

# Connecting Wind and Transmission To Expand Wyoming's Economy

***Wyoming  
Legislative Task  
Force on Wind  
Energy  
August 26 & 27,  
2009  
Casper, Wyoming***



***Submitted by:***  
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# **Wyoming Infrastructure Authority**

***The WIA was created in 2004 by Wyoming Legislature as an instrumentality of the State***

- Its mission is to diversify and expand the state's economy through improvements in the electric transmission system***
- WIA is also promoting the emergence of advanced coal technologies in Wyoming***
- WIA has \$10M to be dedicated to transmission and clean coal feasibility studies***
- WIA has bonding capability of \$1B for financing of transmission projects***



# Policy Driven Demand for Renewable Energy

## Base Case Renewable Energy Targets by Region

- RPS currently in effect in 8 of 11 regions (shaded green)
- Assume 5% for other regions to reflect known renewables plans
- WECC-wide gap:
  - 120,000 GWh, or
  - 14,000 aMW, or
  - 40,000 MW of wind

Region	Base Case Target	Preferred Resource Gap (GWh)
Alberta	5%	2,753
Arizona-Southern Nevada	13%	18,020
British Columbia	12%	9,414
California	20%	43,801
Colorado	15%	12,395
Montana	15%	829
New Mexico	18%	3,988
Northern Nevada	20%	2,574
Northwest	14%	22,946
Utah-Southern Idaho	5%	3,103
Wyoming	5%	415
WECC Total	15%	120,238

# Total Renewable Resource Availability by Region (MW)

	Biogas	Biomass	Geo-thermal	Small Hydro	Solar Thermal	Wind	Total
Alberta	-	-	-	100	-	11,999	12,099
Arizona-Southern Nevada	33	43	-	-	141,243	1,809	143,129
British Columbia	50	208	185	1,521	-	4,601	6,565
California	300	600	3,063	221	310,133	23,762	338,080
Colorado	59	44	20	-	18,050	5,138	23,310
Montana	5	162	-	37	-	54,542	54,745
New Mexico	18	26	80	-	66,897	11,066	78,087
Northern Nevada	15	15	1,281	10	150,062	5,523	156,906
Northwest	88	1,060	335	230	-	17,039	18,753
Utah-Southern Idaho	21	181	1,040	221	43,153	2,805	47,421
Wyoming	2	22	-	17	-	138,721	138,762
<b>WECC Total</b>	<b>592</b>	<b>2,361</b>	<b>6,004</b>	<b>2,356</b>	<b>729,538</b>	<b>277,005</b>	<b>1,017,856</b>

- Biomass & hydro limited and not very interesting
- Some geothermal potential in most areas
- Good wind resources scarce in the Southwest, plentiful in Rockies
- Lots of solar thermal theoretically available, but at high cost

## E3--WEIL Study 2008

*Number for Wyoming is prior to the recent exclusionary criteria due to environmental considerations*

