% POU	No RPS	15%	22%	20% IOU, 10% Co-Op	20% large utilities, 5% small utilities	No RPS	15%	No RPS	
Total RPS Qualifying Generation Needed in 2020 (GWh) (Barbose 2011)				4,882	89,259	12,227	n/a	1,508	7,464	3,814	7,610	n/a	7,607	n/a	**134,372**
Utility Scale and Non Set Aside Capacity Required in 2020 to Meet RPS	A	High Capacity Factor, Low Capacity (MW)	**53%**	735	18,653	2,741		325	783	446	1,713		1,807		**27,205**
	B	LBNL Capacity Factors (Barbose 2011) (MW)	**Various**	771	27,944	2,741		382	783	473	1,791				**34,886**
	C	Low Capacity Factor, High Capacity (MW)	**26%**	1,499	31,354	2,741		662	783	909	3,059		3,238		**44,247**
Distributed Generation and Set Aside Capacity in 2020 (MW) (Barbase 2011)				644					112	512	20				**1,288**
Total Capacity Required in 2020 to Meet RPS	A	High Capacity Factor, Low Capacity (MW)	**53%**	1,380	18,653	2,741		325	896	958	1,733		1,807		**28,493**
	B	LBNL Capacity Factors (Barbose 2011) (MW)	**Various**	1,415	27,944	2,741		382	896	985	1,811		2,952		**39,126**
	C	Low Capacity Factor, High Capacity (MW)	**26%**	2,144	31,354	2,741		662	896	1,421	3,079		3,238		**45,535**

- **The biggest driver for RE in the U.S. remains state based renewable portfolio standards, which typically require that a certain % of the energy used to meet demand in the state comes from renewable sources.**
- **Of the 11 states in the western U.S. only ID, UT and WY do not have an RPS**
- **There are other drivers but these will have less of an influence moving forward – tax credits for wind expiring this year; Cash in lieu of tax credit (1603) has ended; loan guarantee program has challenges**
- **No significant national legislation is expected (e.g. climate bill, national RPS,)**

AB 32 requires 80% reduction in GHG emissions over 1990 levels by 2050

CEC estimates approx 40,000 MW needed by 2040 to be on track to meet this law

2010 Progress Towards Meeting State RPS Requirements (GWh)

2010 Actual RE Generation (GWh) (Plants Located within the State)	Arizona	California	Colorado	Idaho	Montana	Nevada	New Mexico	Oregon	Utah	Washington	Wyoming	Total WECC
2010 RPS Requirement (GWh)	1,016	41,902	1,700	(a)	692	3,381	852	(a)	(a)	(a)	(a)	**49,544**
Total (Excluding Hydropower[1])	319	25,450	3,555	1,014	1,027	2,287	1,855	4,757	3,369	6,617	3,247	**53,496**
Biomass	168	6,002	60	501	97	0	14	837	56	1,872	0	**9,608**
Geothermal	0	12,600	0	72	0	2,070	0	0	2,865	0	0	**17,607**
Solar	16	769	42	0	0	217	9	0	0	0	0	**1,053**
Wind	135	6,079	3,452	441	930	0	1,832	3,920	448	4,745	3,247	**25,228**
Hydro	6,622	33,431	1,578	9,154	9,415	2,157	217	30,542	696	68,288	1,024	**163,125**

- **(a) – Oregon RPS started in 2011 and Washington in 2012; ID, UT, WY do not have RPS**

WECC 2010 Installed Renewable Capacity (MW)

	Arizona	California	Colorado	Idaho	Montana	Nevada	New Mexico	Oregon	Utah	Washington	Wyoming	**Total WECC**	**Percent**
Wind (MW)	128	3,124	1,297	288	385	0	701	2,204	222	2,086	1,418	**11,854**	**64%**
Biomass (MW)	40	1,200	21	136	19	0	7	346	12	461	0	**2,241**	**12%**
Solar – PV (MW)	23	175	54	0	0	77	30	8	0	1	0	**368**	**2%**
Solar – CSP (MW)	3	413	0	0	0	76	0	0	0	0	0	**491**	**3%**
Geothermal (MW)	0	2,968	0	18	0	437	0	0	52	0	0	**3,475**	**19%**
Total Renewable Energy (Excluding Hydropower) (MW)	**194**	**7,880**	**1,372**	**441**	**404**	**589**	**738**	**2,558**	**287**	**2,547**	**1,419**	**18,429**	**100%**

- PV: does not include off-grid or customer sited (net-metered) systems
- California has 43% of the generation, more than three times next closest states (WA, OR)

