Summary of SSG-WI 2003 Economic Studies

RM/DSW Transmission Planning

January 14, 2004

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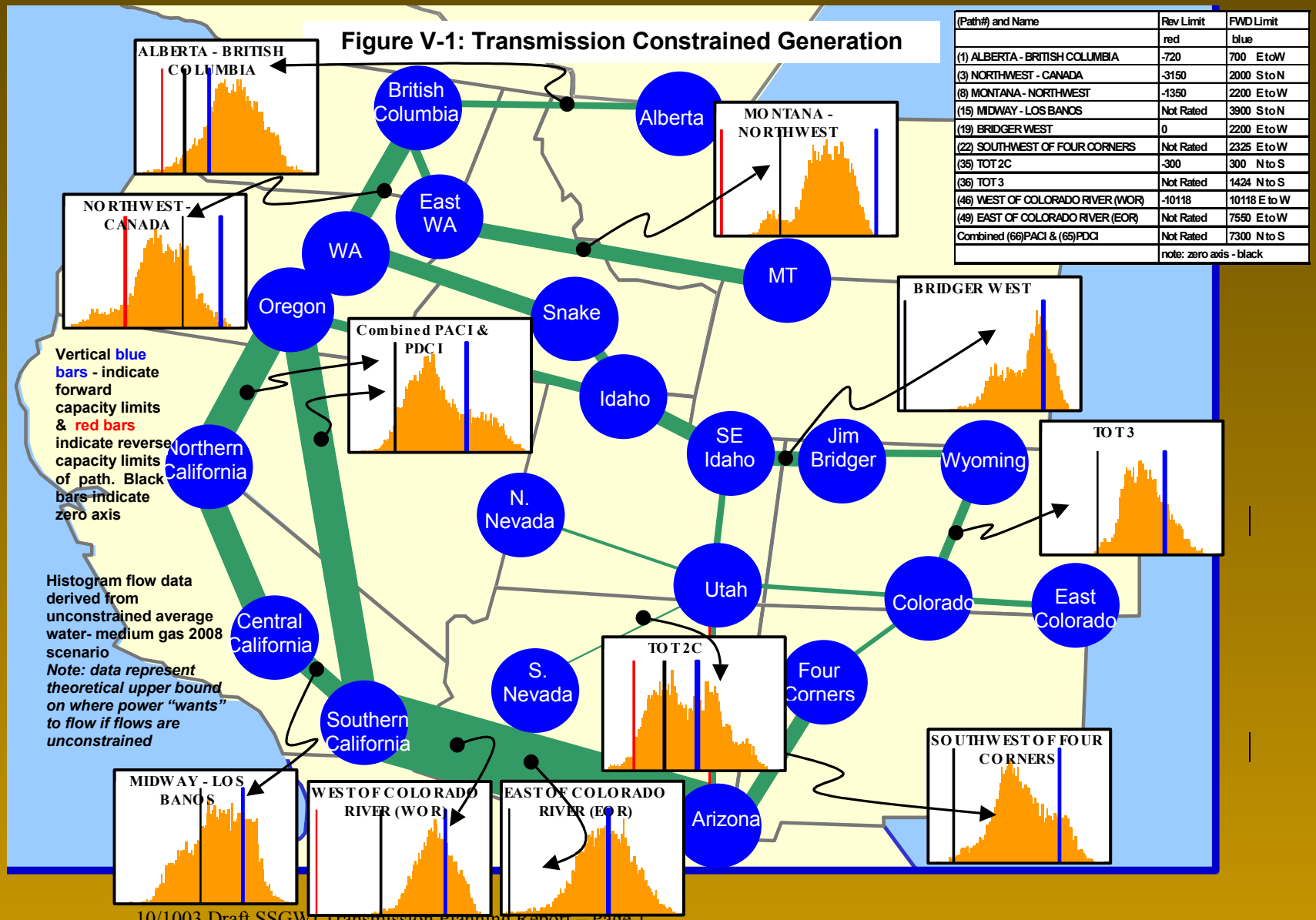
Study Program