**Western Governor's  
Association's  
WREZ Study to define  
Renewable Energy Zones**

**Legend**

**Hydro projects (MW)**

- 1 - 10
- 10 - 100
- 100 - 500
- 500+

**Geothermal projects (MW)**

- 8 - 10
- ▲ 10 - 100
- ▲ 100 - 500
- ▲ 500+

**Wind resource**

**NREL wind power class (50m)**

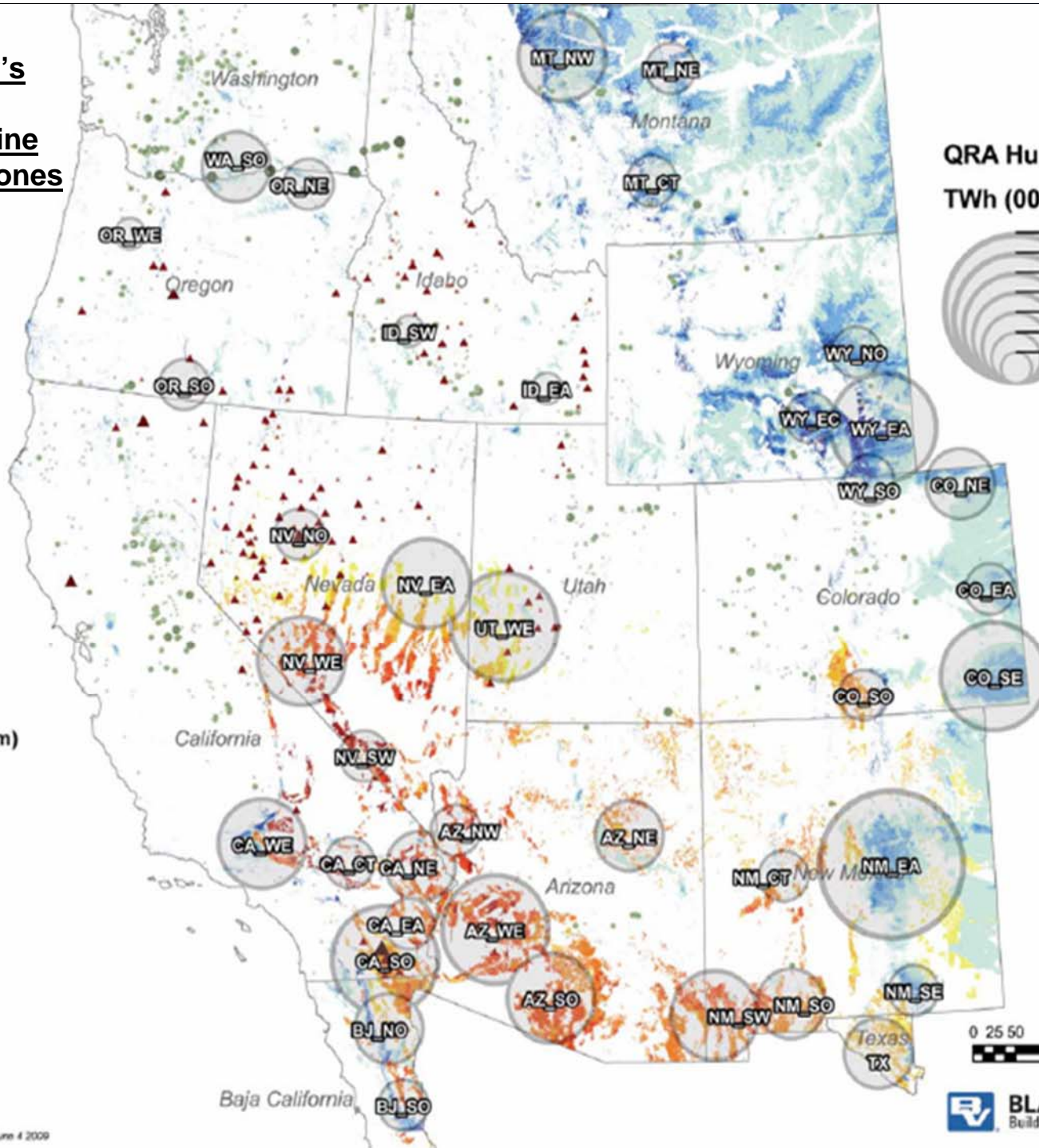
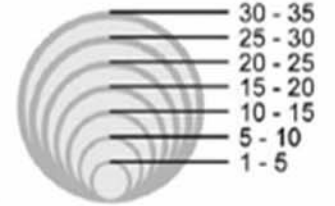
- 3
- 4
- 5
- 6
- 7

**Solar thermal resource**

**DNI (kWh/sqmr/day)**

- 6.5 - 6.75
- 6.75 - 7
- 7 - 7.25
- 7.25 - 7.5
- 7.5+

**QRA Hub Size Guide  
TWh (000s of GWh)/yr**



## Further Defining Wind Development Criteria

The Wyoming Governor's Office, in coordination with State and Federal agencies, have mapped environmental constraints for wind development in all portions of the state reported by the National Renewable Energy Laboratory (NREL) to have Class 4 or better winds. Three categories of environmental constraints were identified:

- ***Green Areas: Minimal Environmental Conflicts***
- ***Pink Areas: Sensitive Areas***
- ***Orange Areas: High Sensitive Areas***
- ***Red Areas: Excluded Areas***

The map may be downloaded at:

