SSG-WI 2008 Base Case

SSGwi

Seams Steering Group of the Western Interconnection

September 2005

Base Case Objectives

- **Estimate production costs for 2008**
  - Using different natural gas price assumptions
  - Total west-wide and area bases
- **Identify areas of transmission congestion**
- **Employ new modeling capabilities**
- **Refresh west-wide database**
  - Detailed resource and transmission information
  - Improved fuel price forecasts
  - Fuller coordination with states and subject matter experts

Base Case Results

- Wheeling charges & line losses
- Variable operation & maintenance costs (VOM)
- Congestion indicated by Locational Marginal Prices (LMP)
- Evaluation of congested paths

All analyses were conducted with transmission wheeling charges & line loss calculation, except as noted

SSGwi

Seams Steering Group of the Western Interconnection

Base Case Sensitivities

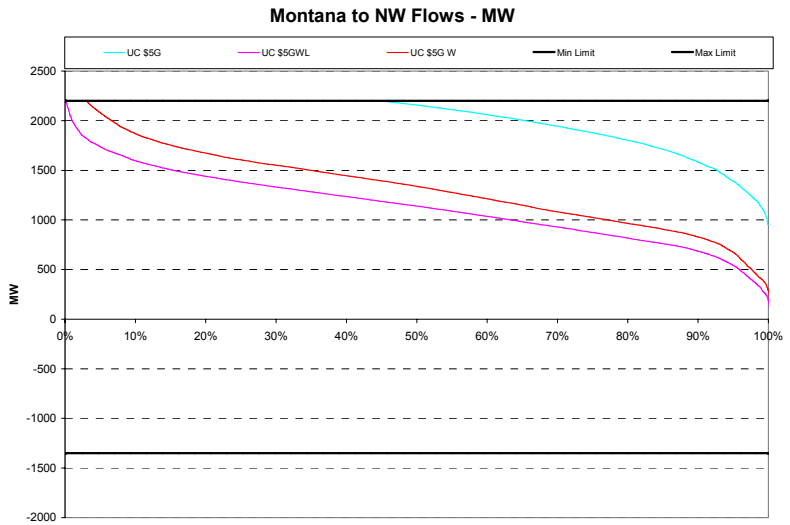
Base Henry Hub average prices in 2005 dollars			Transmission Losses
$4 Gas	**$5 Gas**	**$7 Gas**	
	x		
	x		**x**
x			**x**
		x	**x**
2008 Average Loads & Average Hydro			

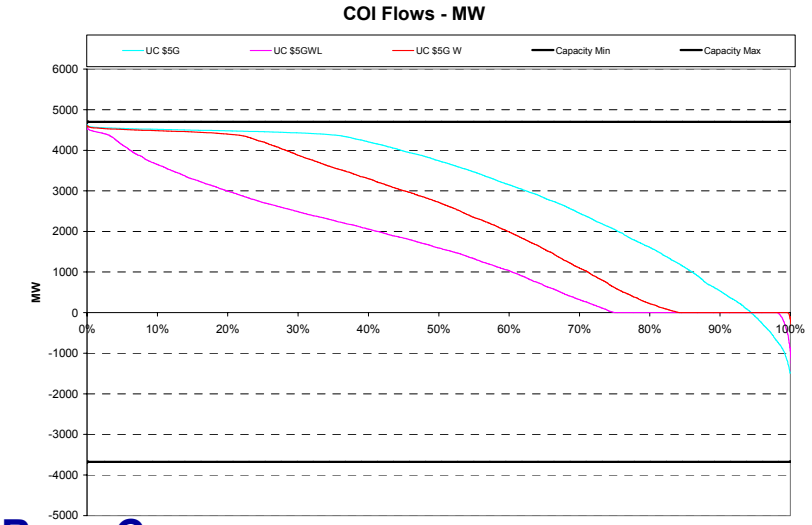
Wheeling Charges and Line Losses

SSGwi

Seams Steering Group of the Western Interconnection

Path Flow Impacts of Wheeling Charges and Transmission Losses





Cases

- $5 Gas: without line losses, and without wheeling charges
- $5 Gas W: with wheeling charges
- $5 Gas W L: with wheeling charges, and with line losses

Wheeling Charges

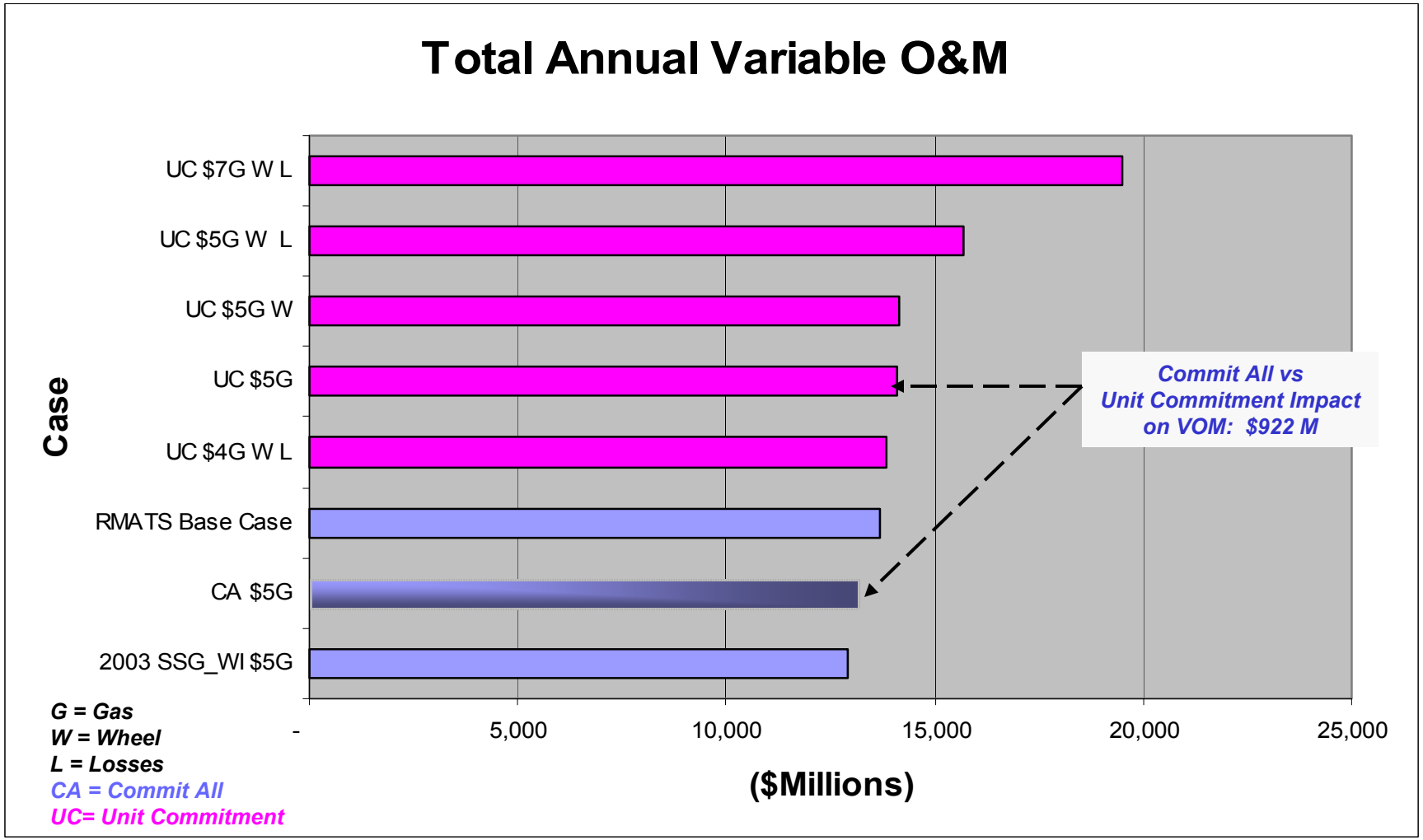
- Transmission wheeling charges place an added cost on using a line, which tends to reduce demand, in this case path flows (compare blue to red)

Line Losses

- Transmission losses penalize the remote generator by requiring that more MWs be generated and sent on a line to meet demand at the other end. This added production cost makes remote generators more expensive and local generators more competitive, reducing flow on major transfer paths.

2008 Base Case
September 2005

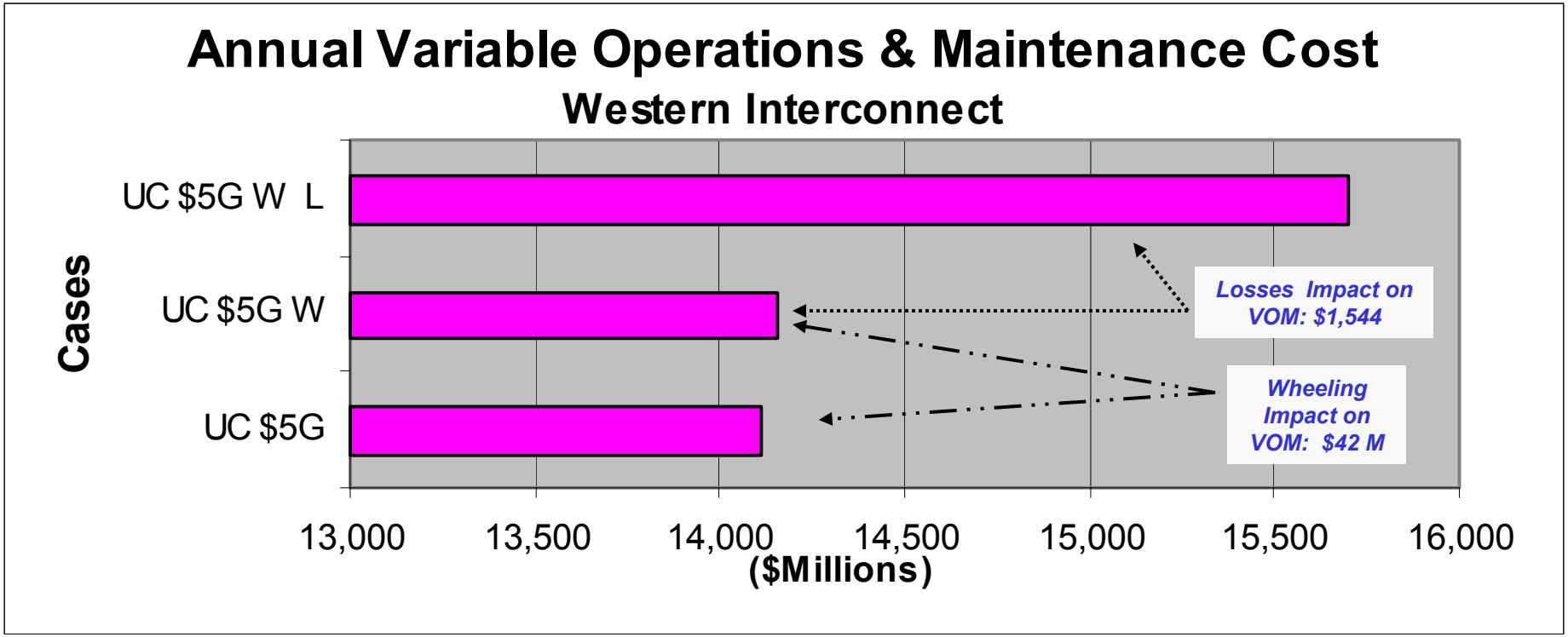
Production Costs



2008 Base Case
September 2005

SSGwi
Seams Steering Group of the Western Interconnection

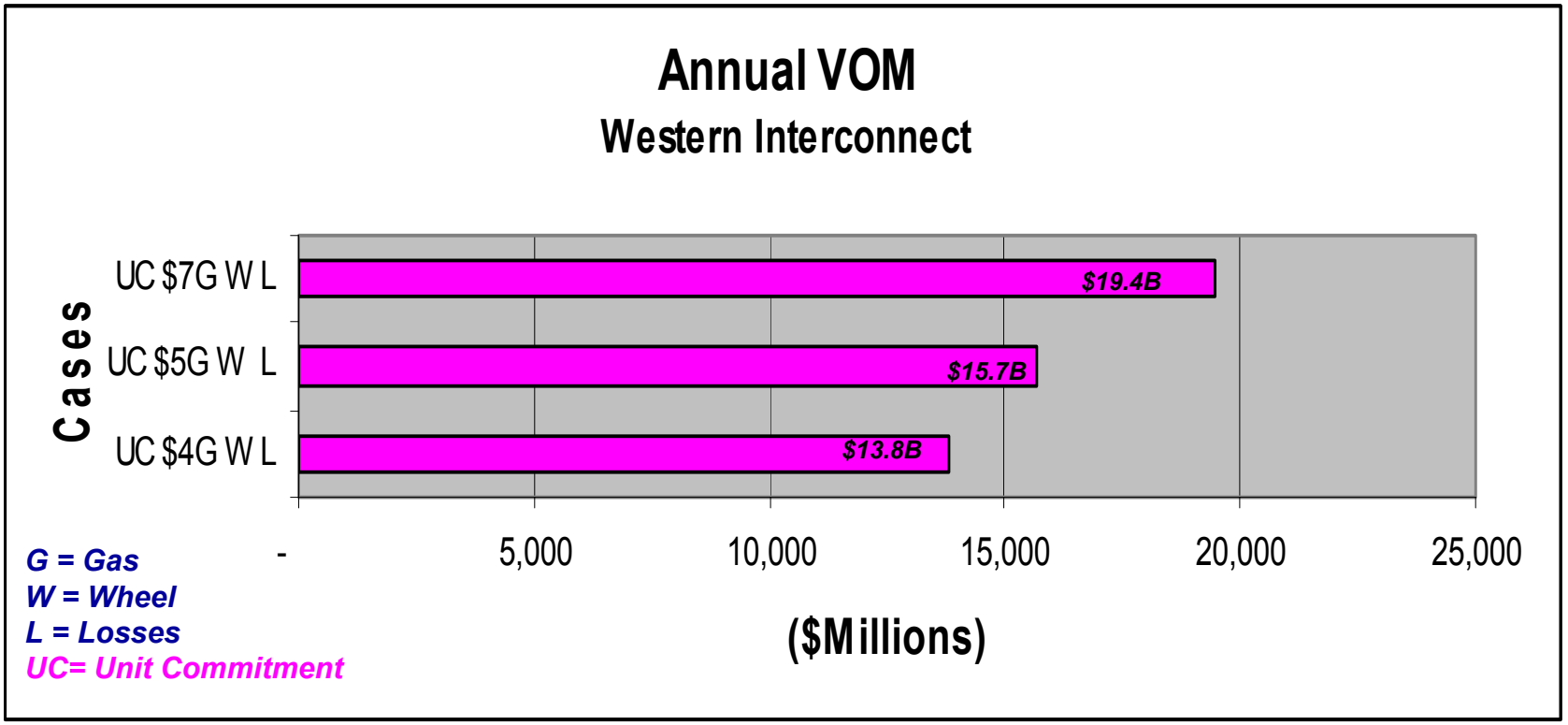
Production Cost Impact of Wheeling Charges and Transmission Losses