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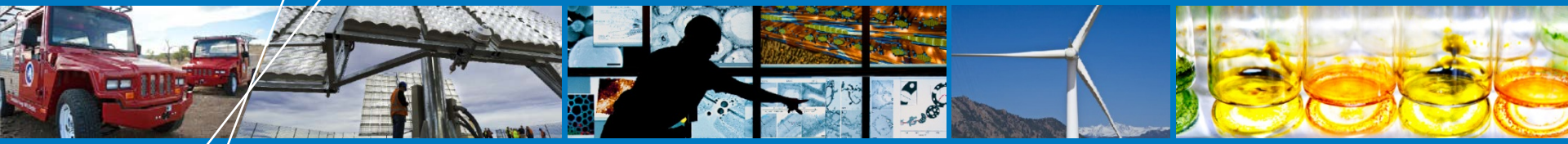
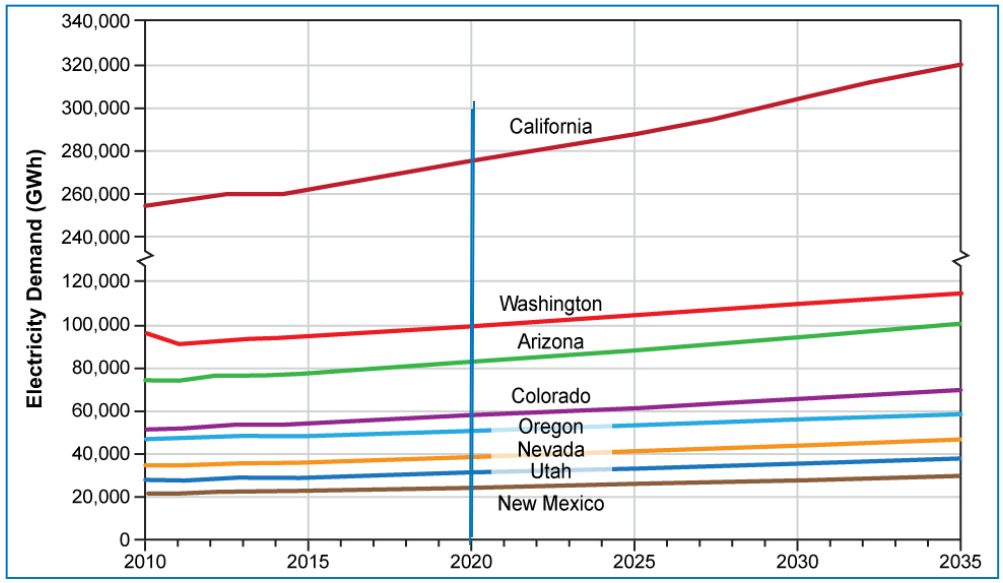


The Crystal Ball:

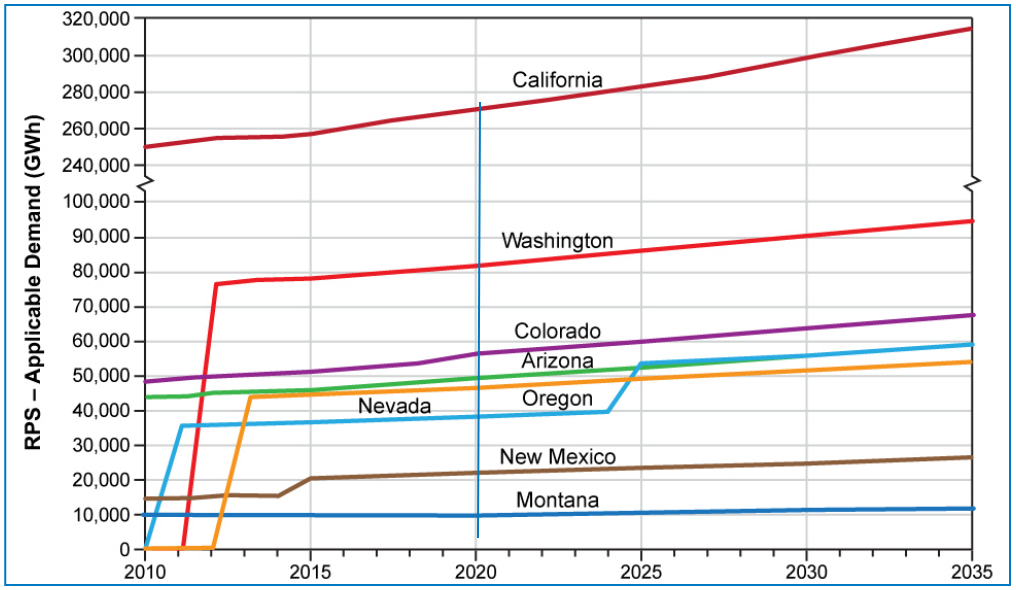
2020 Projections for Load and RPS-Driven Demand (GWh)

2010 - 2035 Projected Load and RPS Eligible Load (GWh)



Projected Load Growth

RPS Eligible Load



Source: Galen Barbose, LBNL. 2011

Projects Under Construction or Advanced Development in the WECC Region (MW)