<http://wyia.org/wp-content/uploads/2009/05/class-4-winds-2.pdf>

# Wyoming Class 4+ Winds

## Wind Development Environmental Conflicts

### Legend

- Wind Class < 4 -- Conflicts Not Evaluated
- Minimal Environmental Conflicts

### Excluded

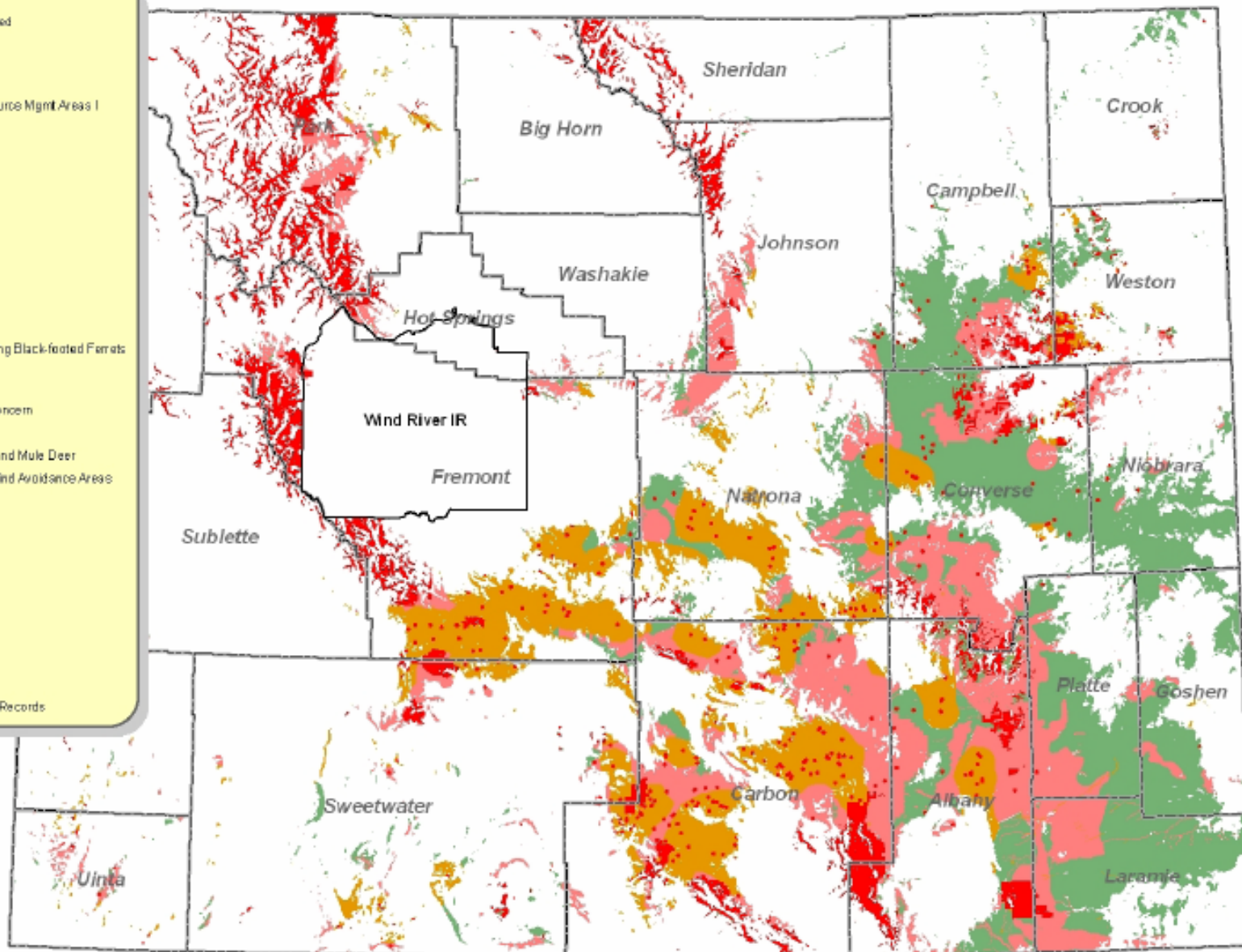
- Wilderness Study Areas & Visual Resource Mgmt Areas I
- State Wildlife/Habitat Mgmt Areas
- State Parks
- National Wildlife Refuges
- National Park Service
- Sage-grouse Lek Buffers
- National Forest System

### High Sensitive

- Sage-grouse Core Areas
- USFWS Critical Habitat
- USFWS T&E Species Records Excluding Black-footed Ferrets

### Sensitive

- BLM Areas of Critical Environmental Concern
- Visual Resource Mgmt Areas II
- Crucial Range for Bighorn Sheep, Elk and Mule Deer
- BLM Rawlins Resource Mgmt Plan - Wind Avoidance Areas
- WGFD Key Upland Habitats
- WGFD Key Riparian Habitats
- Premont Migration Corridors
- Mule Deer Migration Corridors
- Elk Migration Corridors
- Bighorn Sheep Migration Corridors
- Golden Eagle Nesting Areas
- Ferruginous Hawk Nesting Areas
- Bald Eagle Nesting Areas
- USFWS Candidate/Petitioned Species Records