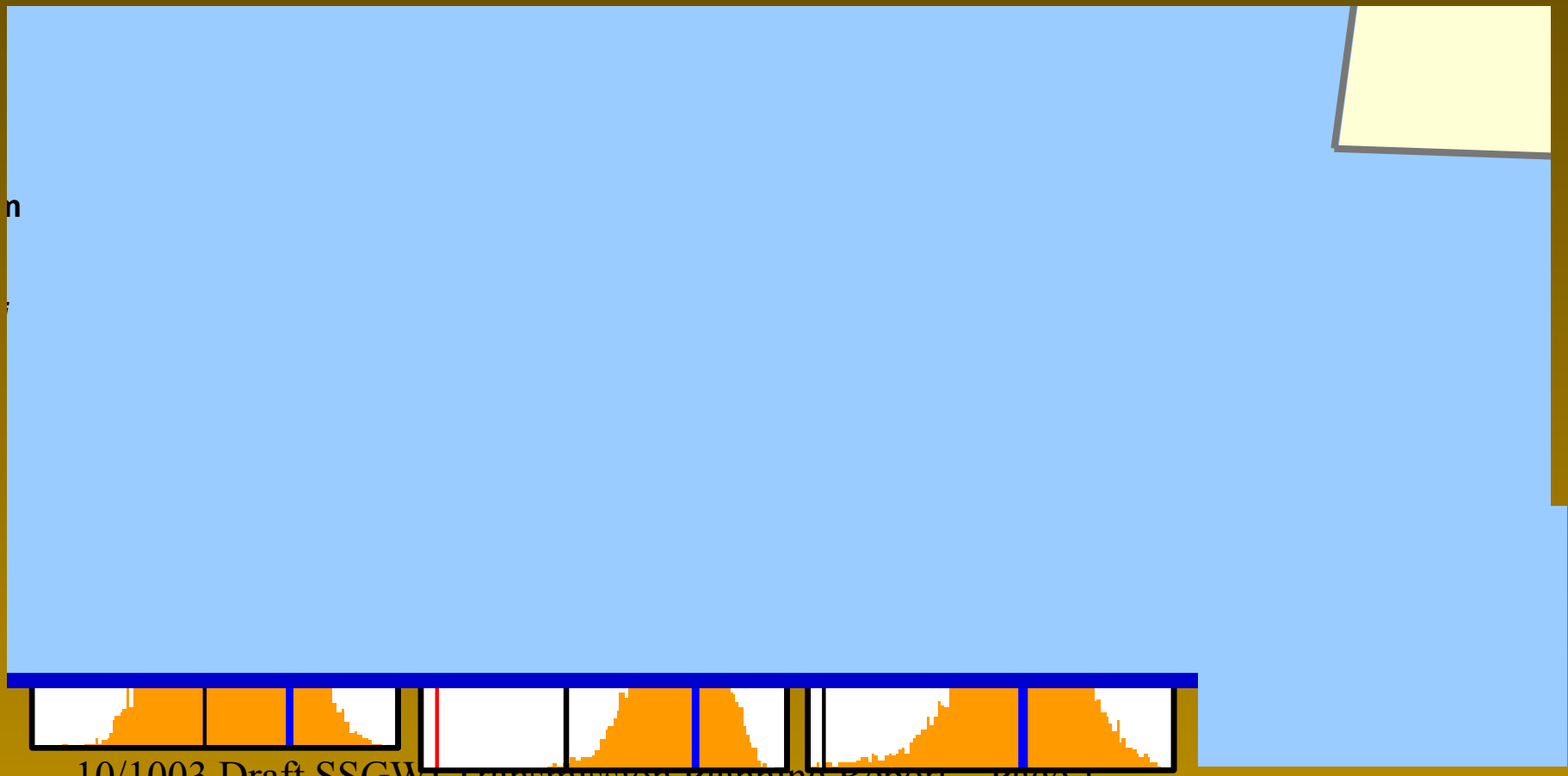
- 2008 – Base Case
- 2013
  - Gas – Assumes 86% of new generation is fueled with gas near load centers
  - Coal – Assumes 66% of new generation is coal fired remote from load centers
  - Renewable – Assumes 72% of new generation is from renewable (wind, etc.) remote from load
- Sensitivity Studies for Gas Price and Hydro

2008 Findings

- In the 2008 study, identified approximately $110 million in unrealized production cost savings due to path congestion (with planned facilities).
- Identified paths that may be congested in the near future