	Arizona	California	Colorado	Idaho	Montana	Nevada	New Mexico	Oregon	Utah	Washington	Wyoming	**Total**
Wind (MW)	229	2,842	29	472	300	152	125	655	0	1,160	2,841	**8,805**
Biomass (MW)	0	98	0	9	0	14	0	20	0	0	0	**141**
Solar (MW)	703	6,659	62	20	0	1,053	5	14	0	75	0	**8,590**
Geothermal (MW)	113	769	0	63	0	155	0	174	0	10	0	**1,283**
Hydro (MW)	0	1,756	0	0	1	0	0	2,013	0	58	5	**3,833**
Renewable Energy Total Including Hydropower (MW)	**1,045**	**12,124**	**91**	**564**	**301**	**1,374**	**130**	**2,876**	**0**	**1,303**	**2,846**	**22,653**
Renewable Energy Total Excluding Hydropower (MW)	**1,045**	**10,367**	**91**	**564**	**300**	**1,374**	**130**	**864**	**0**	**1,245**	**2,841**	**18,820**

Source: SNL Financial, 2011

Advanced development means at least two of the following have been met: 1) Signed PPA; 2) all permits obtained; 3) EPC contractor hired; 4) financing finalized; 5) major equipment ordered.

Estimated 2020 Gap or Oversupply (MW)

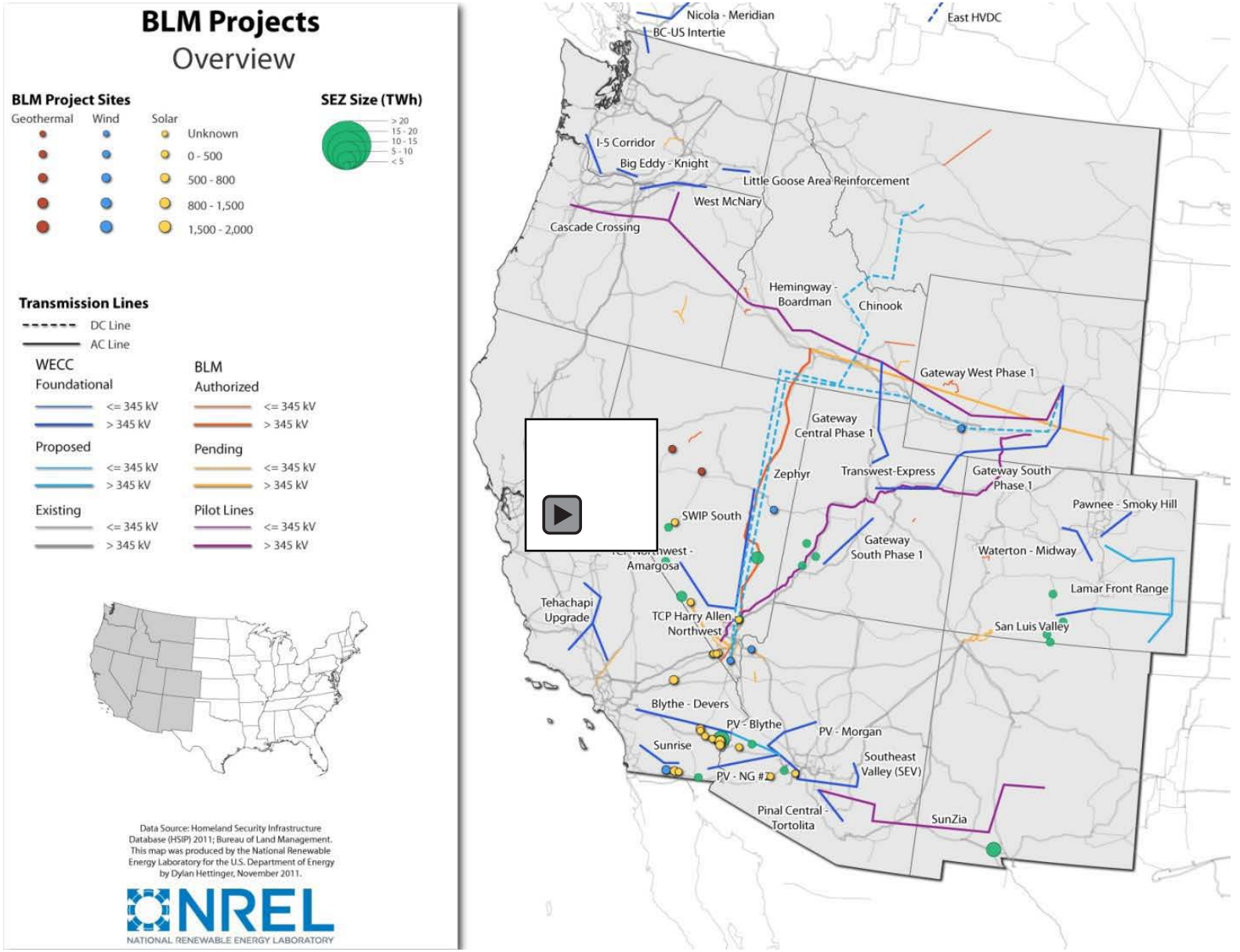
Note: 3,800 MW of hydro not included in the supply numbers