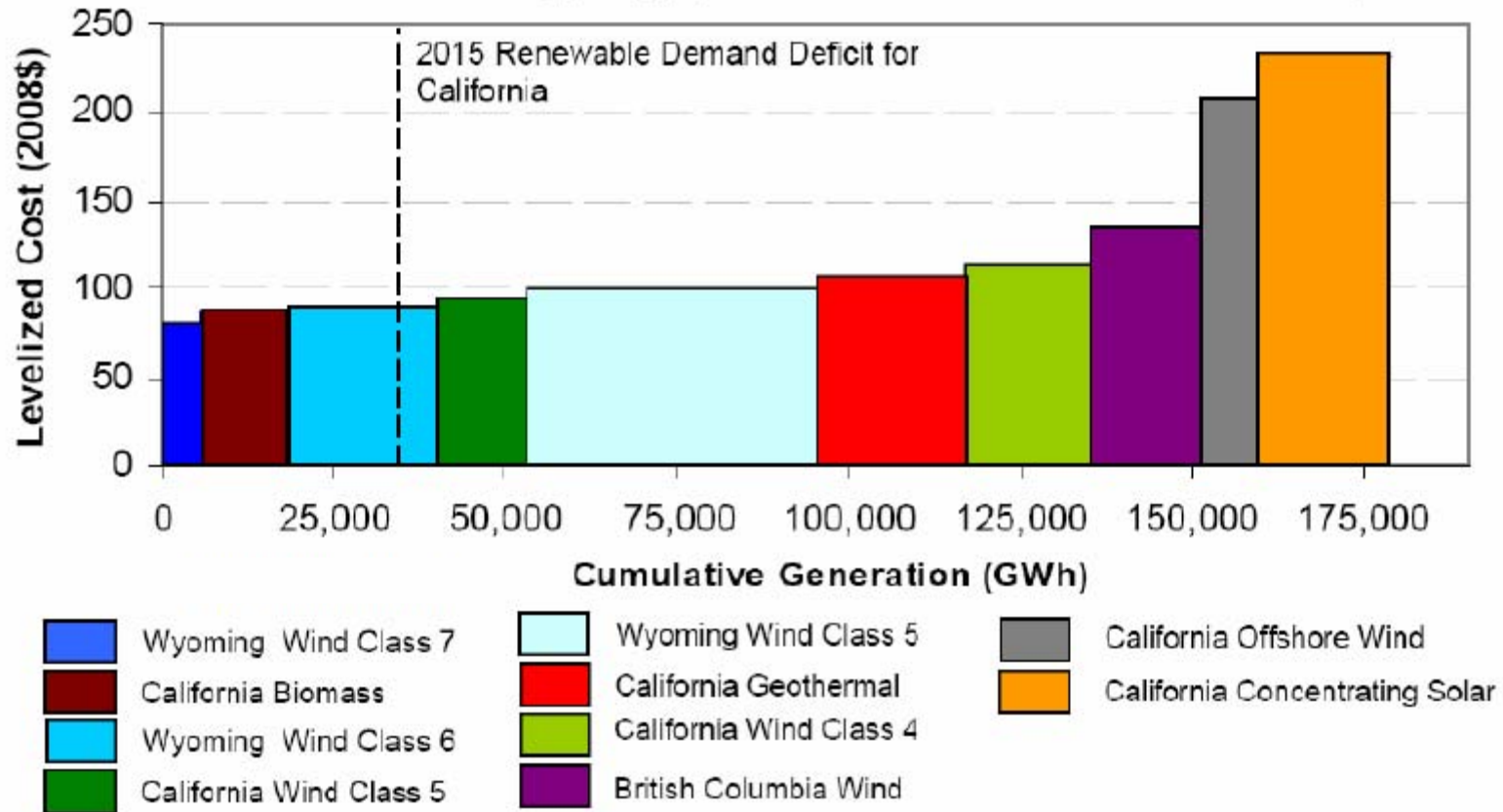
0 20 40 80 120 160 Miles

Map Version 3  
May 21, 2009

# Comparable Cost for Wind Energy (\$/MWh)

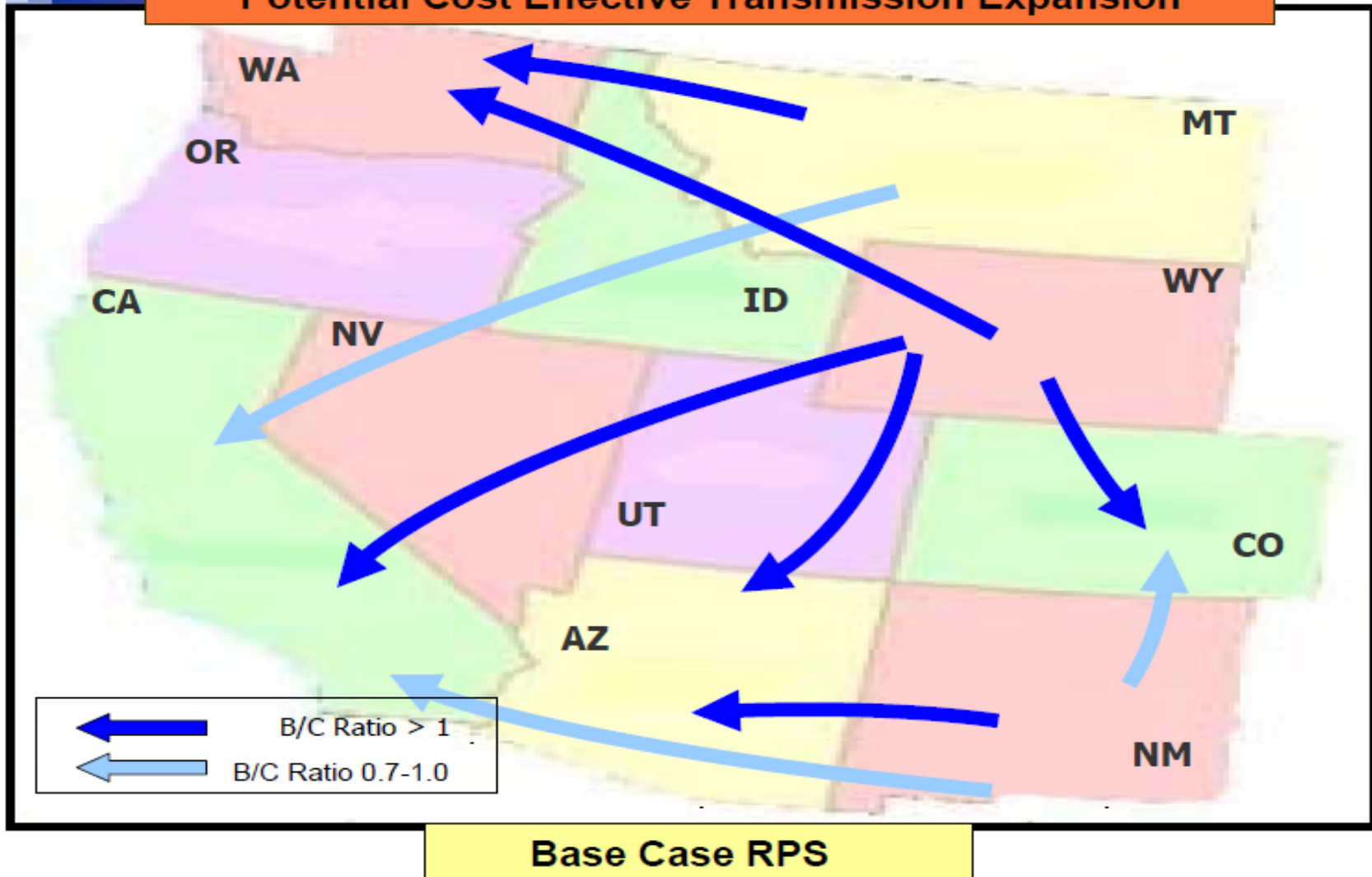
(wind only projects)