2008 Base Case
September 2005

Gas Price Sensitivities

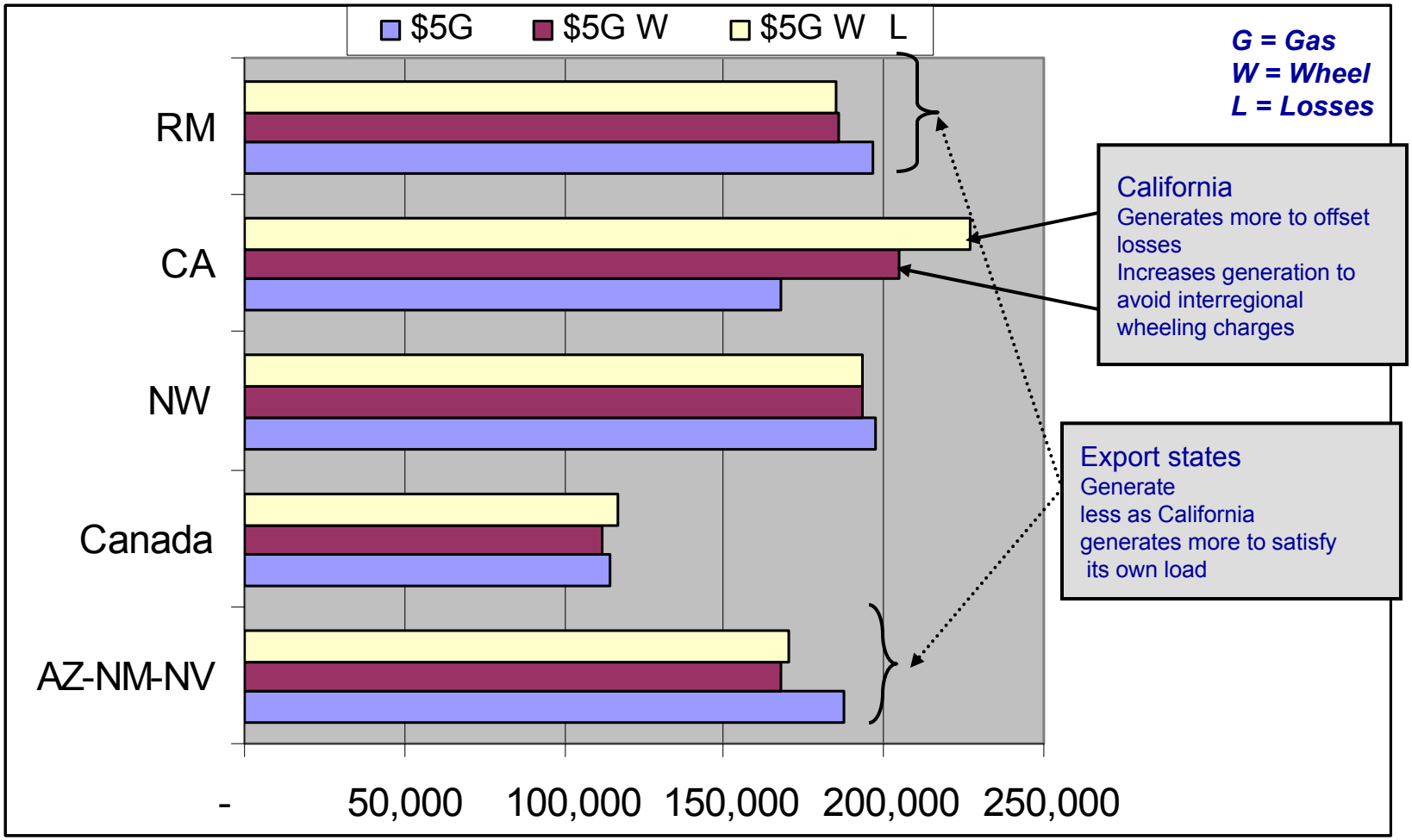
A $2 increase in HH gas prices ($5 to $7 annual average) causes the West's annual production costs to increase by $3.8 Billion



SSGwi
Seams Steering Group of the Western Interconnection

Generation Impact of Wheeling Charges and Transmission Losses

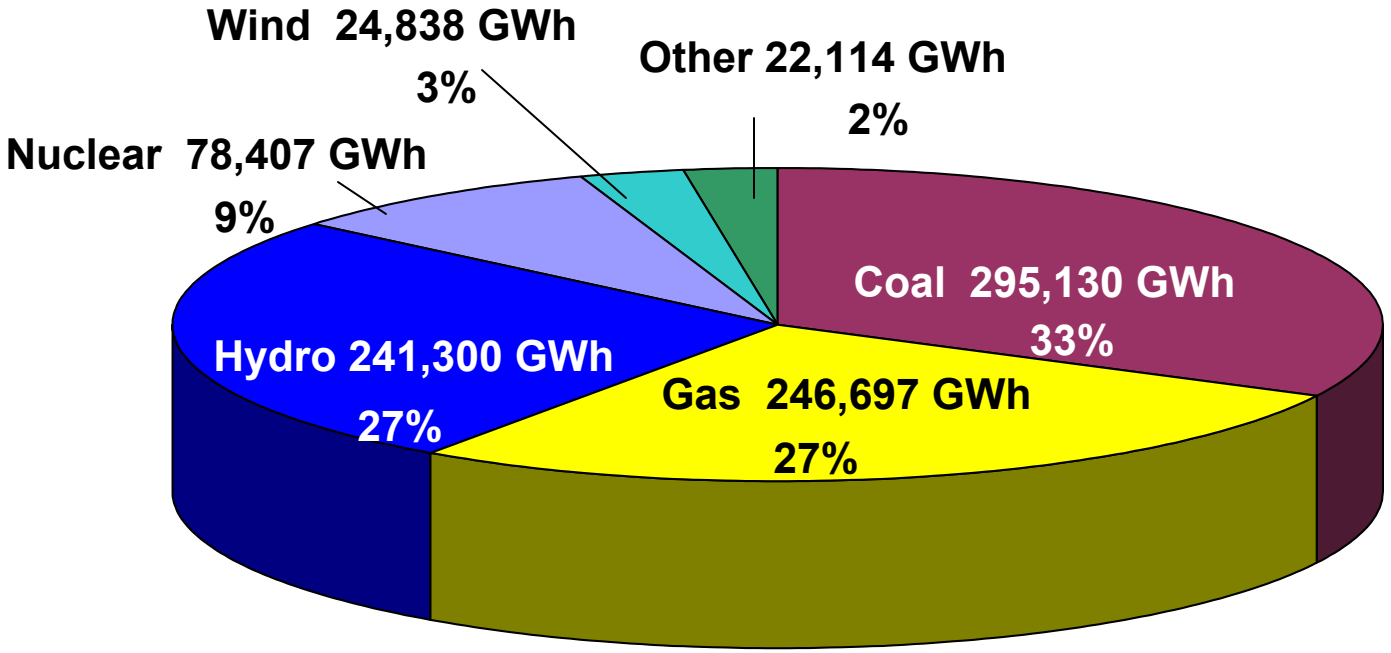
Western Interconnect Annual Generation



2008 Base Case
September 2005

Generation (Energy) by Fuel Type

WECC Region – 2008 Base Case



Total Generation = 908,486 GWh

$5 Henry Hub Gas, Wheeling Charges and Losses

Hydro: Includes pumped storage

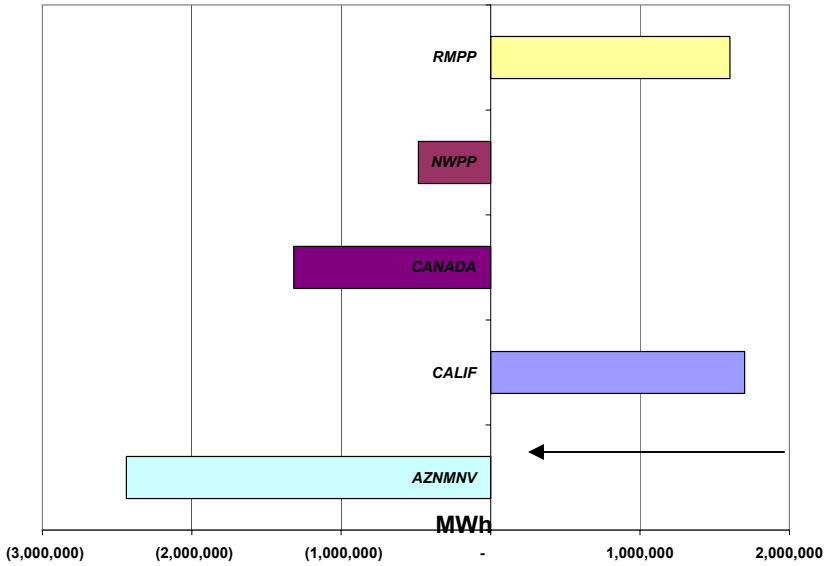
Other: Oil, Biomass, Geothermal, Solar

2008 Base Case
September 2005

Change in Generation by Region and Area

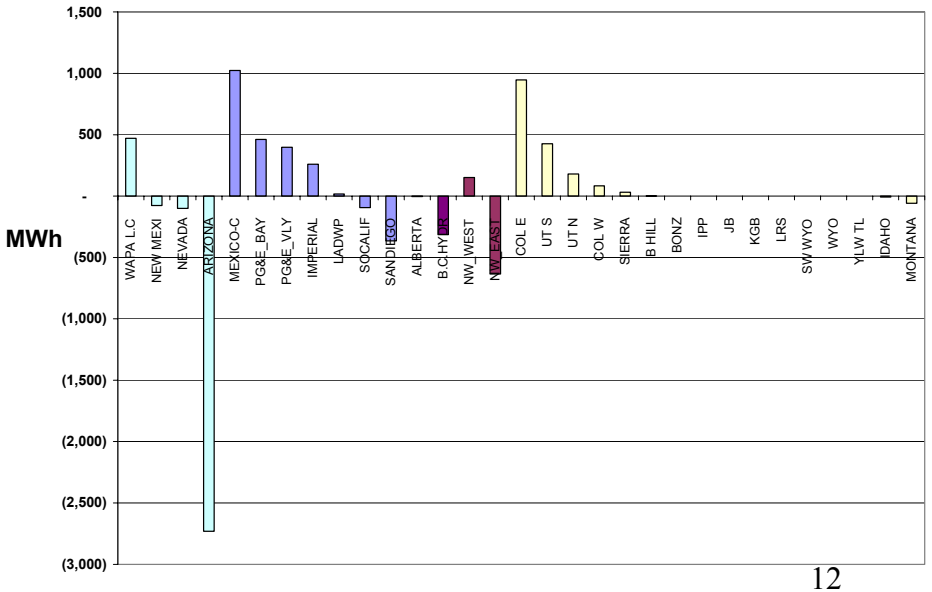
Due to Gas Price Increase from $5 to $7/MMBtu

Net Generation Change By Region



Generation in Arizona shows the most dramatic reaction (reduction) to a change in Gas price from HH $5 to $7/MMBtu

Net Generation Change By Area



Generation in Mexico-C and Colorado-East each show increases of approximately 1,000,000 MWh per year with the increased natural gas price

2008 Base Case
September 2005

SSGwi
Seams Steering Group of the Western Interconnection

Change in Generation by Fuel Type

Due to Gas Price Increase from $5 to $7/MMBtu

	GWh @ $7 HH	GWh @ $5 HH	Difference	Cap. Fact. @ $7	Cap. Fact. @ $5
Coal	295,132	295,130	0.0%	92.3%	92.3%
Gas	244,917	246,697	-0.7%	31.7%	31.9%
Hydro (Incl Pumped storage)	241,300	241,300	0.0%	42.7%	42.7%
Nuclear	78,407	78,407	0.0%	92.9%	92.9%
Wind	24,838	24,838	0.0%	44.8%	44.8%
Other	23,955	22,114	8.3%	46.9%	43.3%
	908,550	908,486	0.0%	49.1%	49.1%

Minor reduction in gas generation after increase of gas price.