				Arizona	California	Colorado	Idaho	Montana	Nevada	New Mexico	Oregon	Utah	Washington	Wyoming	Total WECC
SUPPLY	As of December 2011 – Not Including Hydropower[4]	Existing Renewable Energy Plant Capacity (MW)[1] (SNL 2011c)		194	7,880	1,372	441	404	589	738	2,558	287	2,547	1,419	**18,429**
		Planned Renewable Energy Projects Capacity (MW) (SNL 2011a)		1,045	10,367	91	564	300	1,374	130	864	0	1,245	2,841	**18,820**
		Sum of Existing and Planned Renewable Energy Capacity (MW)		1,239	18,247	1,462	1,005	704	1,963	868	3,422	287	3,792	4,260	**37,249**
DEMAND	Capacity Required in 2020 to Meet Current RPS Requirements (MW)[2]	A	High Capacity Factor, Low Capacity (MW)	1,380	18,653	2,741	0	325	958	896	1,733	0	1,807	0	**28,493**
		B	LBNL Capacity Factors (Barbose 2011) (MW)	1,415	27,944	2,741	0	382	896	985	1,811	0	2,952	0	**39,126**
		C	Low Capacity Factor, High Capacity (MW)	2,144	31,354	2,741	0	662	1,421	896	3,079	0	3,238	0	**45,535**
GAP	Oversupply or (Unmet Demand) in 2020[3]	A	High Capacity Factor, Low Capacity (MW)	(141)	(406)	(1,279)	1.005	379	1,005	(28)	1,689	287	1,985	4,260	**8,756**
		B	LBNL Capacity Factors (Barbose 2011) (MW)	(176)	(9,697)	(1,279)	1,005	322	1,067	(117)	1,611	287	840	4,260	**(1,877)**
		C	Low Capacity Factor, High Capacity (MW)	(905)	(13,107)	(1,279)	1,005	42	542	(28)	343	287	554	4,260	**(8,286)**

Transmission Context

- **BLM and WECC Foundational lines are mapped in the market assessment report, and BLM project locations plotted against these**
- **Latest WECC Ten Year Study summarized**
- **Seven pilot lines (focus of the Rapid Response Transmission Team)**
  - How to best align BLM renewable energy program with ongoing transmission planning efforts?
- **Several BLM Solar Energy Zones are being evaluated by WECC in current transmission studies**
- **David Hurlbut will talk more about transmission in next part of this webinar**

All Projects W/in 5 Miles of AC Line



Major Findings

- **37,249 MW of renewables already constructed or under advanced development**
  - Projected 2020 Demand: 28,493 to 45,535 MW
  - Either already have what we need, need 8,700 more MW, or have overbuilt by 8,200 MW
- **California is likely to dominate the market for foreseeable future**
- **If constructed, the BLM projects presently approved will account for ~10% of 2020 renewable energy demand in WECC**
- **BLM pending applications = pool of potential projects moving forward**

Opportunities for BLM

- **Increase the strategic value of BLM projects**
  - Which SEZ's and projects have highest values? Look for the "filet mignon" of zones and projects, and optimize the value
  - Locate RE near critical loads and infrastructure, so as to optimize economic value while minimizing transmission
    - For example, explore the feasibility of siting solar projects on Reclamation and BLM lands near pumping stations along the Central Arizona Project (or other water supply projects).
- Likely to see increased interest in projects closer to load (e.g. 10-20 MW infill projects)
- **Look for synergies across previously disturbed lands**
- **Coordinate across all land ownerships to optimize sites**
  - DoD needs 2,000 MW to meet internal goals;
  - possible joint BLM/DoD projects?

Other Efforts

- ***Renewable Electricity Futures (REF) Study*** **– NREL (http://www.nrel.gov/analysis/re_futures/)**
  - technically feasible to obtain up to 80% renewable energy by 2050 across all of U.S. with today's technologies and a more flexible electric system
- ***Changes in the Economic Value of Variable Generation with Increasing Penetration Levels: A Pilot Study of California*** **– LBNL (http://eetd.lbl.gov/ea/emp/reports/lbnl-5445e.pdf)**
  - Value to the grid from a portfolio of renewable energy technologies, especially CSP with storage
  - True value of geographic diversity

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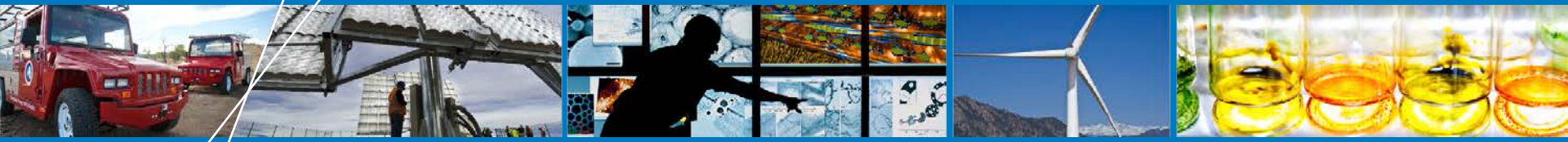
Transmission 101: Components, Functions