California Renewable Energy Supply Stack Based on Technical Feasibility in 2015



Source: National Grid

## Potential Cost Effective Transmission Expansion



E3--WEIL Study 2008

# Benefits of Wind Development to Wyoming

- Wyoming increasingly a green energy provider
- Substantial employment opportunities in developing technologies
- A growing revenue base during construction and operation arise from collector system, transmission and 3,000 MW of wind generation
  - Estimated \$2,090 million in direct and employment benefits and tax revenue during the construction period
  - Estimated \$316 million in benefits per year of operation
  - Expected 176 long term, well paying positions, once facilities are in operation

# WY Benefits during Construction (3 Year period)

In millions of dollars							
	Total Capital Cost	Capital in Wyoming	Direct Employment	Multitplier Effect	Property Taxes	Sales Tax	Total
3,000 MW Transmission	\$3,000	\$1,500	\$168	\$135	\$17	\$32	\$350
3,000 MW Wind Generation	\$6,000	\$6,000	\$600	\$480	\$93	\$267 *	\$1,440
Collector System **	\$800	\$800	\$153	\$123	\$12	\$15 *	\$300
Total	\$9,800	\$8,300	\$920	\$740	\$120	\$310	\$2,090

\* Assumes the sales tax exemption for renewable resources expires before project procurement

\*\* AC lines from the wind farm to the 3,000 MW transmission system

# Annual WY Benefits during Operations

In millions of dollars

	O&M Contracts and Direct	Multiplier Effect	Property Taxes ***	Sales Tax	Total	# Full Time Employees
3,000 MW Transmission	\$22	\$9	\$9	\$1	\$41	13
3,000 MW Wind Generation	\$144	\$58	\$46	\$7 *	\$255	160
Collector System **	\$9	\$4	\$6	1*	\$20	3
<b>Total</b>	<b>\$175</b>	<b>\$71</b>	<b>\$61</b>	<b>\$9</b>	<b>\$316</b>	<b>176</b>

\* Assumes the sales tax exemption for renewable resources expires before project procurement

\*\* AC lines from the wind farm to the 3,000 MW transmission system

\*\*\* Property Taxes may decline slightly over time depending on Fair Market Value assessments

## Projects Under Development

### Projects

Wyoming-Colorado Intertie



Energy Gateway (West & South)