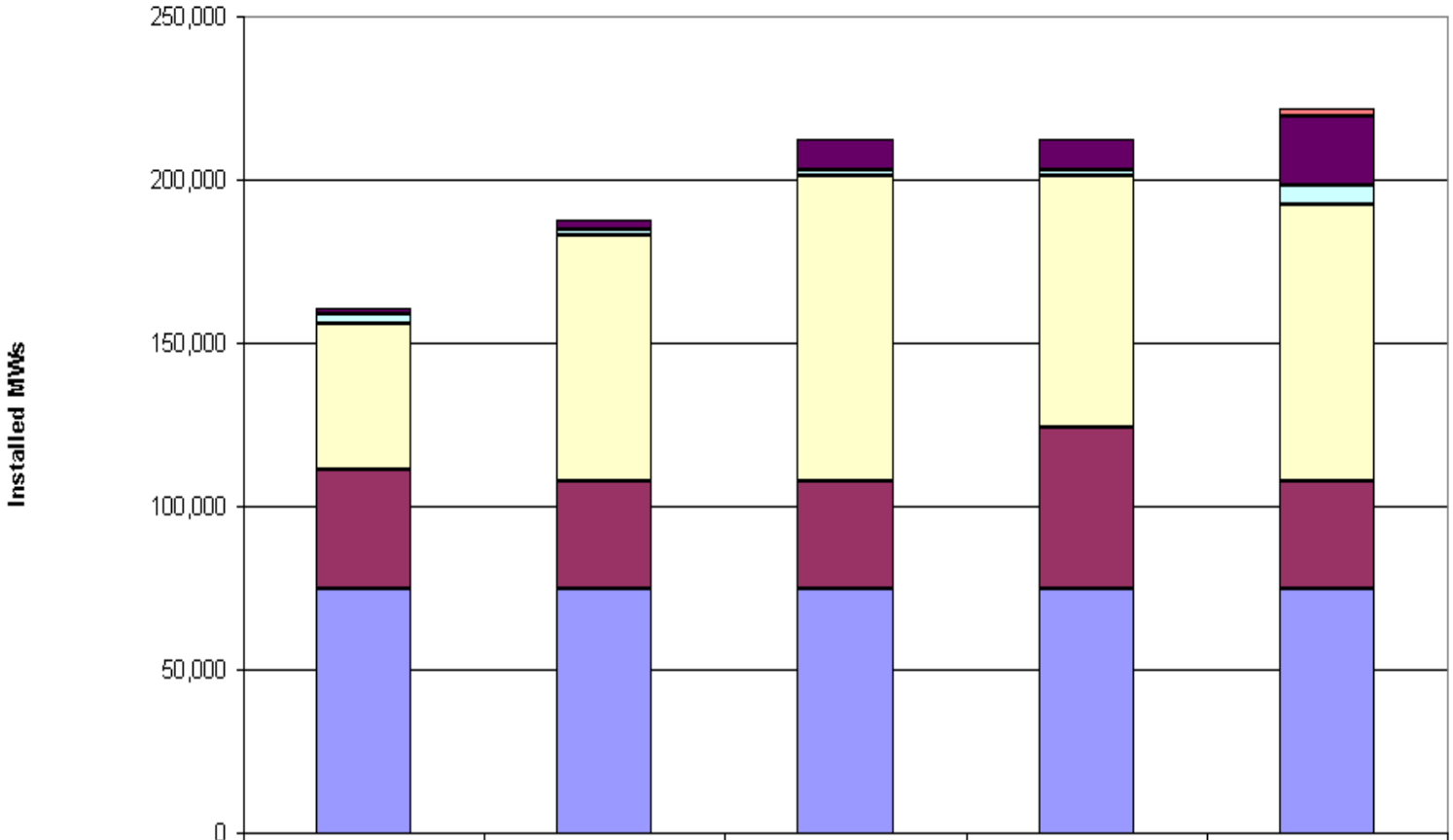


(Path#) and Name	Rev Limit	FWD Limit
	red	blue
(1) ALBERTA - BRITISH COLUMBIA	-720	700 EtoW
(3) NORTHWEST - CANADA	-3150	2000 StoN
(8) MONTANA - NORTHWEST	-1350	2200 EtoW
(15) MIDWAY - LOS BANOS	Not Rated	3900 StoN
(19) BRIDGER WEST	0	2200 EtoW
(22) SOUTHWEST OF FOUR CORNERS	Not Rated	2325 EtoW
(35) TOT 2C	-300	300 NtoS
(36) TOT 3	Not Rated	1424 NtoS
(46) WEST OF COLORADO RIVER (WOR)	-10118	10118 EtoW
(49) EAST OF COLORADO RIVER (EOR)	Not Rated	7550 EtoW
Combined (66)PACI & (65)PDCI	Not Rated	7300 NtoS
	note: zero axis - black	



10/1003 Draft SSGWI Transmission Planning Report – Page 1

WECC Capacity By Energy Source



	2000 Actual	2008 Estimate	2013 Gas	2013 Coal	2013 Renewable
Solar	0	0	0	0	2,442
Wind	1,200	2,800	9,350	9,350	21,350
Geo & Biomass	3,169	2,169	2,169	2,169	5,941
Gas	44,602	75,195	93,353	77,095	84,699
Coal	36,571	32,573	32,573	48,873	32,573
Nuke/Hydro/Other	74,753	74,965	74,965	74,965	74,965