Bureau of Land Management Transmission Training Webinar

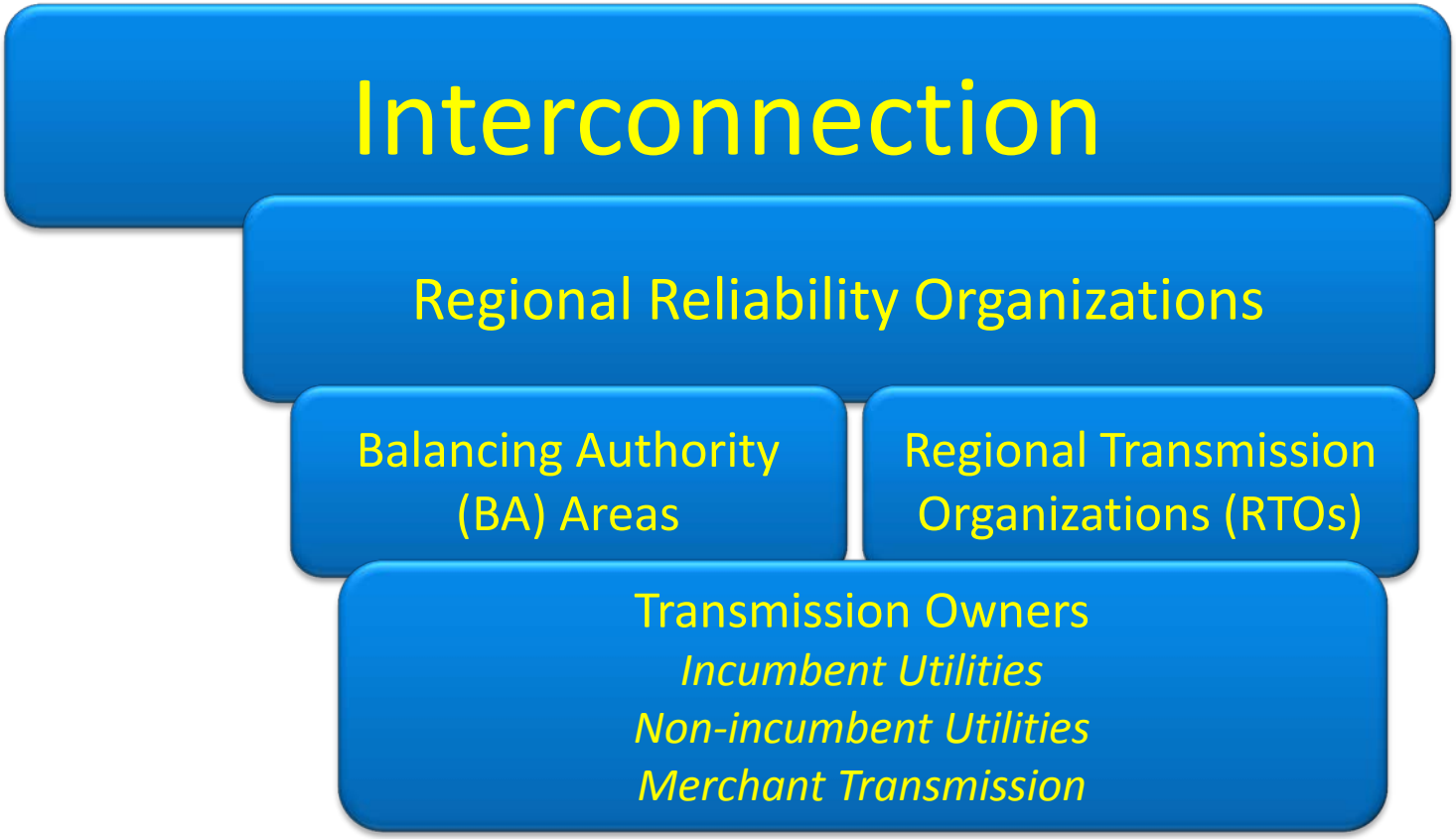
David Hurlbut

October 23, 2012

Outline

- What are the grid's major geographic pieces?
- Who are the players, and what does each do?
- What drives the need for new transmission in the West?

The Pieces (by Size)