Most of the difference made up by dispatching plants using "Other" fuels

	Gen @ $7HH	Gen @ $5HH	Capacity MW	Cap. Factor @ $7HH	Cap. Factor @ $5HH
Solar	1,673,587	1,673,587	213	89.9%	89.9%
Bio	4,390,121	4,258,685	556	90.2%	87.0%
Geothermal	2652864.03	2,652,864	337	89.9%	89.9%
Oil-H	7,703,851	4,466,877	968	90.9%	51.3%
Oil-L	39,452	0	892	0.5%	0.0%
Petroleum Coke	1,964	2,260,979	309	0.1%	80.7%
Refuse	692,898	327	185	42.7%	0.0%
Nuclear	78,407,445	78,407,445	9,637	92.9%	92.9%
WH	228,584	228,584	27	96.5%	90.3%
Wood	6,571,639	6,571,639	819	91.5%	89.1%

Oil-related fuels derivatives start dispatching at current oil price assumptions

2008 Base Case
September 2005

Transmission Congestion via Locational Marginal Prices (LMPs)

SSGwi

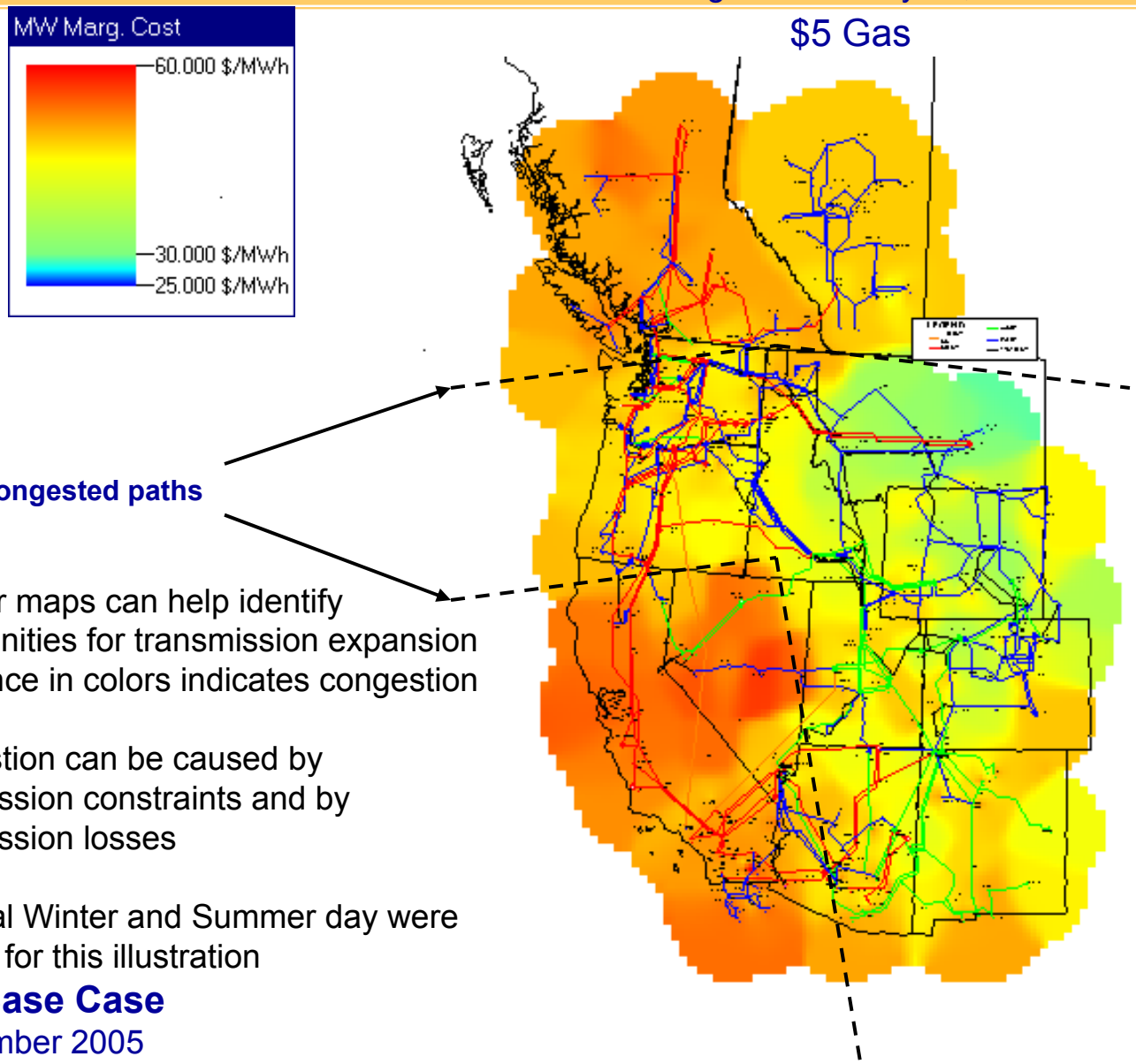
Seams Steering Group of the Western Interconnection

SSGwi
Seams Steering Group of the Western Interconnection

Transmission Congestion

Average for January 24, 2008

$5 Gas



Congested paths

Contour maps can help identify opportunities for transmission expansion
Difference in colors indicates congestion

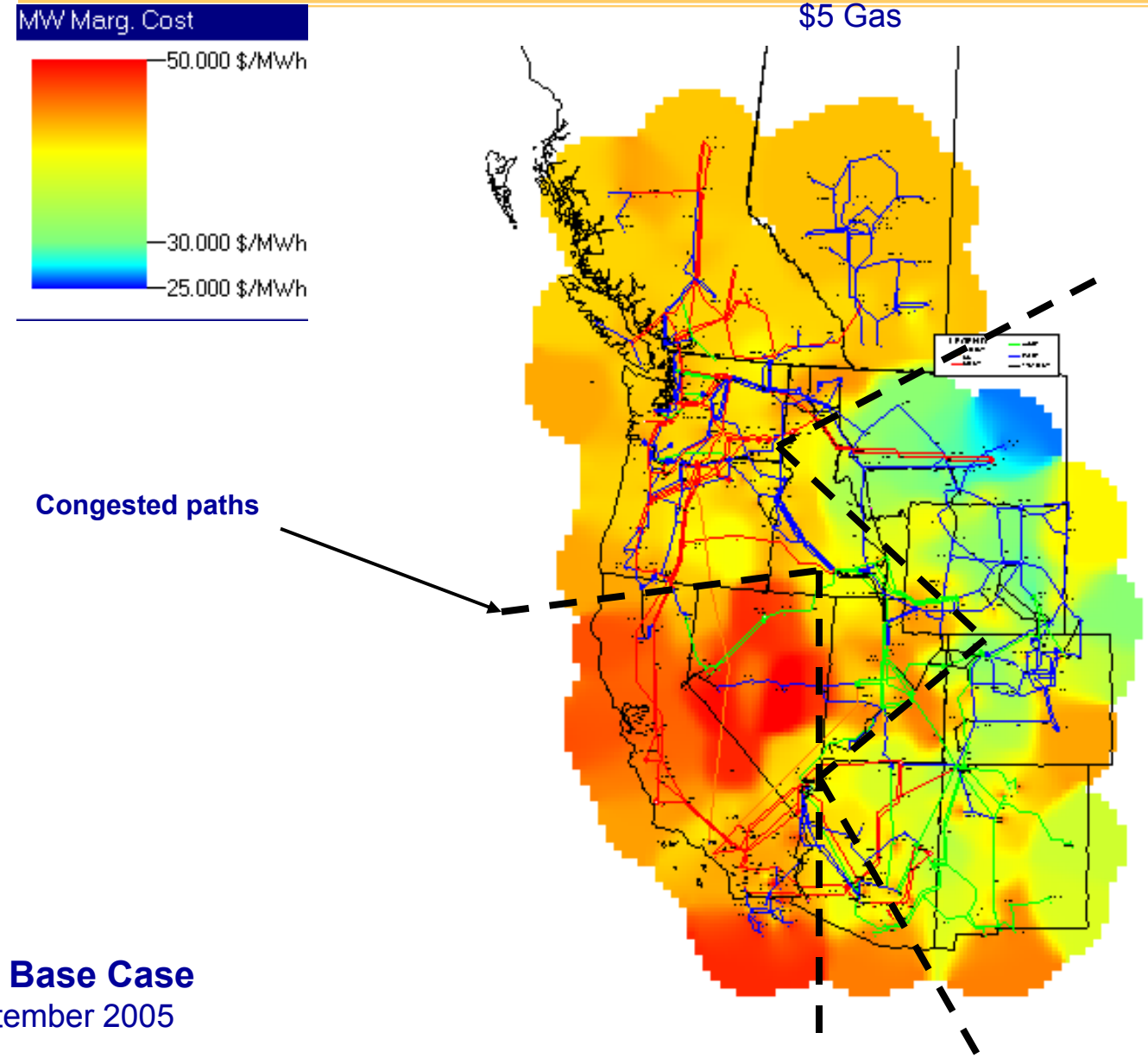
Congestion can be caused by transmission constraints and by transmission losses