TransWest Express



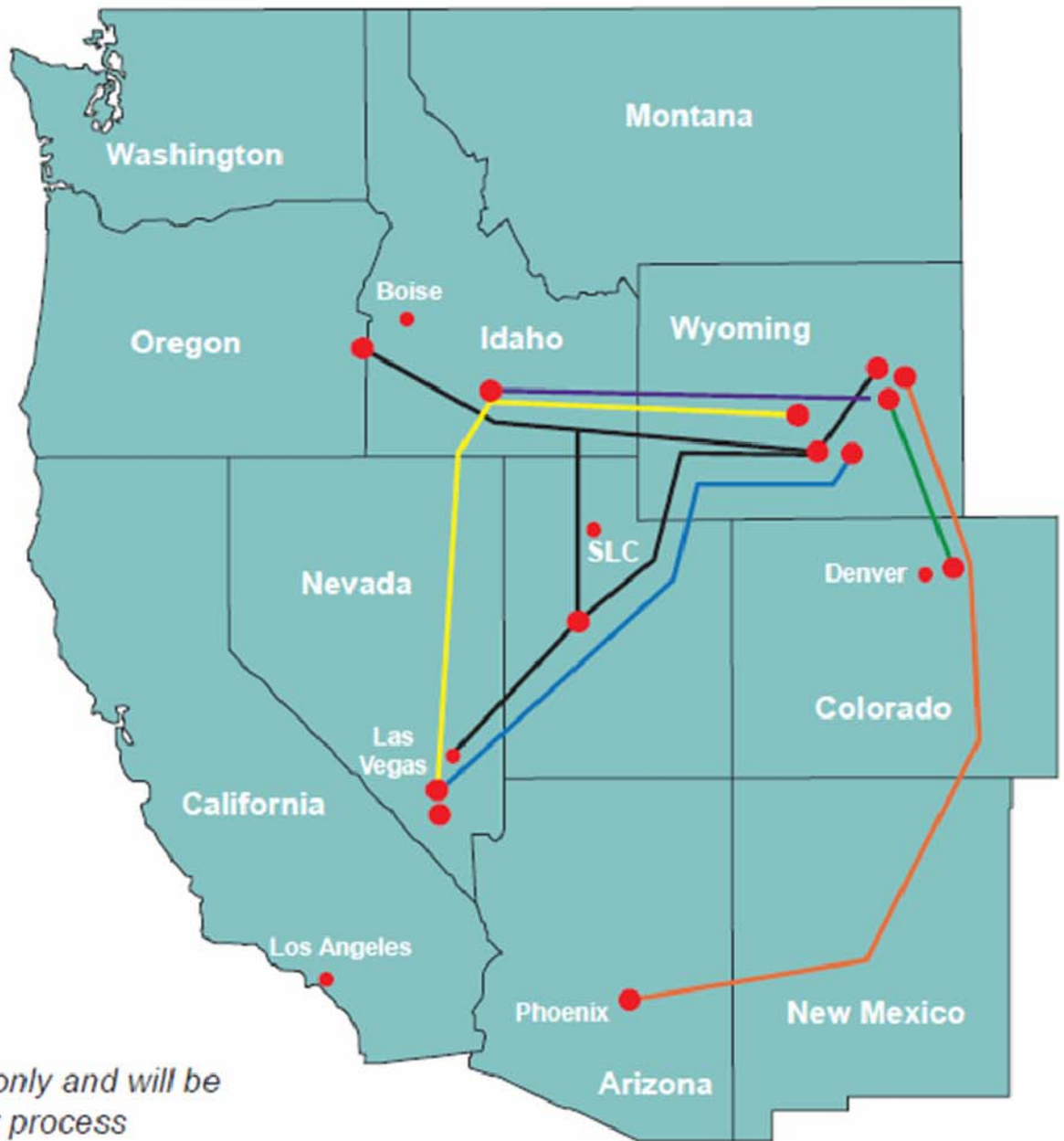
High Plains Express



Zephyr



Overland Intertie



*Routes shown are for illustrative purposes only and will be finalized following a comprehensive review process*