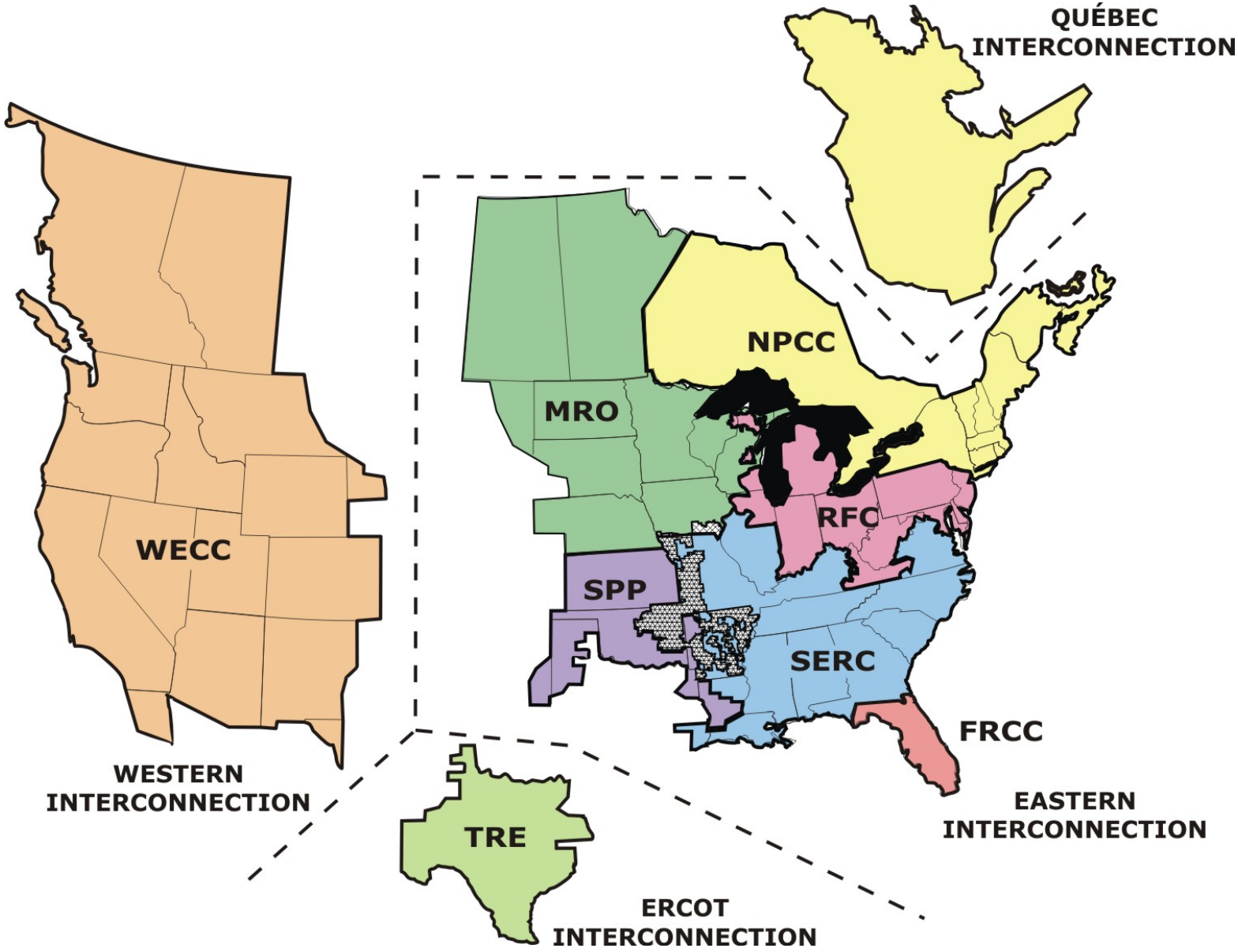
Interconnections

- Major U.S. interconnections: Western, Eastern, Texas
- Defined by physical ability to transfer power anywhere on the alternating current (AC) network
- Power flows between interconnections require AC-DC-AC transformers

Regional Reliability Organizations

- **Ensure that the RRO's defined area of the bulk electric transmission system is reliable, adequate and secure**
- **Are generally subdivisions within an interconnection, although:**
  - Western Electric Coordinating Council (WECC) functions as the RRO for the entire Western Interconnection
  - The Electric Reliability Council of Texas (ERCOT) functions as the RRO for the entire Texas Interconnection

Interconnections, Reliability Organizations



BAs and RTOs

- **BAs and RTOs conduct daily grid operations**
- **Operations must conform to standards established by the RRO**
- **BAs and RTOs differ with respect to:**
  - The amount of operational control retained by transmission owners
  - Commercial transactions