A typical Winter and Summer day were chosen for this illustration

2008 Base Case
September 2005

Transmission Congestion

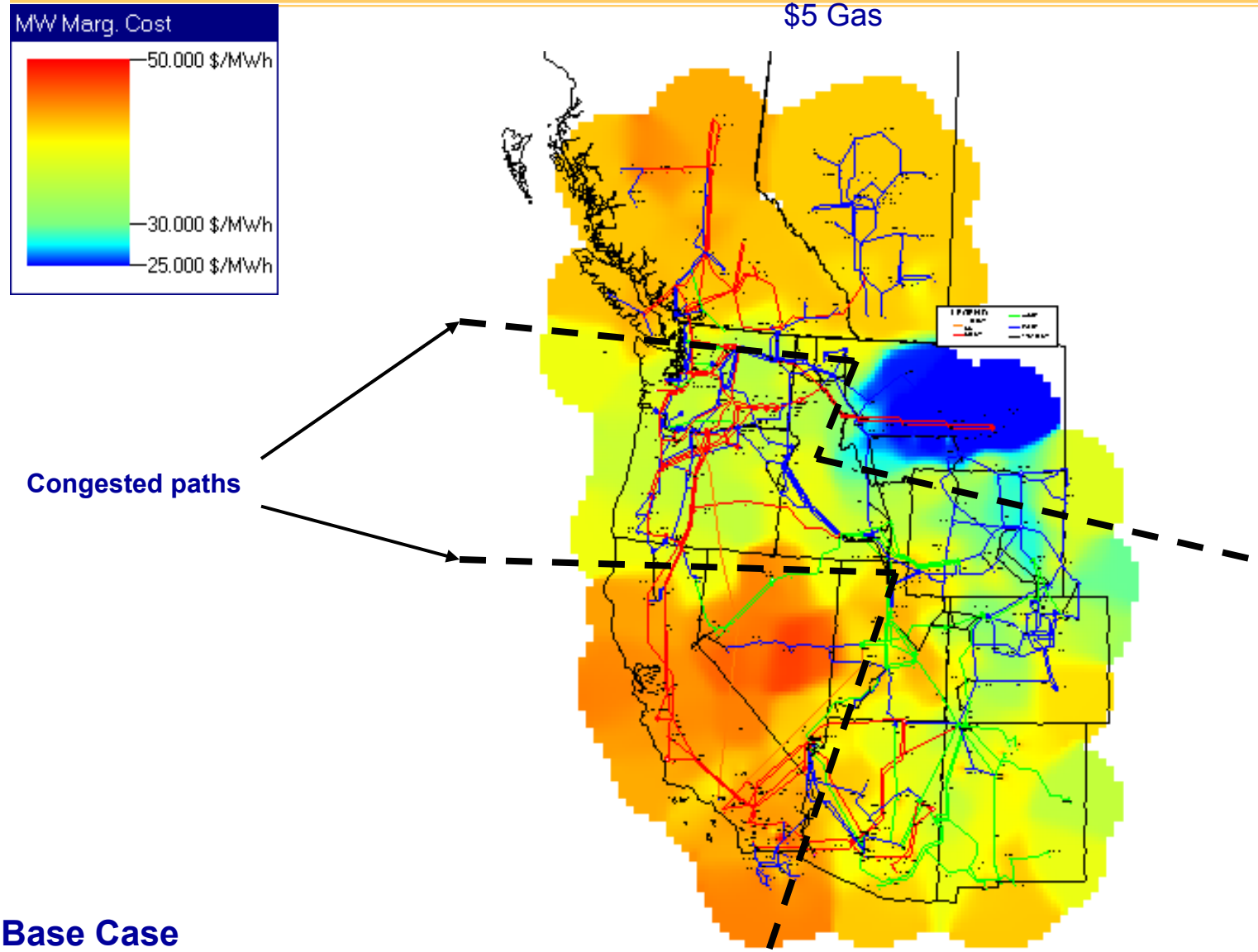
Average for August 11, 2008
$5 Gas



2008 Base Case
September 2005

Transmission Congestion

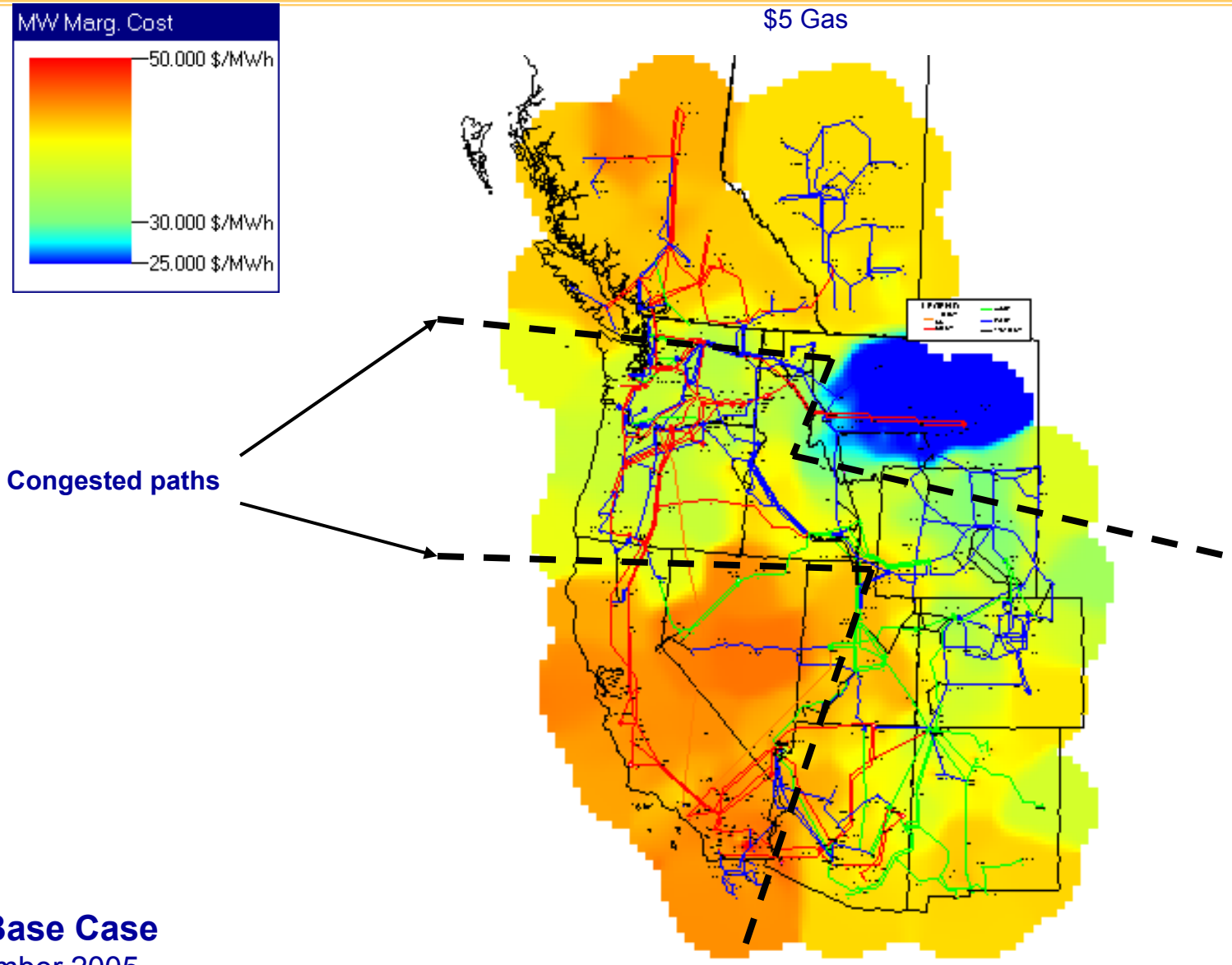
Average for June 16, 2008
$5 Gas



2008 Base Case
September 2005

Transmission Congestion

June 16, 2008 hr 10
$5 Gas



2008 Base Case
September 2005

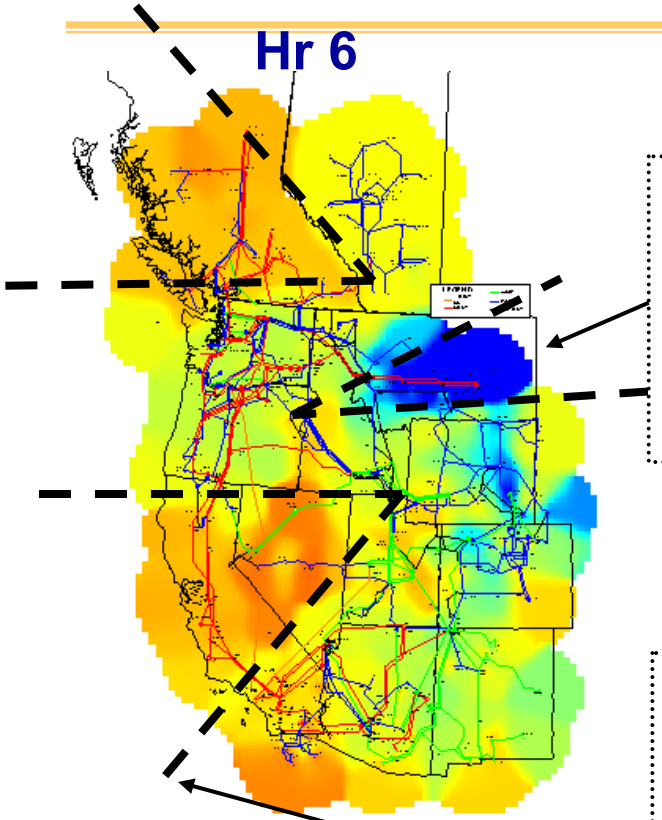
SSGwi
Seams Steering Group of the Western Interconnection

Transmission Congestion

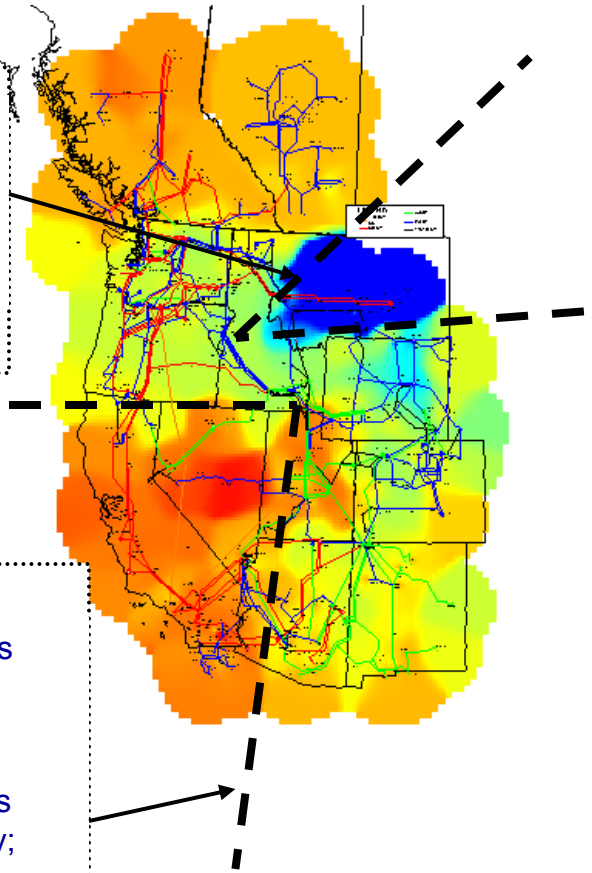
June 16, 2008

$5 Gas

Hr 6



Hr 16



Dark Blue indicates bottled energy due to congestion (supply > than demand, power cannot get out)

LMPs increase as loads pick up during the day due to:

1) Congested paths (demand>supply; cannot import)
2) Gas generation becomes the marginal unit

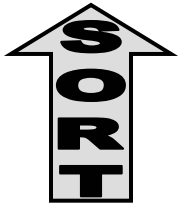
2008 Base Case
September 2005

Incremental Congestion Costs

Savings if capacity on congested paths increases by 1 MW

Interface Name	Forward Limit (MW)	Reverse Limit (MW)	Rank			Congestion Cost (k$) (Shadow Price X Path Flow)		
			$4 Gas	$5 Gas	$7 Gas	$4 Gas	$5 Gas	$7 Gas
IPP DC LINE	1920	-1400	1	1	1	7,476	9,696	12,347
PATH C	775	-850	2	2	2	5,831	6,037	6,086
Navajo - Crystal	1411	-1411	3	3	4	3,992	3,509	4,168
BONANZA WEST	785		4	4	3	2,661	3,158	5,715
CORONADO - SILVER KING - KYRENE	1100		8	5	5	1,364	2,167	3,232
NORTHWEST - CANADA	2000	-2800	7	6	6	1,484	1,955	2,780
ALBERTA - BRITISH COLUMBIA	700	-720	5	7	8	1,949	1,899	2,097
FOUR CORNERS 345_500	840	-840	6	8	7	1,515	1,644	2,379
SOUTHWEST OF FOUR CORNERS	2325		9	9	9	550	835	945
TOT 2C	300	-300	11	10	10	364	595	857
BRIDGER WEST	2100		10	11	11	503	360	645
TOT 1A	650		13	12	13	217	186	201
PACIFICORP_PG&E 115 KV INTERCON.	80	-45	14	13	14	151	152	157
El Centro Bank	215	-215	15	14	15	115	127	157

Incremental congestion costs, combined with line-loading data (see duration curves later in this package), help to focus potential investment.



Key Assumptions

- Network representation
- Loads
- Resources
- Fuel Prices

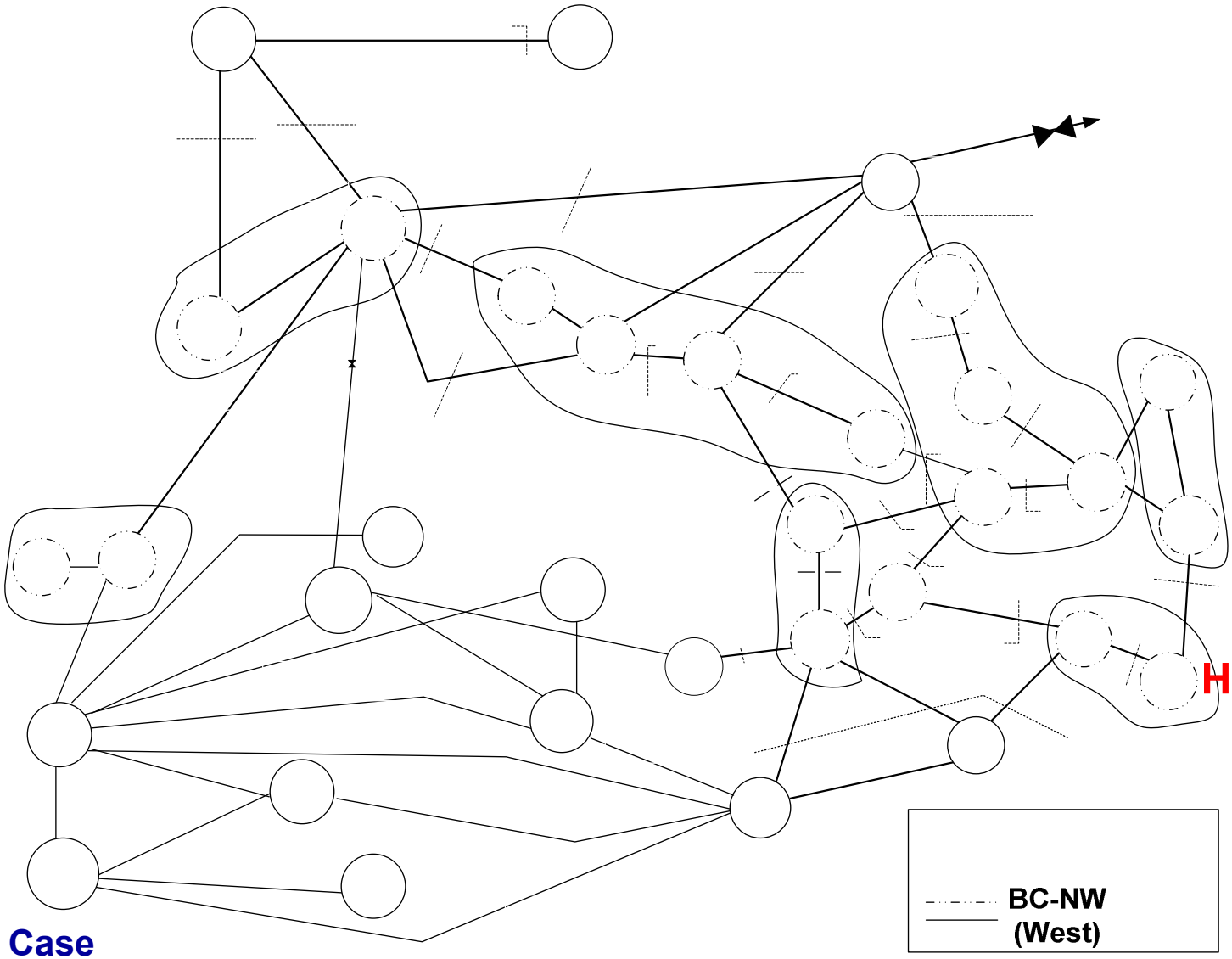
SSGwi

Seams Steering Group of the Western Interconnection

Network Representation and Topology

- **Used WECC Powerflow case (2008 HS2A) for network definition**
  - Powerflow case includes transmission assets and resources, and simulates power flows.
  - Case was rerun to net out station service capacity from Pmax and to include updates since the case was published.
  - Case was not rerun to reflect currently planned resources as revisions were applied direct in GridView.
- **Used WECC 22-bubble network topology, with these exceptions:**
  - The single NW bubble is split into west and east NW bubbles.
  - The single PG&E bubble is split into Bay Area and PG&E bubbles to accommodate variations in load shapes.
  - The RMATS topology is used for the Rocky Mountain states, except that the Montana bubbles are reduced from 2 to 1. The SSG_WI topology includes a total of 33 bubbles.