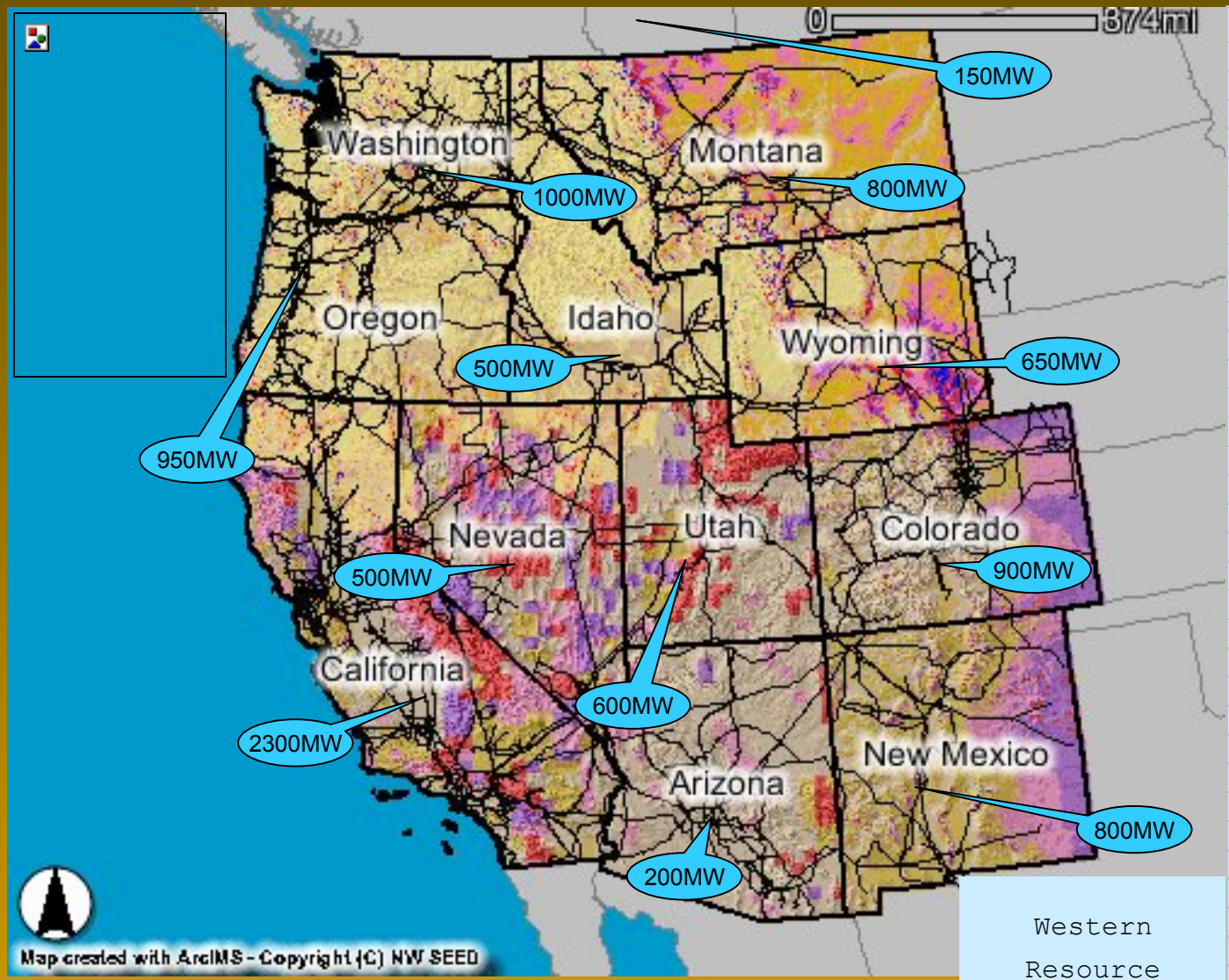
SSGwi

Wind Power Potential in the Western United States

State	Windy Land Area, per Best Current Data (Acres) (1)	Potential Nameplate Capacity (MW) (2)	Underlying Data Source
Arizona	76,850	1,555	1991/92 PNL Reports
California	728,961	14,750	1991/92 PNL Reports
Colorado	10,446,380	211,375	1997 Brower and Company
Idaho	814,499	16,481	2002 TrueWind Analysis
Montana	17,351,305	351,091	2002 TrueWind Analysis
Nevada	899,464	18,200	1991/92 PNL Reports
New Mexico	987,186	19,975	1997 Brower and Company
Oregon	1,182,864	23,934	2002 TrueWind Analysis
Utah	365,716	7,400	1991/92 PNL Reports
Washington	1,038,791	21,019	2002 TrueWind Analysis
Wyoming	14,456,930	292,526	2002 TrueWind Analysis

(1) Windy area refers to land with a wind resource of class four or greater. Land use exclusions taken into account.
(2) Assumes 5 MW developable per square kilometer.

Wind



	SSG-WI Assumed Wind	
		2013 Base
		(MW)
AZ	E of Tuscon	100
AZ	Navajo	100
CA	Thch_Wd1	650
CA	SnGrgnWd	350
CA	AltmntWD	500
CA	SolanoWd	250
CA	Thch_Wd2	550
CO	CO (E) Ft Collins	400
CO	CO (E) Trinidad	400
CO	CO (W)	100
ID	Burley	200
ID	Mtn. Home	200
ID	Pocatella	100
MT	NW - Conrad/Shelb	400
MT	SC - Livingston	400
NV	N - Tonopah/Eureka	100
NV	S - NW of Vegas	400
NM	E- Tucumcari/Clovis	600
NM	4 Corners	200
NW	Columbia Gorge	650
NW	Bend	300
UT	Monticello	100
UT	St George	100
UT	NE Corner ???	400
NW	Columbia Gorge	200
NW	Ellensburg	500
NW	Spokane	300
WY	Casper/Rawlins	500
WY	Laramie	150
Canac	Alberta	150
		9350