# About the Wyoming Collector System Task Force



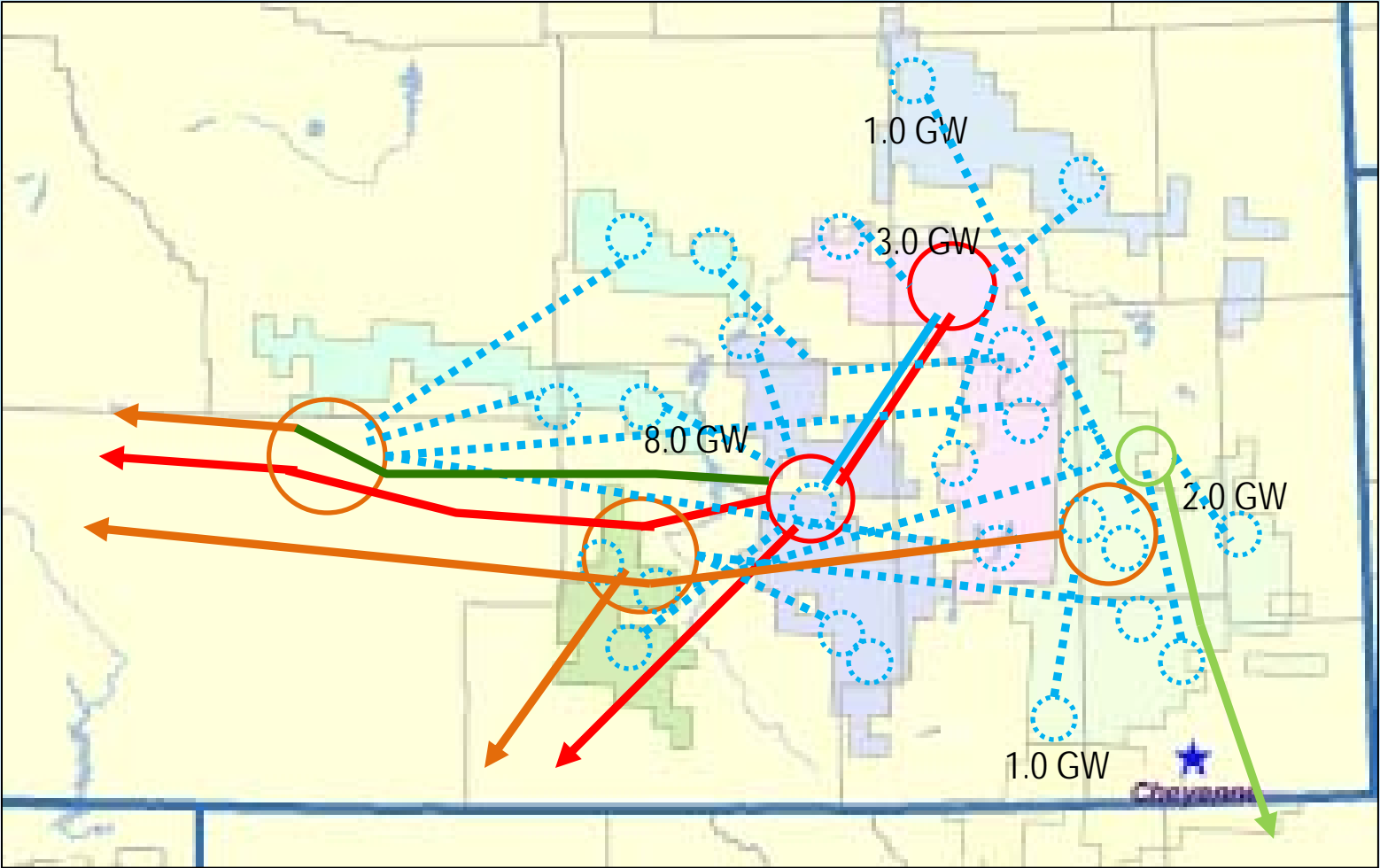
**LS Power**

# Wyoming Wind Collector and Transmission Task Force Objectives

- Develop a coordinated, staged conceptual plan for the collector system
- Develop a proposal to accommodate the interstate transmission lines and corridors required to collect and export these new resources
- Transmission Planning Process:
  - Scale to accommodate all projects – ‘sinks’
  - Various Resource Scenarios – ‘sources’
  - Analyze different collector designs
  - Build out stages

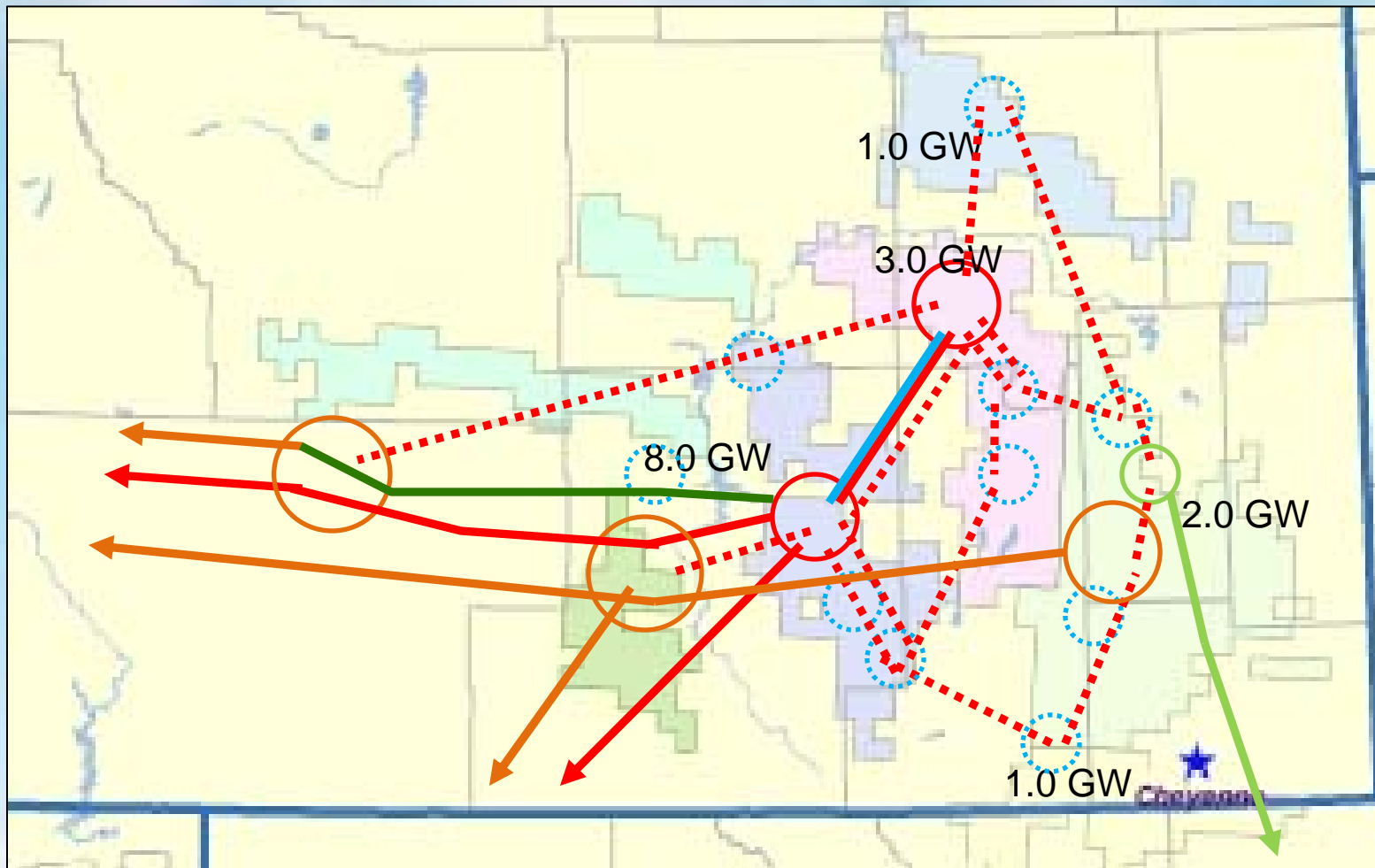
# Wind Farm to Hub Radial Collector Design