SSG-WI Topology



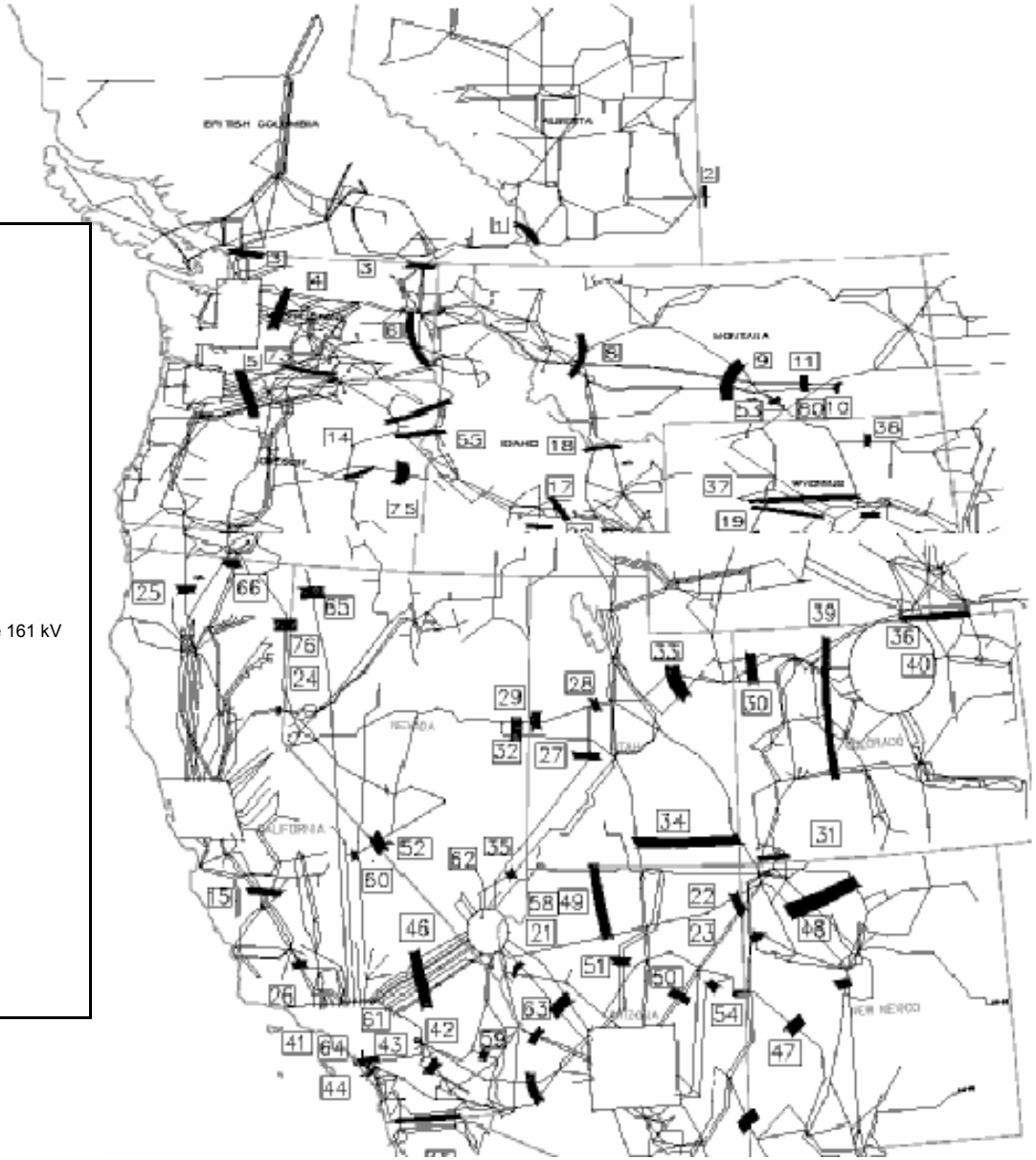
2008 Base Case
September 2005

SSGwi
Seams Steering Group of the Western Interconnection

Western Interconnect

Major Paths

1. Alberta-British Columbia	38. TOT 4B
2. Alberta-Saskatchewan	39. TOT 5
3. Northwest-Canada	40. TOT 7
4. West of Cascades-North	41. Sylmar to SCE
5. West of Cascades-South	42. IID-SCE
6. West of Hatwai	43. North of San Onofre
7. Intentionally Left Blank	44. South of San Onofre
8. Montana to Northwest	45. SDG&E-CFE
9. West of Broadview	46. West of Colorado River (WOR)
10. West of Colstrip	47. Southern New Mexico (NM1)
11. West of Crossover	48. Northern New Mexico (NM2)
12. Intentionally Left Blank	49. East of the Colorado River (EOR)
13. Intentionally Left Blank	50. Cholla-Pinnacle Peak
14. Idaho to Northwest	51. Southern Navajo
15. Midway-Los Banos	52. Silver Peak-Control 55 kV
16. Idaho-Sierra	54. Coronado West
17. Borah West	55. Brownlee East
18. Idaho-Montana	58. Eldorado-Mead 230 kV Lines
19. Bridger West	59. WALC Blythe 161 kV -SCE Blythe 161 kV
20. Path C	60. Inyo-Control 115 kV Tie
21. Arizona to California	61. Lugo-Victorville 500 kV Line
22. Southwest of Four Corners	62. Eldorado-McCullough 500 kV line
23. Four Corners 345/500 Qualified Path	63. Perkins-Mead-Marketplace
24. PG&E-Sierra	500 kV Line
25. PacifiCorp/PG&E 115 kV Interconnection	64. Marketplace-Adelanto
26. Northern-Southern California	65. Pacific DC Intertie (PDCI)
27. Intermountain Power Project DC Line	66. COI
28. Intermountain-Mona 345 kV	71. South of Allston
29. Intermountain-Gonder 230 kV	73. North of John Day
30. TOT 1A	75. Midpoint-Summer Lake
31. TOT 2A	76. Alturas Project
32. Pavant-Gonder 230 kV	77. Crystal-Allen
33. Bonanza West	78. TOT 2B1
35. TOT 2C	79. TOT 2B2
36. TOT 3	80. Montana Southeast
37. TOT 4A	



2008 Base Case
September 2005

SSGwi
Seams Steering Group of the Western Interconnection

SSG-WI Path Limits

WECC Path Catalogue Operating Limits & Other Adjustments Made by SSG_WI

Interface Name	Forward Limit (MW)	Reverse Limit (MW)
ALBERTA - BRITISH COLUMBIA	700	-720
ALBERTA - SASKATCHEWAN	150	-150
ALTURAS PROJECT	300	-300
BILLINGS - YELLOWTAIL	400	-400
BONANZA WEST	785	
BORAH WEST	2307	
BORAH WEST	2200	
BROWNLEE EAST	1850	
CHOLLA - PINNACLE PEAK	1200	
COI	4700	-3675
CORONADO - SILVER KING - KYRENE	1100	
Crystal - H Allen 500 kV PS	950	
Crystal - H Allen230 kV PS	950	
Devers Bank No. 1	1120	-1120
EAGLE MTN 230_161 KV - BLYTHE 16		-218
El Centro Bank	215	-215
EOR	8055	
FOUR CORNERS 345_500	840	-840
HA-Red Butte PS	300	-300
IDAHO - MONTANA	337	-337
IDAHO - NORTHWEST	2400	-1200
IDAHO - SIERRA	500	-360
IID - SCE	600	
INTERMOUNTAIN - GONDER 230 KV	220	
INTERMOUNTAIN - MONA 345 KV	1400	-1200
INYO - CONTROL 115 KV TIE	56	-56
IPP DC LINE	1920	-1400

Interface Name	Forward Limit (MW)	Reverse Limit (MW)
MIDPOINT - SUMMER LAKE	1500	-600
MIDWAY - LOS BANOS	5400	
MONTANA - NORTHWEST	2200	-1350
NORTH OF JOHN DAY	8600	-8600
North of Miguel	2000	
NORTH OF SAN ONOFRE	2440	
NORTHERN NEW MEXICO (NM2)	1665	-1450
NORTHWEST - CANADA	2000	-2800
NW to Canada East BC	400	-400
PACI vs PDCI	7300	
PACIFIC DC INTERTIE (PDCI)	3000	-2100
PACIFICORP_PG&E 115 KV INTERCON.	80	-45
Path 26	3700	-3000
Path 45	408	-800
PATH C	775	-850
PAVANT INTRMTN - GONDER 230 KV	440	-235
PERKINS - MEAD - MARKETPLACE 500	1400	
PG&E - SPP	160	-150
Pinto - 4 Corners PS	600	-600
PV West	3600	
SCIT	16700	-16700
SDGE Import Limit	2850	
Shiprock - Lost Canyon PS	400	-400
Sigurd - Glen Canyon PS	300	-300
SILVER PEAK - CONTROL 55 KV	17	-17
South of Lugo	6100	-6100
South of Navajo	2264	

Interface Name	Forward Limit (MW)	Reverse Limit (MW)
SOUTH OF SAN ONOFRE	2500	
SOUTHERN NEW MEXICO (NM1)	1048	-1048
SOUTHWEST OF FOUR CORNERS	2325	
SYLMAR - SCE	1600	-1600
TOT 4a 4b combined	1096	
TOT 1A	650	
TOT 2A	690	
Tot 2a 2b 2c Nomogram	1570	-1600
TOT 2B	780	-850
TOT 2B1	560	-600
TOT 2B2	265	-300
TOT 2C	300	-300
TOT 3	1450	
TOT 4A	810	
TOT 4B	680	
TOT 5	1675	
TOT 7	890	
WEST OF BROADVIEW	2573	
WEST OF CASCADES - NORTH	10500	-10500
WEST OF CASCADES - SOUTH	7000	-7000
WEST OF COLSTRIP	2598	
WEST OF CROSSOVER	2598	
WEST OF HATWAI	2750	
WOR	10623	
WOR - IID230	600	-600
WOR - N.Gila	1861	
WOR -n- El Dor to Lugo	2754	
WOR -n- Mc-Vic	2592	

2008 Base Case
September 2005

Wheeling Charges

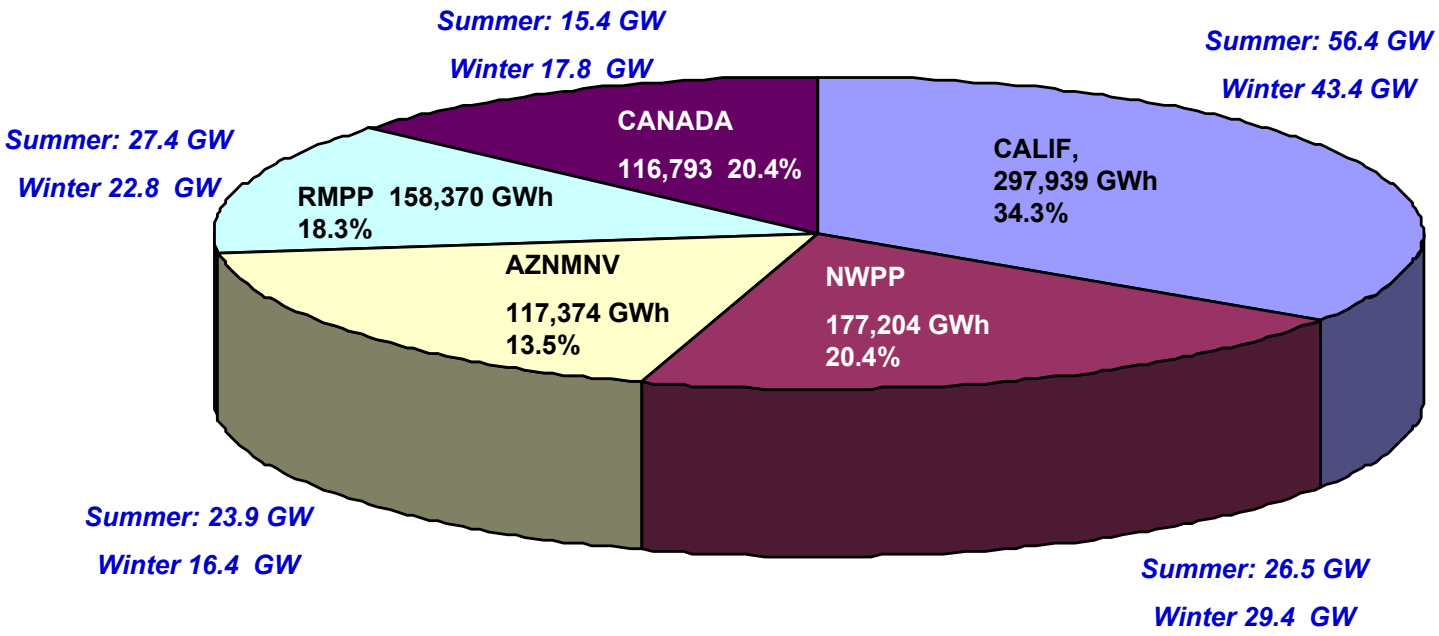
INTERTIE	Forward, $/MW	Based on Tariff for:	Reverse, $/MW	Based on Tariff for:
ALBERTA - BRITISH COLUMBIA	4.00	*Alberta*	5.00	*BC Hydro*
NORTHWEST - CANADA	2.96	*BPA Network*	5.00	*BC Hydro*
MONTANA - NORTHWEST	7.86	*BPA NT plus Mt Intertie*	2.96	*BPA Network*
IDAHO - NORTHWEST	2.07	*IDAHO*	3.60	*Ave Avista, BPA, PacifiCorp*
IDAHO - SIERRA	2.07	*IDAHO*	6.00	*SPPC*
IDAHO - MONTANA	2.07	*IDAHO*	4.25	*Northwestern*
PACIFICORP_PG&E 115 KV INTERCON.	5.84	*PacifiCorp*	3.20	*PG & E*
INTERMOUNTAIN - MONA 345 KV	9.00	*LADWP*	5.84	*PacifiCorp*
INTERMOUNTAIN - GONDER 230 KV	9.00	*LADWP*	6.00	*SPPC*
TOT 1A	2.50	*WAPA UC*	7.42	*Deseret*
PAVANT INTRMTN - GONDER 230 KV	5.84	*PacifiCorp*	6.00	*SPPC*
TOT 2B	5.84	*PacifiCorp*	2.80	*ARIZONA*
TOT 2C	5.84	*PacifiCorp*	4.09	*NEVADA*
TOT 3	3.00	*Estimate*	3.00	*Estimate*
Z2-EOR	2.80	*ARIZONA*	3.10	*SOCALIF*
PACIFIC DC INTERTIE (PDCI)	6.35	*BPA NT plus Intertie*	12.39	*LADWP + Intertie*
Z6-COI	6.35	*BPA NT plus Intertie*	6.59	*PG & E + Intertie*

- Charges above are based on published tariffs (Non-firm, on-peak hourly charge for originating utility)
- Because the charge is determined by the area's originating utility it may be different by direction (Forward/Reverse)
- The charges are modeled at a path, not line, level. Intent is to show friction between control areas.
- Pacific DC Intertie Rate : Bonneville Power Administration (BPA) has two different types of tariff. The Intertie rate is used to bring power into the network. The Intertie rate itself is not a network tariff. Charges for transactions using the Intertie attract its charge as well as the originating utility's wheeling rate.