Balancing Authorities

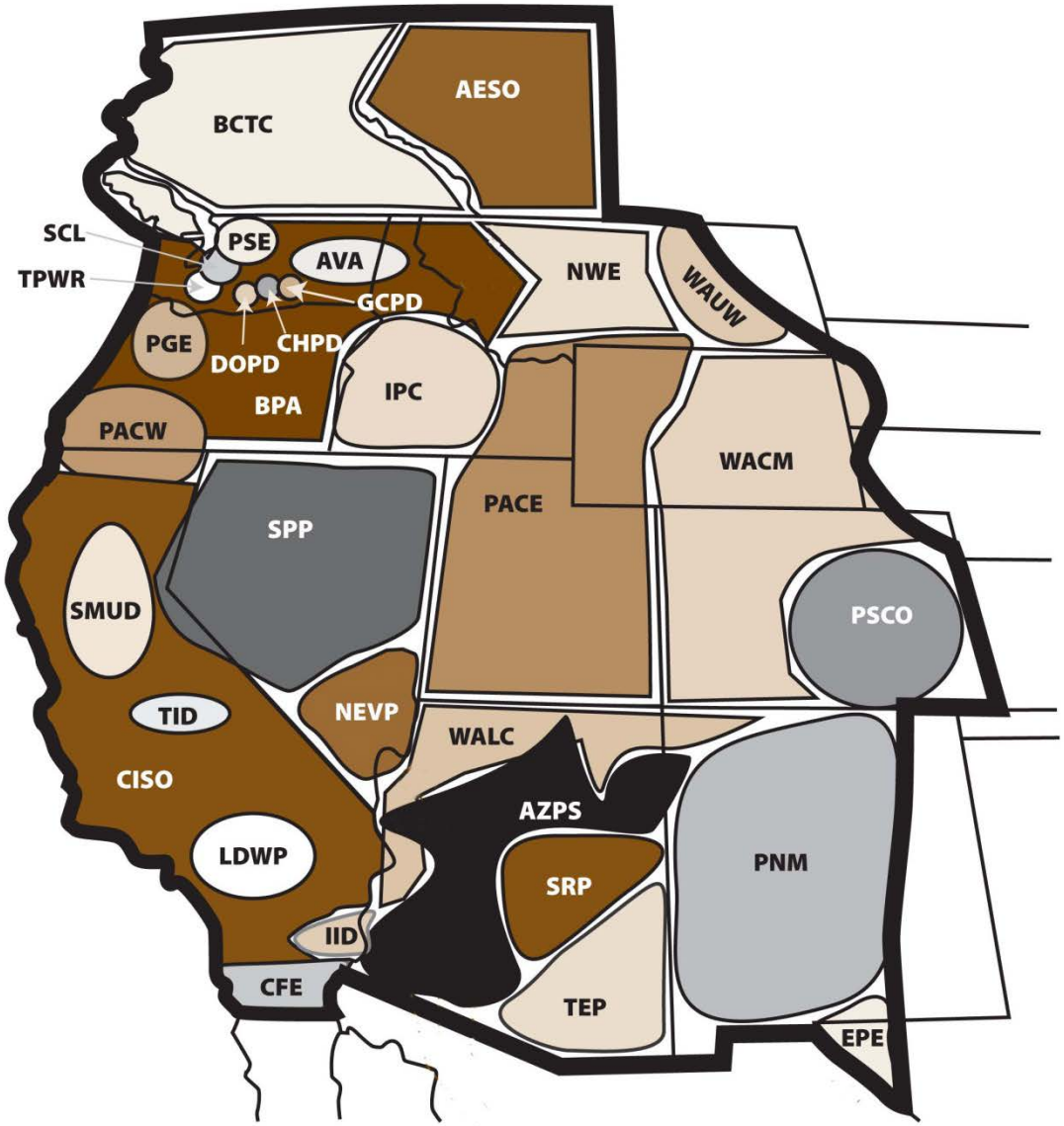
- Control center for all metered points (generators, substations, interchanges) in the BA area
- BA responsibilities
  - Integrate resource plans ahead of time
    - Next-day hourly load forecasts
    - Scheduled dispatch from all generators in the BA area
  - Maintain load-interchange-generation balance within the BA area throughout the operating day

    generation + imports ± deployed reserves = load + exports
  - Support interconnection frequency in real time

Transmission Owners in a BA Area

- **Operate their systems in accordance with FERC-approved open access transmission tariff (OATT)**
- **Provide service to transmission customers on a nondiscriminatory basis, under approved OATT rates**
  - "Rate pancaking": accumulation of transmission charges by wheeling power through two or more transmission systems