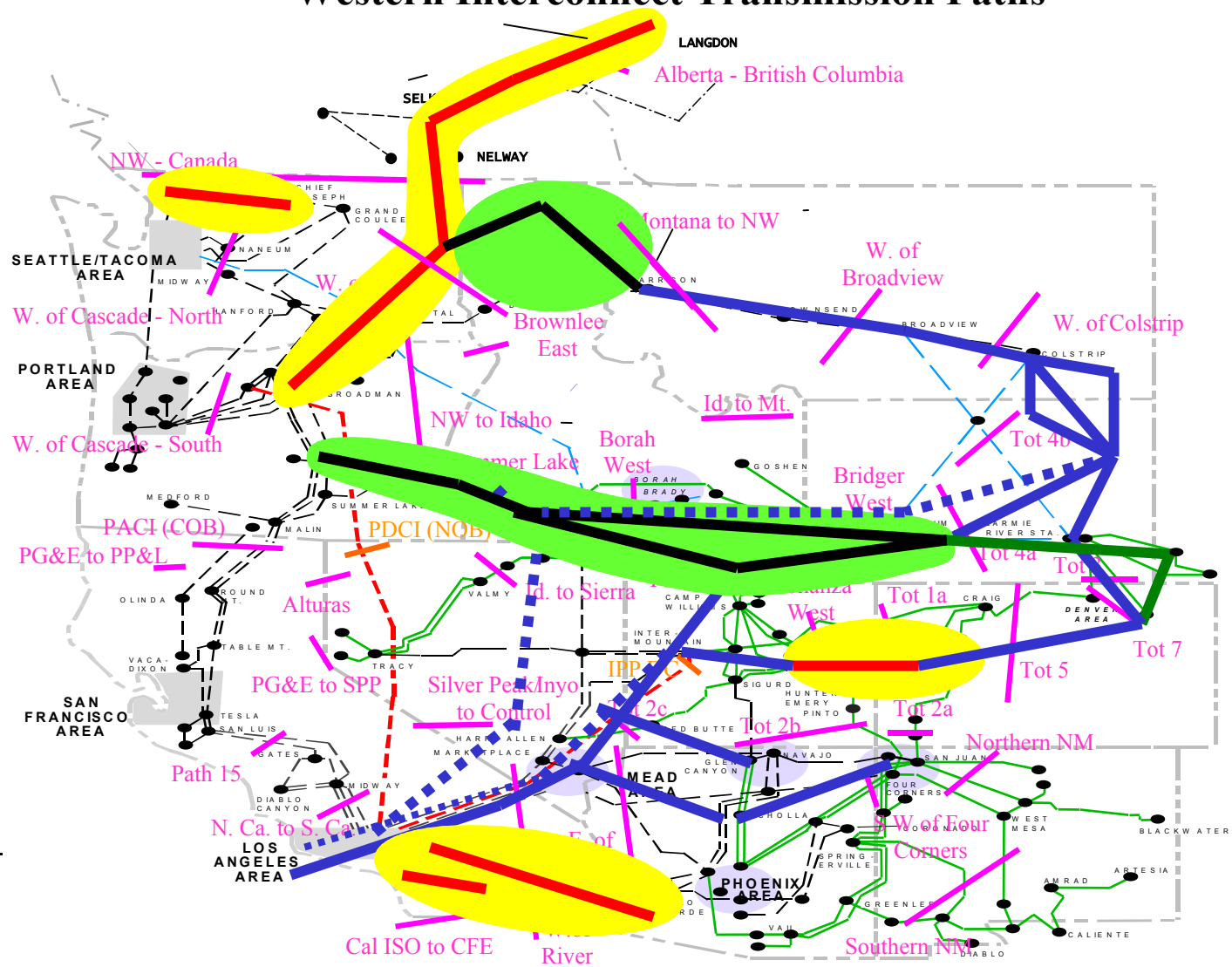
Western Resource Advocates

2013 Findings

- Identified transmission facilities necessary to alleviate path congestion for 3 bookend resource scenarios
  - Gas – 1325 miles
  - Coal – 7605 miles
  - Renewable – 3360 miles
- Found that certain transmission facilities are common to all 3 resource scenarios