SSGwi
Seams Steering Group of the Western Interconnection

2008 Load Forecast: Annual Energy and Non-Coincident Peaks (GW)

Based on WECC L&R Forecast issued in 2004, with SSG-WI modifications



Total Load (Energy): 867,680 GWh

Total Non-Coincident Summer Peak: 149.5 GW

2008 Base Case
September 2005

SSGwi
Seams Steering Group of the Western Interconnection

WECC Non-Coincident Peak Load by Area

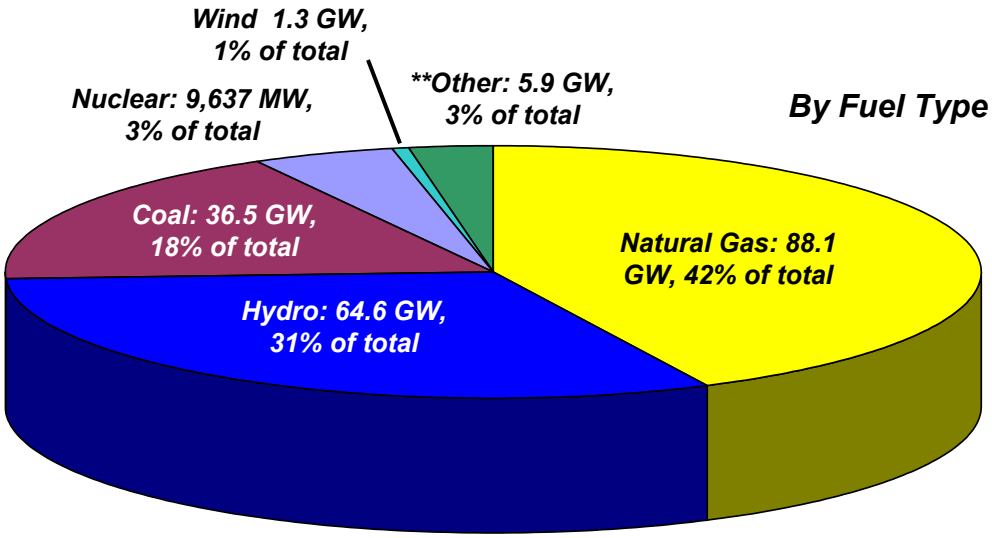
		Summer MW July-August Summer MW	Winter MW Dec-Jan Winter MW			Summer MW July-August Summer MW	Winter MW Dec-Jan Winter MW
CAISO	IMPERIAL	740	351	RMPP	B HILL	851	835
CAISO	LADWP	5,396	4,059	RMPP	BHB	425	474
CAISO	MEXICO-C	1,631	1,223	RMPP	BONZ	197	147
CAISO	PG&E_BAY	7,998	6,887	RMPP	COL E	8,878	7,920
CAISO	PG&E_VLY	17,240	13,103	RMPP	COL W	871	913
CAISO	SANDIEGO	3,254	3,091	RMPP	IDAHO	3,025	2,311
CAISO	SOCALIF	20,106	14,652	RMPP	IPP	1	1
	Total	56,365	43,366	RMPP	JB	1	1
				RMPP	KGB	1,275	965
AZNMNV	ARIZONA	15,204	10,578	RMPP	LRS	531	520
AZNMNV	NEVADA	4,998	2,592	RMPP	MONTANA	1,611	1,620
AZNMNV	NEW MEXI	3,290	2,882	RMPP	SIERRA	1,737	1,439
AZNMNV	WAPA L.C	358	355	RMPP	SW WYO	481	400
	Total	23,850	16,407	RMPP	UT N	6,256	4,295
				RMPP	UT S	967	672
CANADA	ALBERTA	8,217	8,570	RMPP	WYO	338	289
CANADA	B.C.HYDR	7,199	9,187	RMPP	YLW TL	1	1
	Total	15,416	17,757		Total	27,446	22,803
NWPP	NW_EAST	10,955	12,017				
NWPP	NW_WEST	15,508	17,378				
	Total	26,463	29,395				
					Total West Non-Coincident Peak MW	149,540	129,728

	Summer MW July-August	Winter MW Dec-Jan
Coincident West Peak MW	143,710	123,673

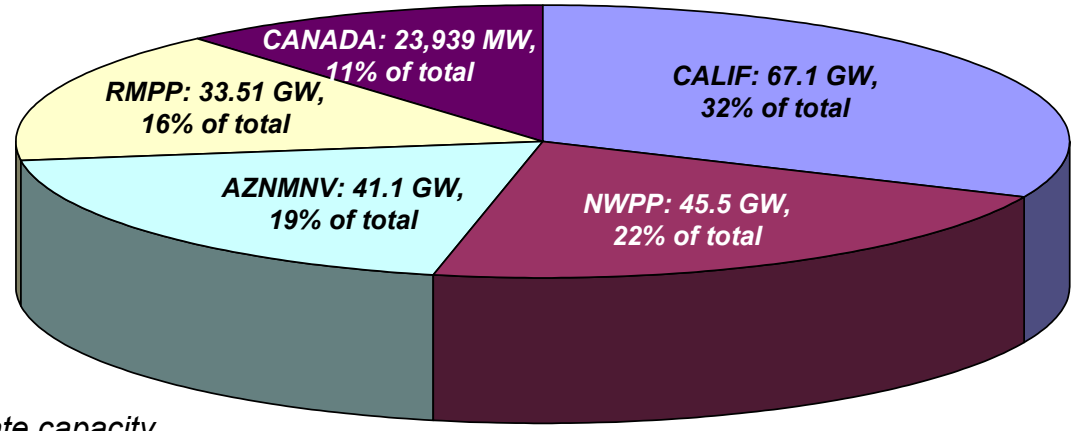
2008 Base Case
September 2005

SSGwi
Seams Steering Group of the Western Interconnection

WECC Resource Capacity by Fuel Type and Region



By Fuel Type



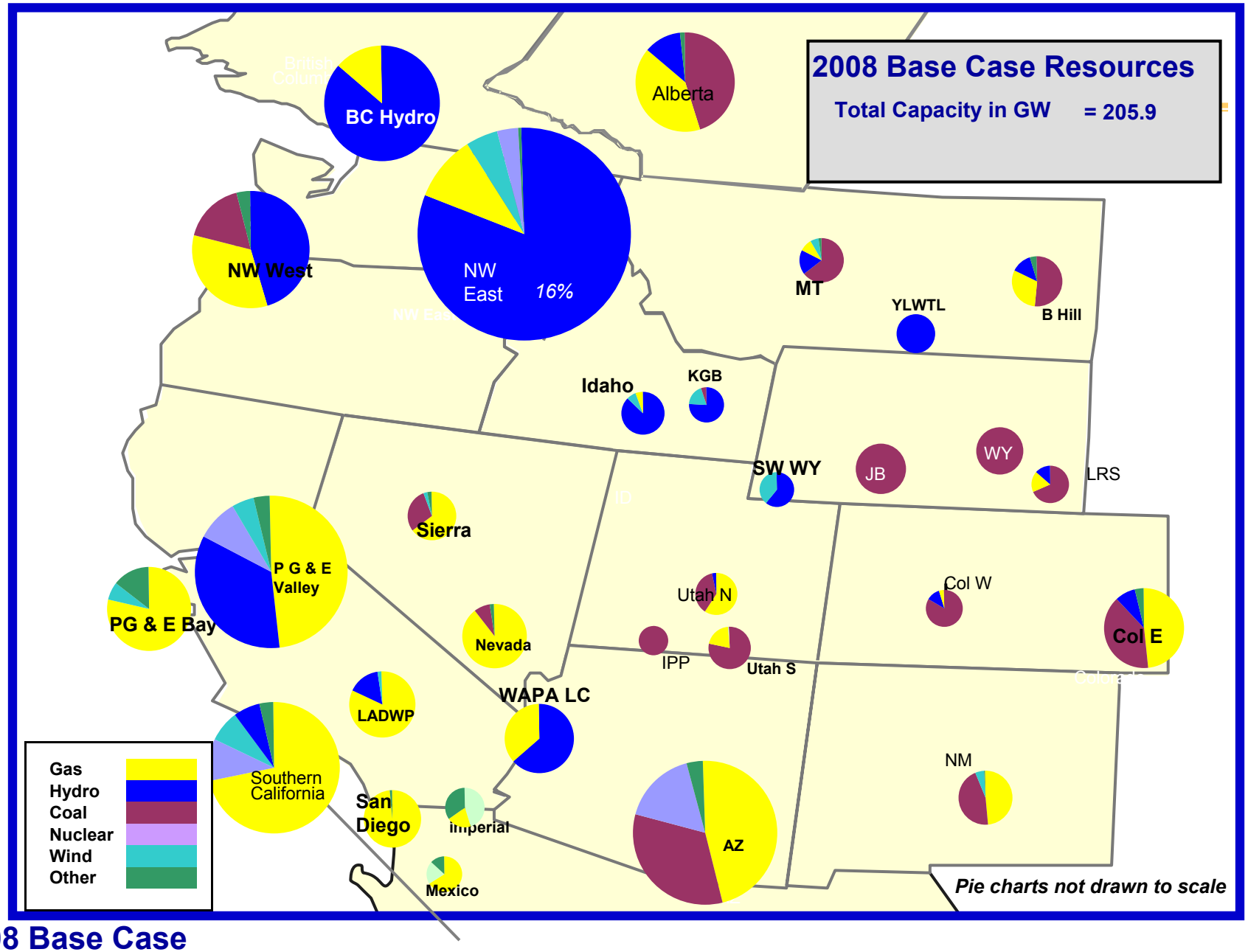
By Region

Total WECC *Capacity = 205.9 GW

**Capacity includes 80% discount of wind nameplate capacity*

***Other: Oil, Biomass, solar, oils*

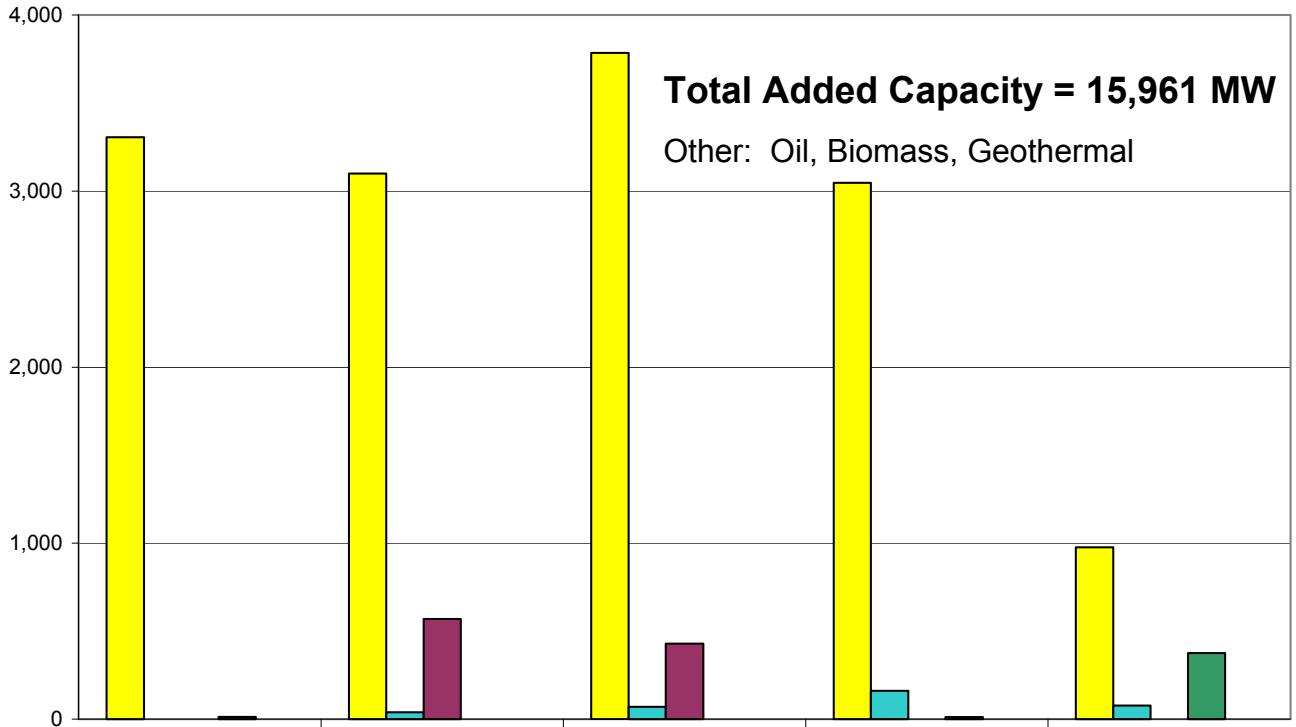
2008 Base Case
September 2005



2008 Base Case

September 2005

New Capacity 2004-2008 by Fuel Type

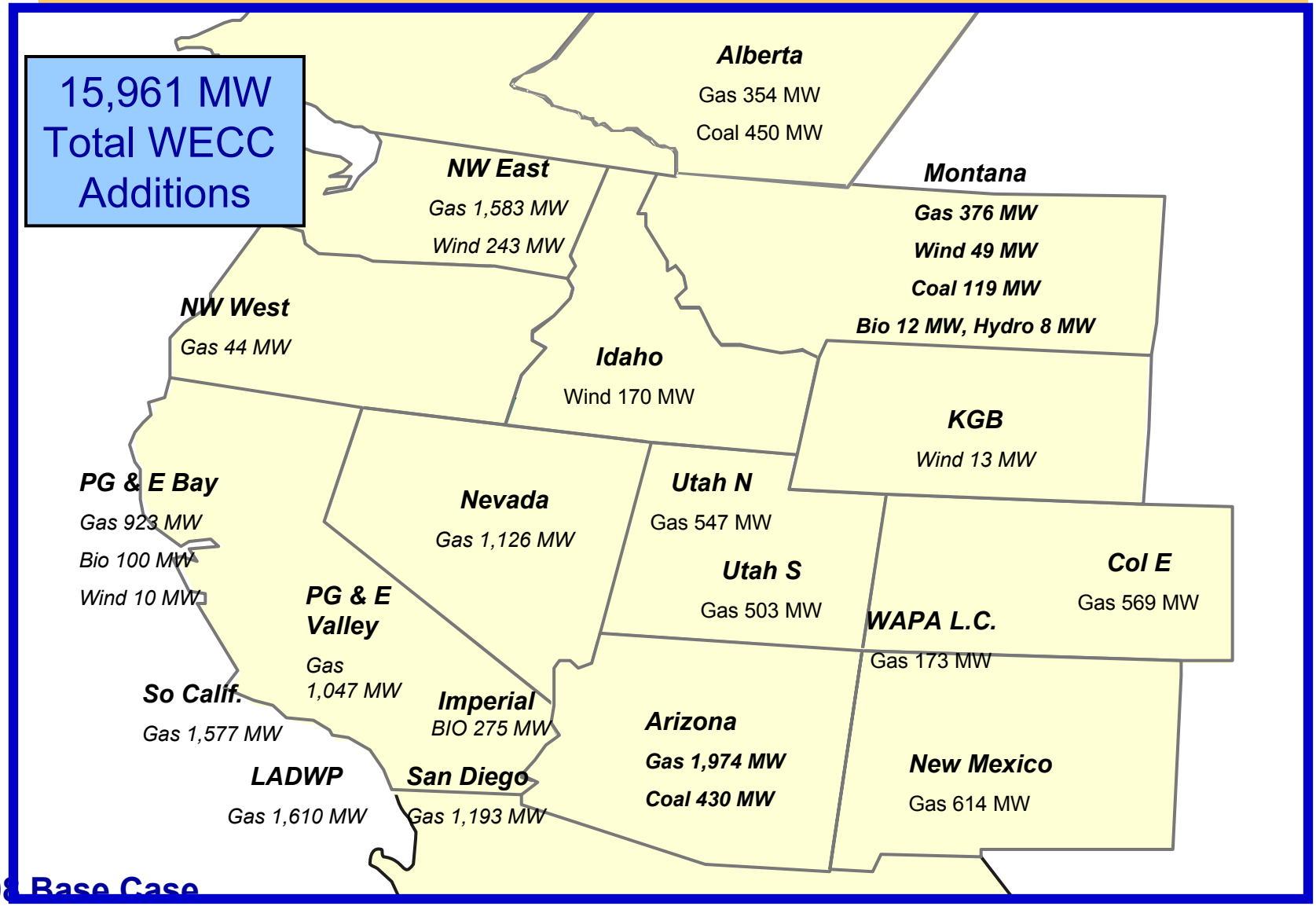


	2004	2005	2006	2007	2008
Gas	3,306	3,099	3,784	3,047	977
**Wind		39	70	162	78
Coal		569	430		
Other	13	0	0	12	375
Total Additions	3,319	3,708	4,284	3,221	1,430