Individual (large or groups of small) wind farms  
build 230 kV transmission taps to transmission hubs



# Wyoming Network Collector Design

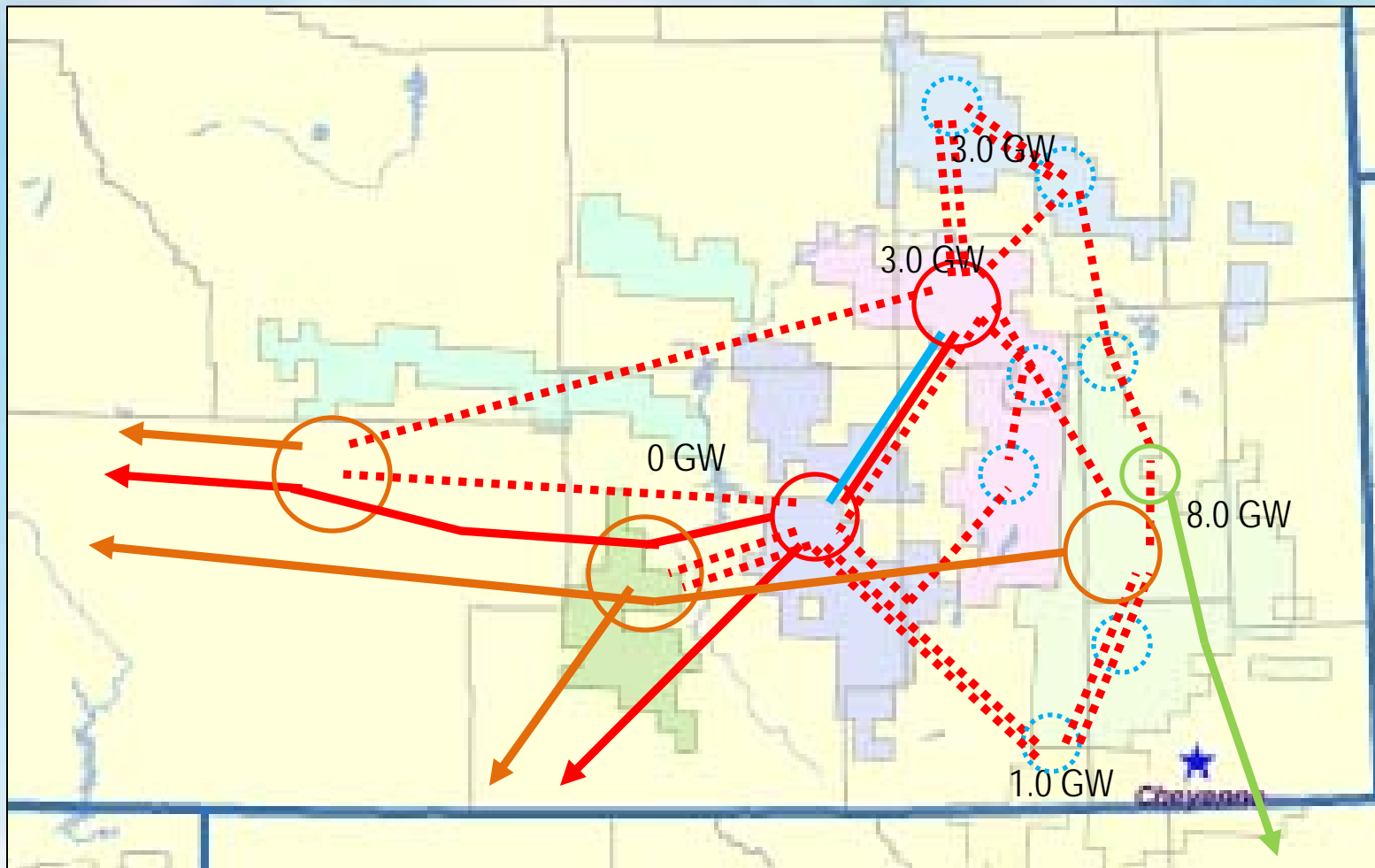
Coordinated development of small area hubs connected to transmission project hubs



*Draft Working Paper of WY Wind Collector System Task*

Force

# Network Collector Design with Alternative Resource Deployment



*Draft Working Paper of WY Wind Collector System Task  
Force*

# Next Steps for Collector Task Force

- Develop line mileage and cost estimates for various scenarios and designs
- Analyze likely corridors and develop corridor plan
- Develop likely build-out scenarios
- Analyze different commercial arrangements required to support collector system build-out
- Develop recommendations to state and federal regulators

# Conclusion

- Transmission developers are committed to building export capacity that will help improve Wyoming's economy.
- These transmission projects are sensitive to the stability of the development environment for the electricity generators.
- Smart transmission design provides the most flexibility and least environmental impact over the 50 plus years of intended life.
- A Wind Collector System that supports all potential wind and transmission export projects should be supported by Wyoming and the Federal government.