Seams Steering Group of the Western Interconnection

Western Interconnect Transmission Paths



Gas Scenario

Coal Scenario

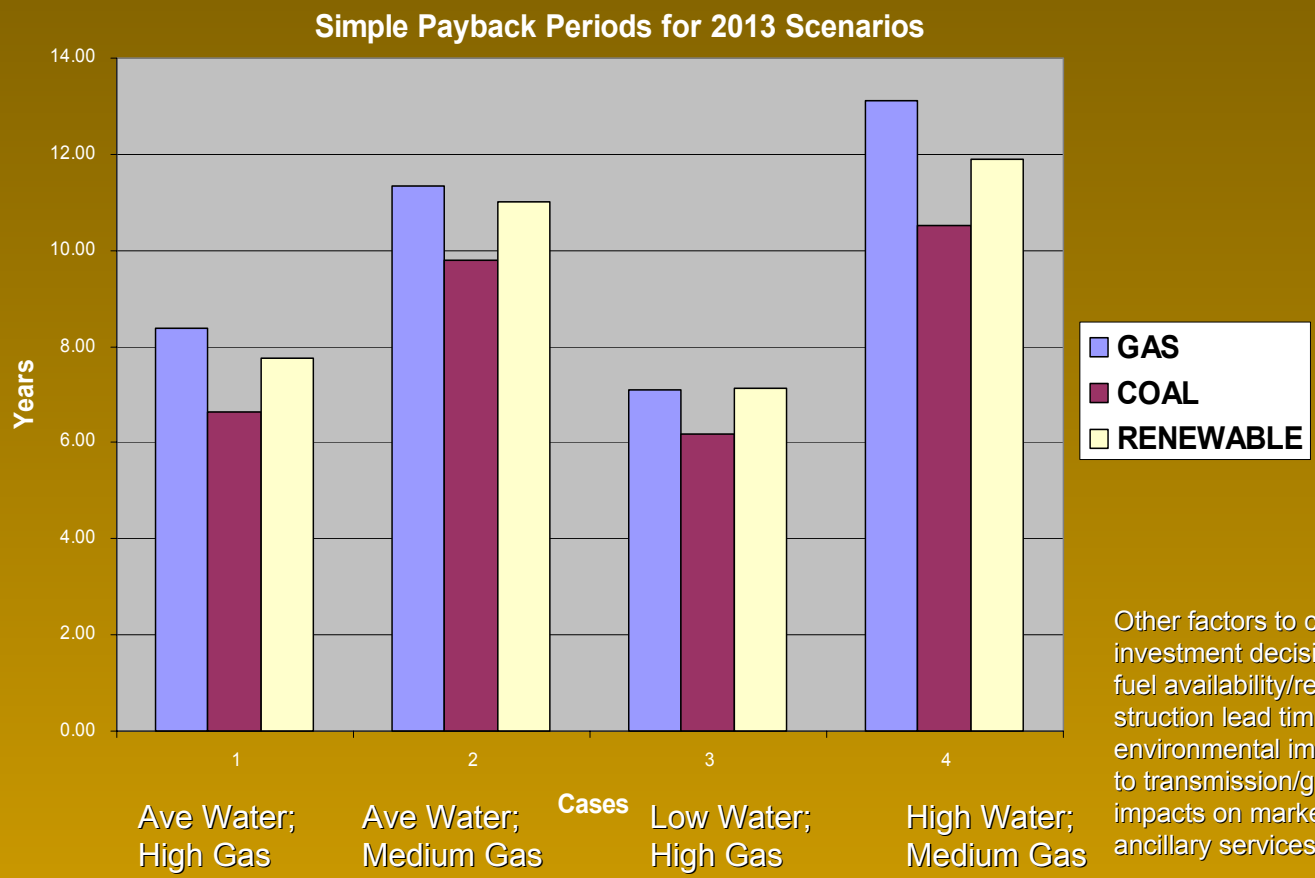
DC

Renewables Scenario

1	Alberta-BC
2	Alberta – Saskatchewan
3	Northwest – Canada
4	West of Cascades – North
5	West of Cascades – South
6	West of Hatwai
7	Blank
8	Montana to Northwest
9	West of Broadview
10	West of Colstrip
11	West of Crossover
12-13	Blank
14	Idaho to Northwest
15	Midway – Los Banos
16	Idaho – Sierra
17	Borah West
18	Idaho – Montana
19	Bridger West
20	Path C
21	Arizona to Calif
23	Four Corners 345/500
24	PG&E – SPP
25	PacifiCorp/PG&E 115 Intercon.
26	Northern – Southern Calif
27	Intermountain Power Project
28	Intermountain – Mona 345 kv
29	Intermountain – Gonder 230 kv
30	TOT 1A
31	TOT 2A
32	Pavant/Intermtn Gonder
33	Bonanza West
34	see paths 78 & 79
35	TOT 2C
36	TOT3
37	TOT 4A
38	TOT 4B
39	TOT 5
40	TOT 7
41	Sylmar to SCE
42	IID – SCE
43	North of San Onofre
44	South of San Onofre
45	SDG&E Comision Fed. de Elect.
46	West of Colorado River (WOR)
47	Southern New Mexico (NM1)
48	Northern New Mexico (NM2)
49	East of the Colrado River
50	Cholla – Pinnacle Peak
51	Southern Navajo
52	Silver Peak – Control 55 kv
53	Billings – Yellowtail
54	Coronado West
55	Brownlee East
56-57	Blank
58	Eldorado – Mead 230 kv Lines
59	WALC Blythe – SCE Blythe

SSG-WI Study Results for 2013 Scenarios

	Gas	Coal	Renewable
New Transmission (Miles)	1,325	7,600	3,360
New Transmission Costs ($B)	2.6	16.7	6.7
New Generation (GW)	57	57	67
New Generation Costs ($B)	17.4	30.5	36.7
Range of Production Cost Savings ($B/yr)	1.5 - 2.8	4.5 - 7.6	3.6 - 6.1



Other factors to consider before investment decisions are made include: fuel availability/resource diversity, construction lead time, transmission losses, environmental impacts/benefits, benefits to transmission/generation reliability, impacts on market competition and ancillary services impacts/benefits.