**Wind is shown at 80% discount to installed capacity*

2008 Base Case
September 2005

NEW CAPACITY BY AREA 2004-2008



2008 Base Case

September 2005

***Wind is shown at 80% discount to installed capacity**

Modeling Assumptions for Hydro and Wind Units

Hydro:

- Northwest hydro generation reflects on historical hourly generation for high (yr 1999), low (yr 2003) and medium (yr 2002) hydro years.
- California and British Columbia actual data were aggregated by river system

Wind:

- Shapes applied to most wind generation was supplied by National Renewable Energy Lab
- CAISO provided wind shapes for its areas based on actual data

Both hydro and wind are treated as fixed inputs to model

Modeling Assumptions for Thermal Unit Operation

Generic, unit-level operational assumptions were developed in a manner that:

- allows dispatch and production costs to be simulated with reasonable accuracy
- takes into account technical expertise and views of States, SPGs and others
- protects commercial sensitivities
- ensures licensing agreements are respected

Generic, unit based assumptions include:

- Heat rate curves, minimum and summer de-rated capacity
- Minimum up and down times, forced outage and planned maintenance rates
- Variable non-fuel O&M (operation & maintenance) and start-up costs

Development of Generic Assumptions:

Heat Rate Curve Example

Use publicly available information, previous studies (SSG-WI, RMATS), and input from states and experts to identify 1,200+ units.

Assign units to thermal unit "buckets" based on:

- Technology type
- Capacity
- Fuel
- Vintage

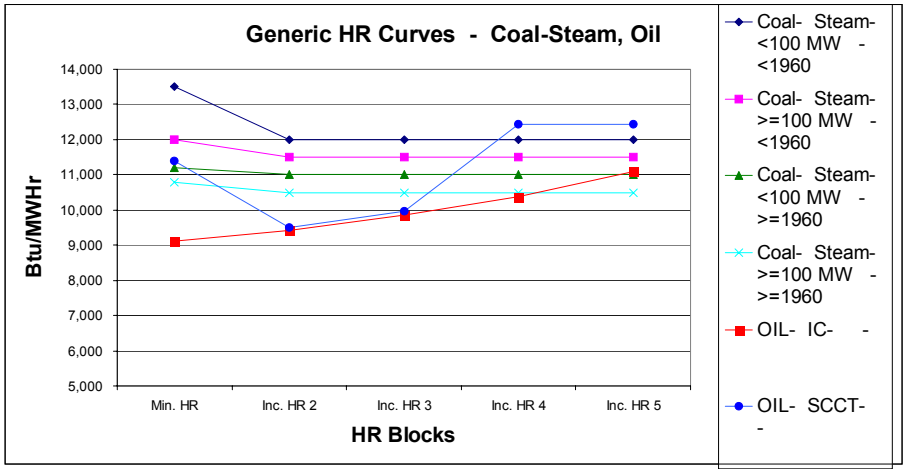
Use commercial database to supply unit-level data that best represents each thermal bucket.

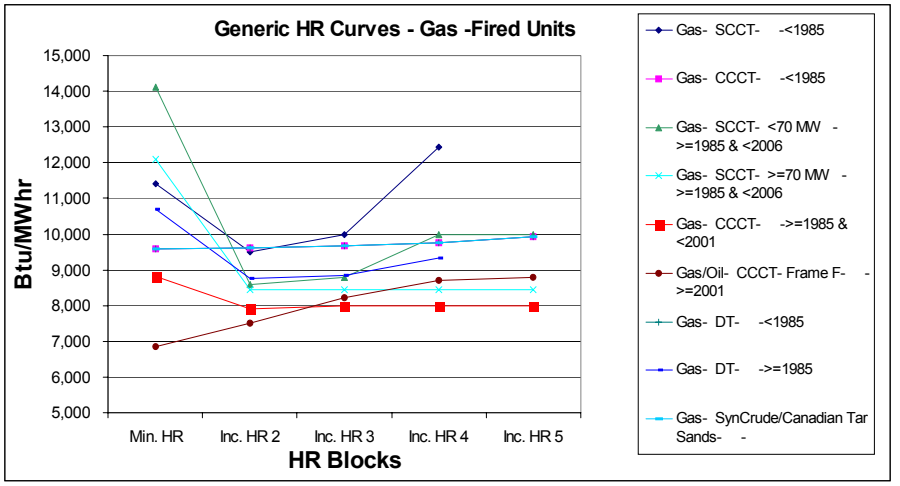
SSG-WI 2008 Database

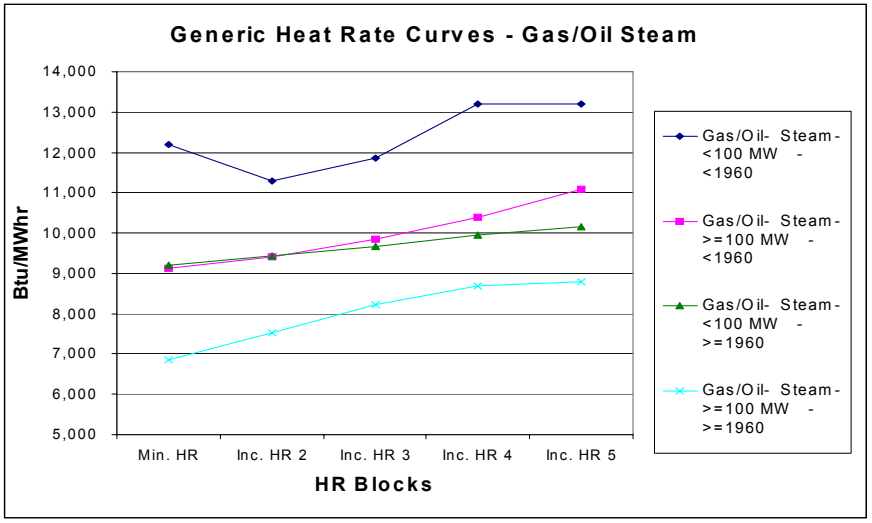
Apply a generic curve to all units in a bucket.

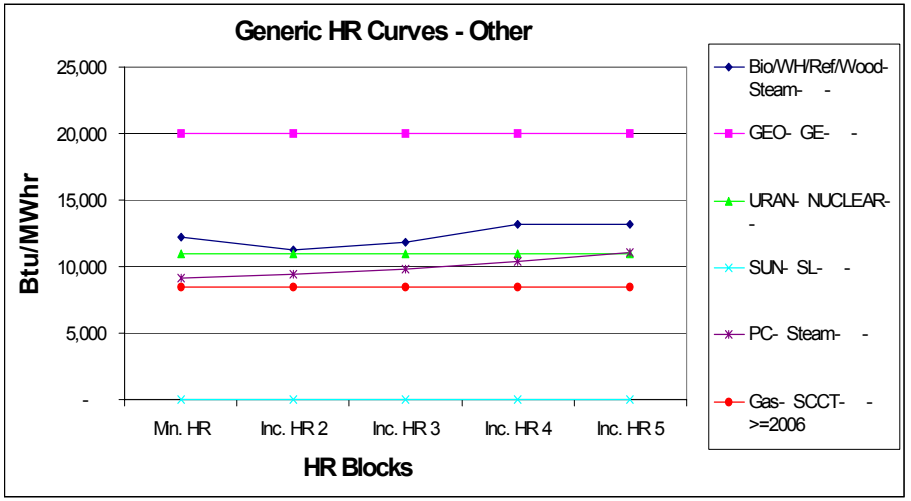
Certain plants in California had heat rate curves published in a CEC paper. Those curves for the corresponding units in this study.

Generic Heat Rate Curves by Fuel, Technology









2008 Base Case
September 2005

Buckets for generic assumptions were defined by Generation Sub-Group

SSGwi
Seams Steering Group of the Western Interconnection

Thermal Unit Generic Assumptions

(Non-Heat Rate Related)

Bucket	Fuel	Technology	Size	Vintage	Heatrate	Non-Fuel Var. O&M ($/MWh)	Forced Outage Rate (FOR)	Forced Outage Duration Hrs	Planned Maint. Rate (PMR)	De-rate for Summer	Ave. Maint. Days	Ramp Rate (MW/Min)	Start-Up Costs $/Start
1	Gas/Oil	**Steam**	<100 MW	<1960	12.5	5.00	0.071	55	0.105	0.973	38	1	-
2	Gas/Oil	**Steam**	>=100 MW	<1960	11.5	5.00	0.071	55	0.105	0.973	38	1	-
3	Gas/Oil	**Steam**	<100 MW	>=1960	10.5	5.00	0.071	55	0.105	0.973	38	1	-
4	Gas/Oil	**Steam**	>=100 MW	>=1960	9.500001	3.00	0.071	55	0.105	0.973	38	1	-
5	Gas	**SCCT**		<1985	13.5	8.00	0.036	89	0.041	0.88	15	1	7,000
6	Gas	**CCCT**		<1985	9.3	5.00	0.055	22	0.041	0.931	15	1	7,000
7	Gas	**SCCT**	<70 MW	>=1985 & <2006	10.5	5.00	0.036	89	0.041	0.88	15	1	7,000
8	Gas	**SCCT**	>=70 MW	>=1985 & <2006	10.7	5.00	0.036	89	0.041	0.88	15	1	7,000
9	Gas	**CCCT**		>=1985 & <2001	7.25	2.00	0.055	22	0.041	0.931	15	1	7,000
10	Gas/Oil	**CCCT- Frame F**		>=2001	7	2.00	0.055	22	0.041	0.931	15	1	7,000
11	Gas	**DT**		<1985	9.57	5.00	0.055	22	0.041	0.931	15	1	-
12	Gas	**DT**		>=1985	7.46	5.00	0.055	22	0.041	0.931	15	1	-
13	Gas	**CCCT/SynCrude/Canadian Oil Sands**			5.8	5.00	0.036	89	0.041	0.931	15	1	7,000
14	OIL	**IC**			11	13.25	0.036	55	0.105	0.973	38	1	7,000
15	OIL	**SCCT**			13.5	8.00	0.036	55	0.041	0.88	15	1	7,000
16	Coal	**Steam**	<100 MW	<1960	12	4.00	0.066	38	0.071	0.973	26	2.5	15,000
17	Coal	**Steam**	>=100 MW	<1960	11.5	2.00	0.066	38	0.071	0.973	26	2.5	15,000
18	Coal	**Steam**	<100 MW	>=1960	11	3.00	0.066	38	0.071	0.973	26	2.5	15,000
19	Coal	**Steam**	>=100 MW	>=1960	10.5	2.00	0.066	38	0.071	0.973	26	2.5	15,000
20	Bio/WH/Re	**Steam**			12.5	5.00	0.071	38	0.105	0.973	38	1	15,000
21	GEO	GE			20	4.00	0.071	16	0.105	1	38	1	-
22	URAN	NUCLEAR			11		0.07	298	0.075	1	27	1	-
23	SUN	SL						1	0.105		38	1	-
24	PC	Steam			11	21.00	0.071	55	0.105	0.973	38	1	-
25	Gas	SCCT		>=2006	8.5	5.00	0.036	55	0.041	0.88	15	1	7,000
26	Gas/Oil	CCCT- Frame G	>450 MW	>=2008	6.3	2.00	0.036	22	0.041	0.931	15	1	7,000