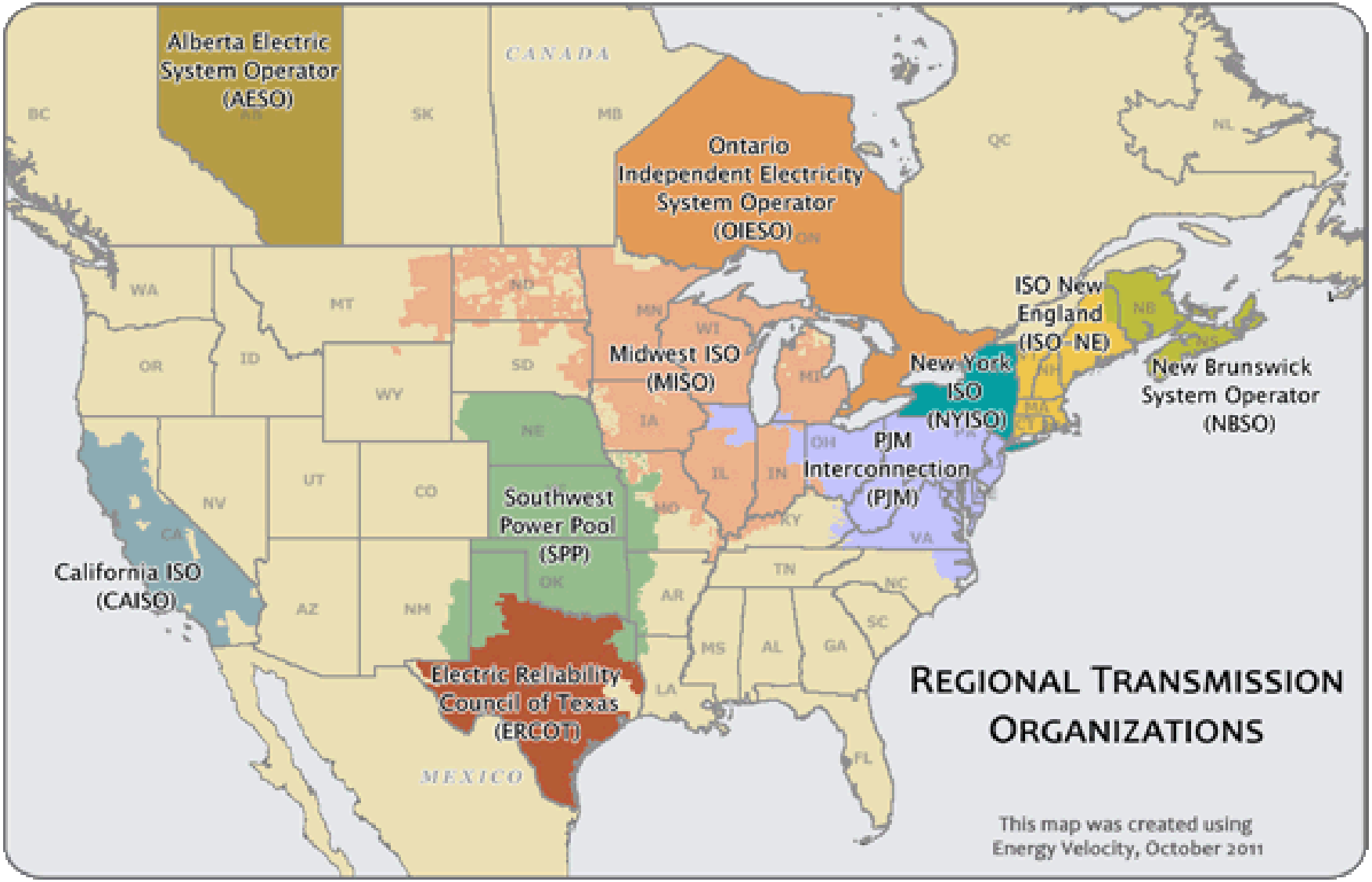
Balancing Authorities in WECC



Regional Transmission Organizations

- **Created to facilitate competitive restructuring of wholesale power markets**
- **Often combined several BA areas into one consolidated operating region**
- **Consolidated RTO tariff instead of separate tariffs for each transmission owner**
- **RTO integrates load/resource schedules, conducts market for allocating transmission capacity**
- **Conducts independent market operations setting wholesale prices and determining generator dispatch**
  - No rate pancaking within an RTO

Regional Transmission Organizations



Drivers for New Transmission

- **Reliability**
  - Avoid blackouts, power fluctuations
  - An upgrade at a weak point of the transmission system can decrease the probability of load loss
- **Economic**
  - Transmission to increase dispatch from least-cost generators
  - Increase access to least-cost renewables

Who Pays?

- **Historically, everyone**
  - When regulated monopolies dominated the utility sector, capital cost of new transmission was added to all other existing capital costs, and applied to rates for all utility customers, on the assumption that the network was the asset
- **Today, trend towards participant funding**
  - Some new and proposed lines have distinct specific beneficiaries; risk and cost recovery can be limited to the customers likely to use the line

Who Decides?

- **Need for the line**
  - Utility and its regulators, focusing on utility's ability to serve captured customer base
- **How much to charge, rules for access**
  - Federal Energy Regulatory Commission (FERC)
- **Routing and permitting**
  - State (particularly when eminent domain is used)
  - Public lands agencies

Crossed Wires over Transmission Planning

- **Cost allocation**
- **Incorporating public policy objectives**
  - Least-cost renewable energy resources
- **Consolidated operations over several BA areas**
- **Transformation of the electricity sector**

Interactive Transmission Project Portal Map

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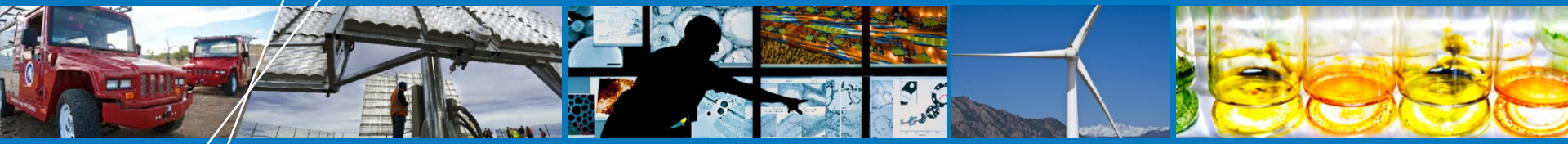

Questions?

David Hurlbut

david.hurlbut@nrel.gov

Kim Berns, Division Chief
Division of Lands, Realty & Cadastral Survey
BLM – Washington Office
kmberns@blm.gov
202-912-7350

Lucas Lucero, Rights-of-Way Branch Chief
BLM - Washington Office
llucero@blm.gov
202-912-7342

Beth Ransel, Linear ROW/Master Agreements Program Lead
BLM – Washington Office
bransel@blm.gov
202-912-7213

NATIONAL SYSTEM OF PUBLIC LANDS