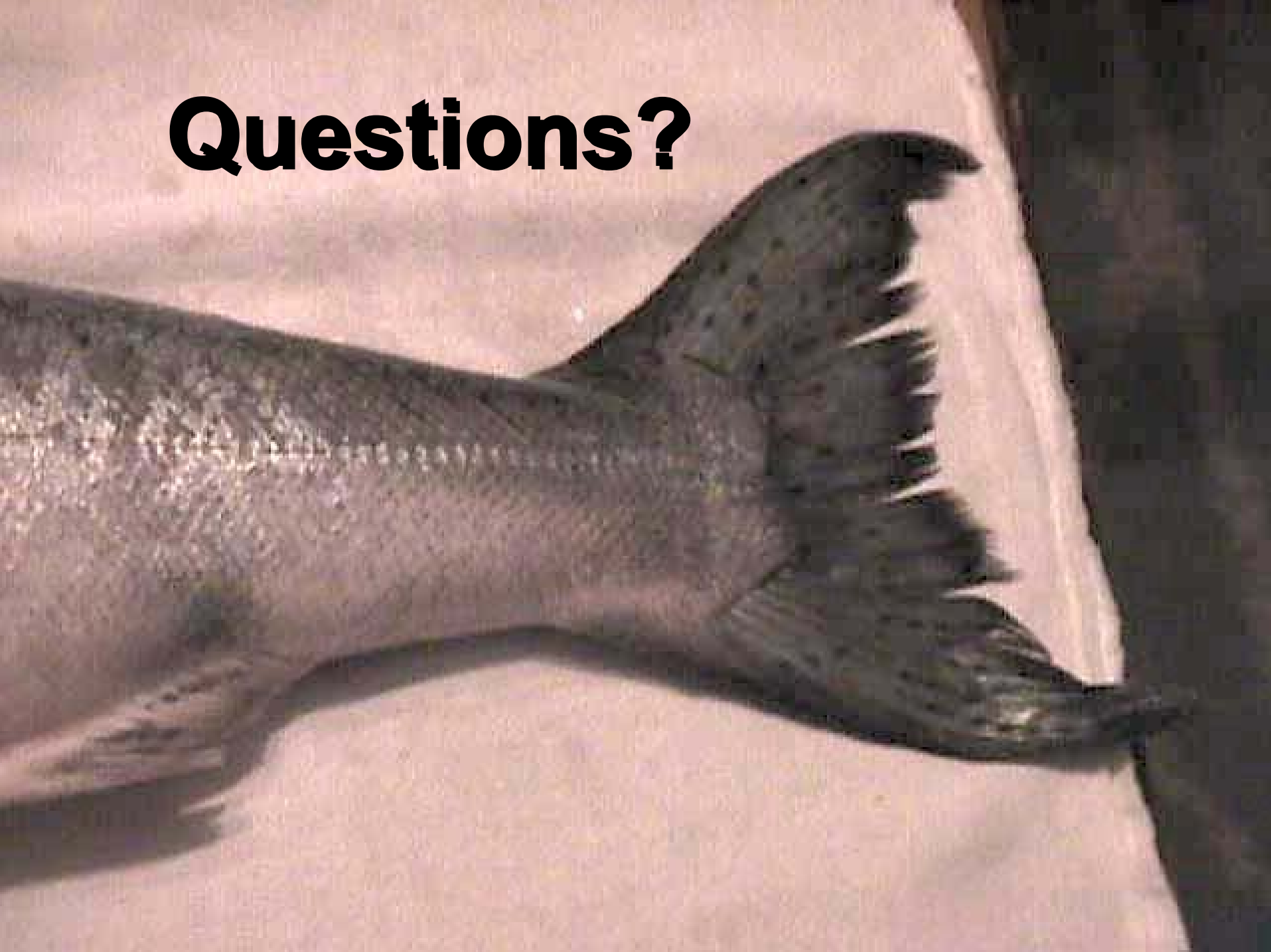
SSG-WI Planning Study Objectives (Tent.)- 2004

1. Select vendor to maintain (upgrade) PWG data base
2. Update ten-year case (2013)
3. New tools for transmission production cost modeling
4. Determine lessons learned from 2003 study
5. Actual flow analysis supplemented with Oasis data
6. Identify subregional issues in base cases and assessment of impacts
7. Initiate long range (20+ yr) transmission planning for WECC area

Personal Opinion

Study Value:

1. Provided economic database for 2008 & 2013
2. Improved understanding of economic study tool
3. Valuable tool to compare alternatives
4. Helps regional planning groups to focus on congested areas


Questions?

Next Steps

- Subregional Planning Groups –
  - perform additional in-depth studies.
- Developing Planning Work Group 2004 Study Objectives

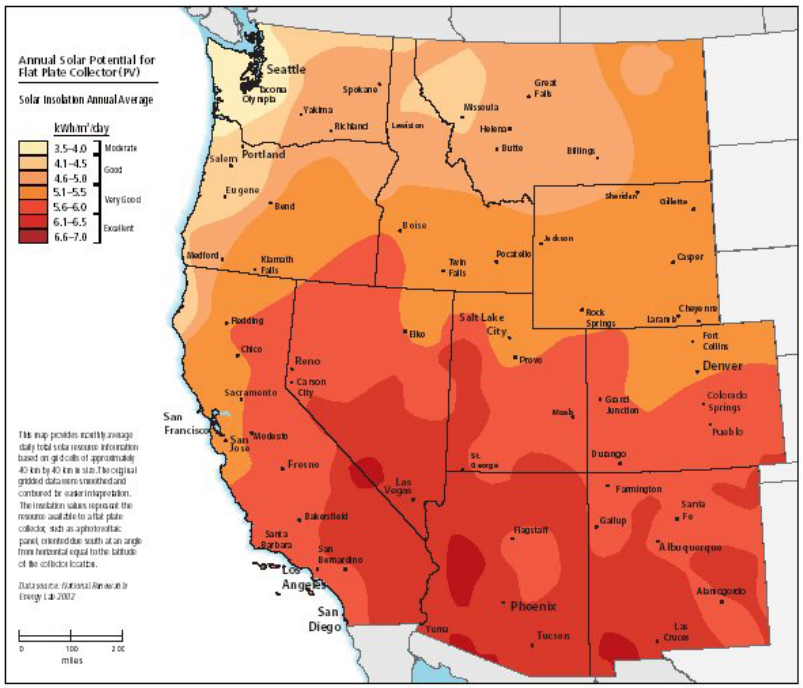
Considerations

- Additional studies are required by SSG-WI and/or Subregional Groups before specific projects can be identified and proposed for implementation.
- Be cautious about drawing resource conclusions from this study – focus was on transmission needs.

Solar

Solar energy is one of the most abundant natural forms of energy. Thousands of buildings across the West use passive solar design, solar hot water systems, photovoltaics, or other types of solar collectors to provide a portion of their energy. This map demonstrates the potential energy available for directly converting the sun's *light* into electricity using photovoltaics. Electricity can also be generated from the sun using concentrating solar technologies – those that turn the sun's *heat* into electricity.

At least 371 MW of solar power are currently installed in the West. Of this, 21 MW are photovoltaics and 350 MW are concentrating solar power.



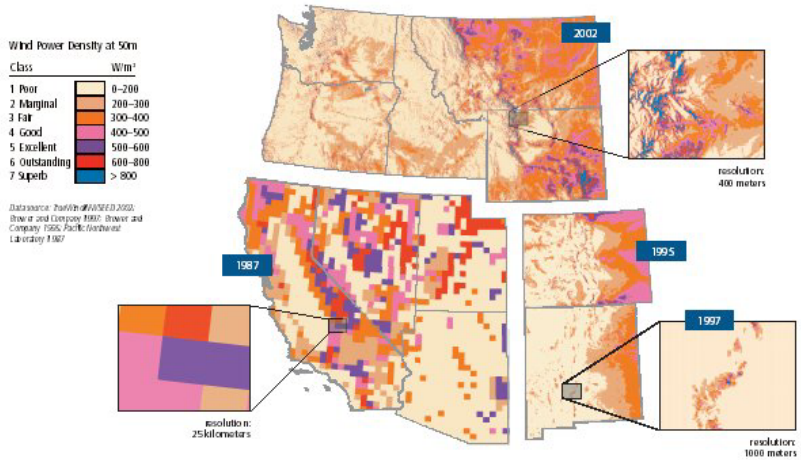
The Renewable Resources

Wind

Wind power is the fastest growing energy resource in the world. Good wind areas, found on 6% of the land in the Western states, could supply more than five times the region's current electricity consumption. This emission-free resource is already being harnessed across the region, but at a fraction of its potential.

Wind resources adequate to power commercial wind farms are very site specific. Relatively small differences in the average wind speed have major impacts on energy production.

The energy potential in the wind is expressed by wind power classes ranging from 1 (least energetic) to 7 (most energetic). Each class is defined by a range of wind speeds and power densities, the expected watts per square meter of the blade swept area. Nearly 2,300 Megawatts of wind turbines are currently installed in the eleven Western states (according to the American Wind Energy Association).



Wind Resource Maps: 1987 to 2002

Wind mapping techniques have improved significantly over the past 10 years. The 1987 Wind Energy Resource Atlas of the United States provided coarse approximations of wind resources. Although it was produced with the best methods available at the time, the 1987 atlas both underestimated and overstated wind resources for specific locations, as gridcell designations were only intended to represent well exposed areas. In the mid-1990s, updated techniques were used to produce maps for Colorado and New Mexico, increasing the resolution from 25 kilometers to 1 kilometer. Since 1997, wind mapping techniques have improved even further, and in 2002, updated maps were produced for Idaho, Montana, Oregon, Washington and Wyoming. The resolution is now 400 meters, a significant improvement over the old standard of 25 kilometers. The image above compares the most recent data for each of the eleven Western states.