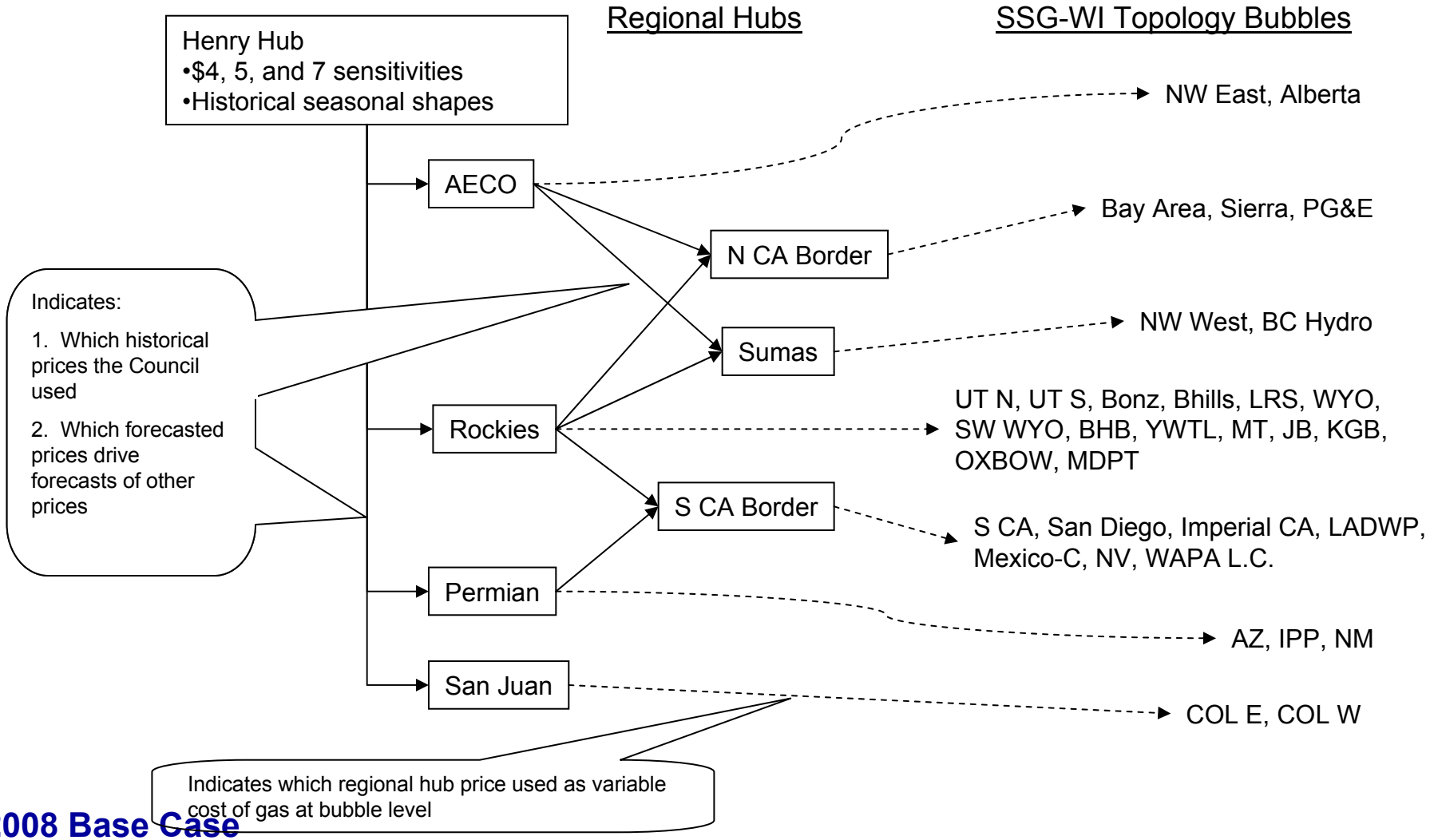
Buckets for generic assumptions were defined by Generation Sub-Group

Gas Price Assumptions

- Objective was to estimate the variable component of gas prices for the SSG-WI topology
  - Based on Henry Hub annual average price scenarios ($4, 5, and 7 in 2005 dollars)
  - Prices determine gas unit dispatch and fuel costs in each SSG-WI bubble
- Northwest Power and Conservation Council's data and methodology was used
  - As reflected in final version of *Fifth Northwest Electric Power and Conservation Plan*
  - Council employs historical hub price data from last 20+ years
  - Linear regression used to forecast prices at Henry Hub, other regional hubs, and some burner tip areas
- Seasonal patterns were added to Council's prices

Gas Price Basis & Transportation:

Drivers of the variable cost of gas



Gas Prices by SSG-WI Topology

Based on $5.00 2008 annual average Henry Hub - $4 and $7 sensitivities were also run
2008 gas price forecast (in 2005$/MMBtu)

Area	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
ALBERTA	$4.89	$4.88	$4.75	$4.05	$3.95	$3.97	$3.99	$4.01	$4.00	$4.01	$4.23	$4.37
ARIZONA	$5.42	$5.40	$5.26	$4.53	$4.43	$4.45	$4.47	$4.49	$4.48	$4.49	$4.73	$4.87
B.C.HYDRO	$5.01	$4.99	$4.86	$4.17	$4.08	$4.10	$4.12	$4.14	$4.12	$4.14	$4.36	$4.49
BAY AREA	$5.70	$5.68	$5.55	$4.86	$4.76	$4.78	$4.80	$4.82	$4.80	$4.82	$5.04	$5.18
BHB	$4.81	$4.80	$4.68	$4.07	$3.99	$4.00	$4.02	$4.04	$4.03	$4.04	$4.23	$4.36
BHILLS	$4.81	$4.80	$4.68	$4.07	$3.99	$4.00	$4.02	$4.04	$4.03	$4.04	$4.23	$4.36
BONZ	$4.81	$4.80	$4.68	$4.07	$3.99	$4.00	$4.02	$4.04	$4.03	$4.04	$4.23	$4.36
COL E	$4.84	$4.83	$4.71	$4.09	$4.01	$4.03	$4.04	$4.06	$4.05	$4.06	$4.26	$4.38
COL W	$4.84	$4.83	$4.71	$4.09	$4.01	$4.03	$4.04	$4.06	$4.05	$4.06	$4.26	$4.38
IMPERIAL CA	$5.67	$5.66	$5.52	$4.82	$4.73	$4.75	$4.77	$4.79	$4.77	$4.79	$5.01	$5.15
IPP	$5.42	$5.40	$5.26	$4.53	$4.43	$4.45	$4.47	$4.49	$4.48	$4.49	$4.73	$4.87
JB	$4.81	$4.80	$4.68	$4.07	$3.99	$4.00	$4.02	$4.04	$4.03	$4.04	$4.23	$4.36
KGB	$4.81	$4.80	$4.68	$4.07	$3.99	$4.00	$4.02	$4.04	$4.03	$4.04	$4.23	$4.36
LADWP	$5.67	$5.66	$5.52	$4.82	$4.73	$4.75	$4.77	$4.79	$4.77	$4.79	$5.01	$5.15
LRS	$4.81	$4.80	$4.68	$4.07	$3.99	$4.00	$4.02	$4.04	$4.03	$4.04	$4.23	$4.36
MDPT BOISE & SNAKE	$4.81	$4.80	$4.68	$4.07	$3.99	$4.00	$4.02	$4.04	$4.03	$4.04	$4.23	$4.36
MEXICO-C	$5.67	$5.66	$5.52	$4.82	$4.73	$4.75	$4.77	$4.79	$4.77	$4.79	$5.01	$5.15
MONTANA	$4.81	$4.80	$4.68	$4.07	$3.99	$4.00	$4.02	$4.04	$4.03	$4.04	$4.23	$4.36
NEVADA	$5.67	$5.66	$5.52	$4.82	$4.73	$4.75	$4.77	$4.79	$4.77	$4.79	$5.01	$5.15
NEW MEXICO	$5.42	$5.40	$5.26	$4.53	$4.43	$4.45	$4.47	$4.49	$4.48	$4.49	$4.73	$4.87
NW EAST	$4.89	$4.88	$4.75	$4.05	$3.95	$3.97	$3.99	$4.01	$4.00	$4.01	$4.23	$4.37
NW WEST	$5.01	$4.99	$4.86	$4.17	$4.08	$4.10	$4.12	$4.14	$4.12	$4.14	$4.36	$4.49
OXBOW/HELLS CANYON	$4.81	$4.80	$4.68	$4.07	$3.99	$4.00	$4.02	$4.04	$4.03	$4.04	$4.23	$4.36
PG AND E	$5.70	$5.68	$5.55	$4.86	$4.76	$4.78	$4.80	$4.82	$4.80	$4.82	$5.04	$5.18
SAN DIEGO	$5.67	$5.66	$5.52	$4.82	$4.73	$4.75	$4.77	$4.79	$4.77	$4.79	$5.01	$5.15
SIERRA	$5.70	$5.68	$5.55	$4.86	$4.76	$4.78	$4.80	$4.82	$4.80	$4.82	$5.04	$5.18
SO CALIF	$5.67	$5.66	$5.52	$4.82	$4.73	$4.75	$4.77	$4.79	$4.77	$4.79	$5.01	$5.15
SW WYO	$4.81	$4.80	$4.68	$4.07	$3.99	$4.00	$4.02	$4.04	$4.03	$4.04	$4.23	$4.36
UT N	$4.81	$4.80	$4.68	$4.07	$3.99	$4.00	$4.02	$4.04	$4.03	$4.04	$4.23	$4.36
UT S	$4.81	$4.80	$4.68	$4.07	$3.99	$4.00	$4.02	$4.04	$4.03	$4.04	$4.23	$4.36
WAPA L.C.	$5.67	$5.66	$5.52	$4.82	$4.73	$4.75	$4.77	$4.79	$4.77	$4.79	$5.01	$5.15
WYO	$4.81	$4.80	$4.68	$4.07	$3.99	$4.00	$4.02	$4.04	$4.03	$4.04	$4.23	$4.36
WYE	$4.81	$4.80	$4.68	$4.07	$3.99	$4.00	$4.02	$4.04	$4.03	$4.04	$4.23	$4.36

Coal Price Assumptions

- **Source: EIA's 2005 Outlook**
- **Transportation costs are key uncertainty**
- **Distance, mode of transportation, source basin and demand region are drivers of transportation costs**
- **EIA employs two transportation price "tiers":**
  - reflects historical averages/trends
  - captures higher cost of expanded shipping distances in large demand regions

Coal Price by SSG-WI Topology

SSG-WI Topology Bubble	**2008 Coal Price** Includes Transportation adder in 2008$/MMBtu, assuming 2.5% yearly inflation rate
ARIZONA	1.49
Big Horn Basin (BHB)	0.44
Colorado East (COL E)	0.97
Colorado West (COL W)	1.10
IPP	1.18
Jim Bridger (JB)	1.06
MONTANA	0.62
NEVADA	1.18
NEW MEXICO	1.47
Northwest West (NW WEST)	1.52
Utah North (UT N)	1.12
Wyoming (WYO)	0.53

Other Fuel Price Assumptions

FUEL	$/MMBtu	Source
Biomass	$2.22	RMATS Study
Oil-L, Petroleum Coke Oil-H	$6.62 $4.42	RMATS Study
Geothermal, Waste Heat	$1.105	RMATS Study
Refuse	$4.41	RMATS Study
Uranium	$0.60	RMATS Study

Validation

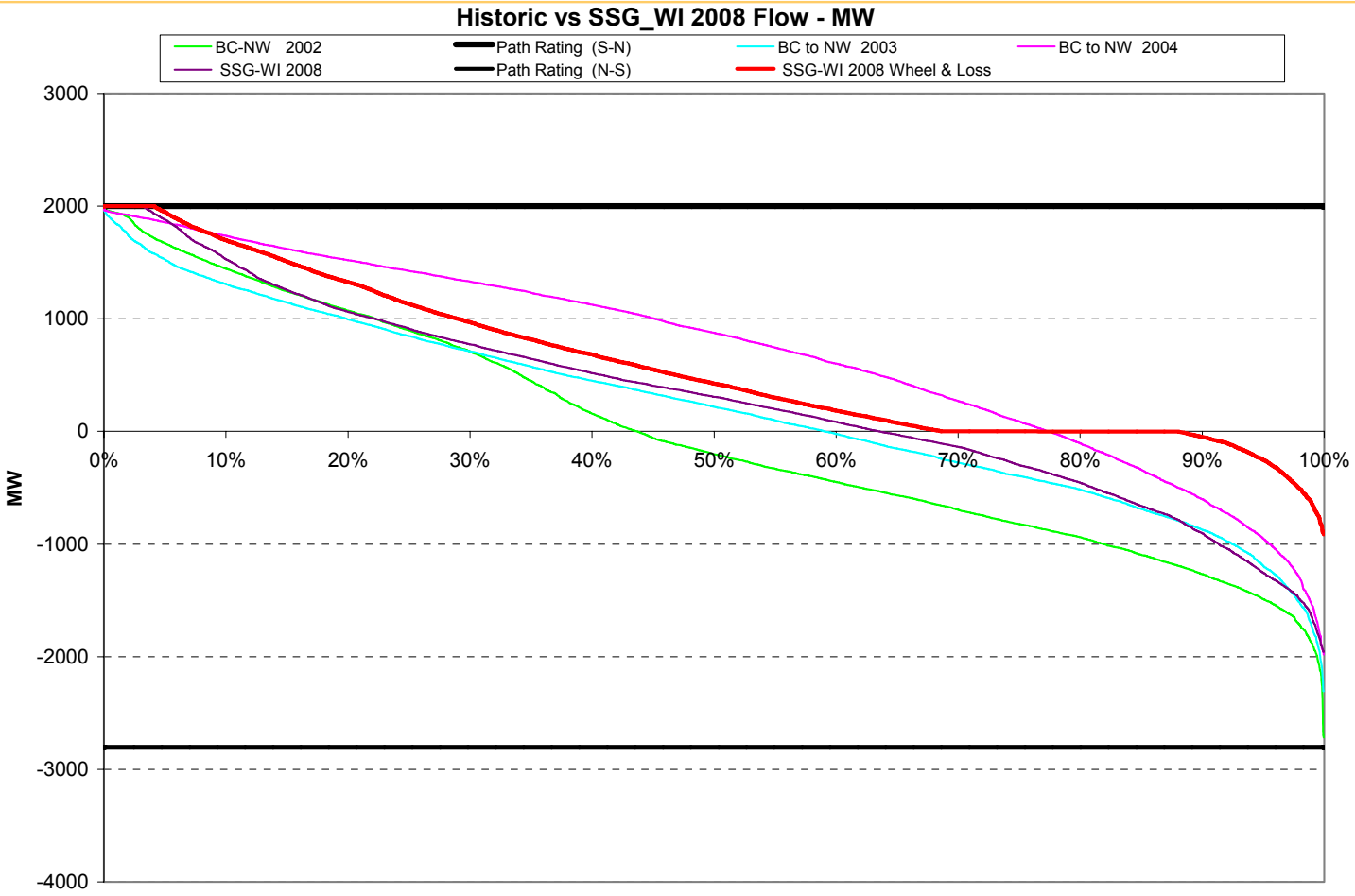
SSGwi

Seams Steering Group of the Western Interconnection

Benchmarking modeling results to historical actual

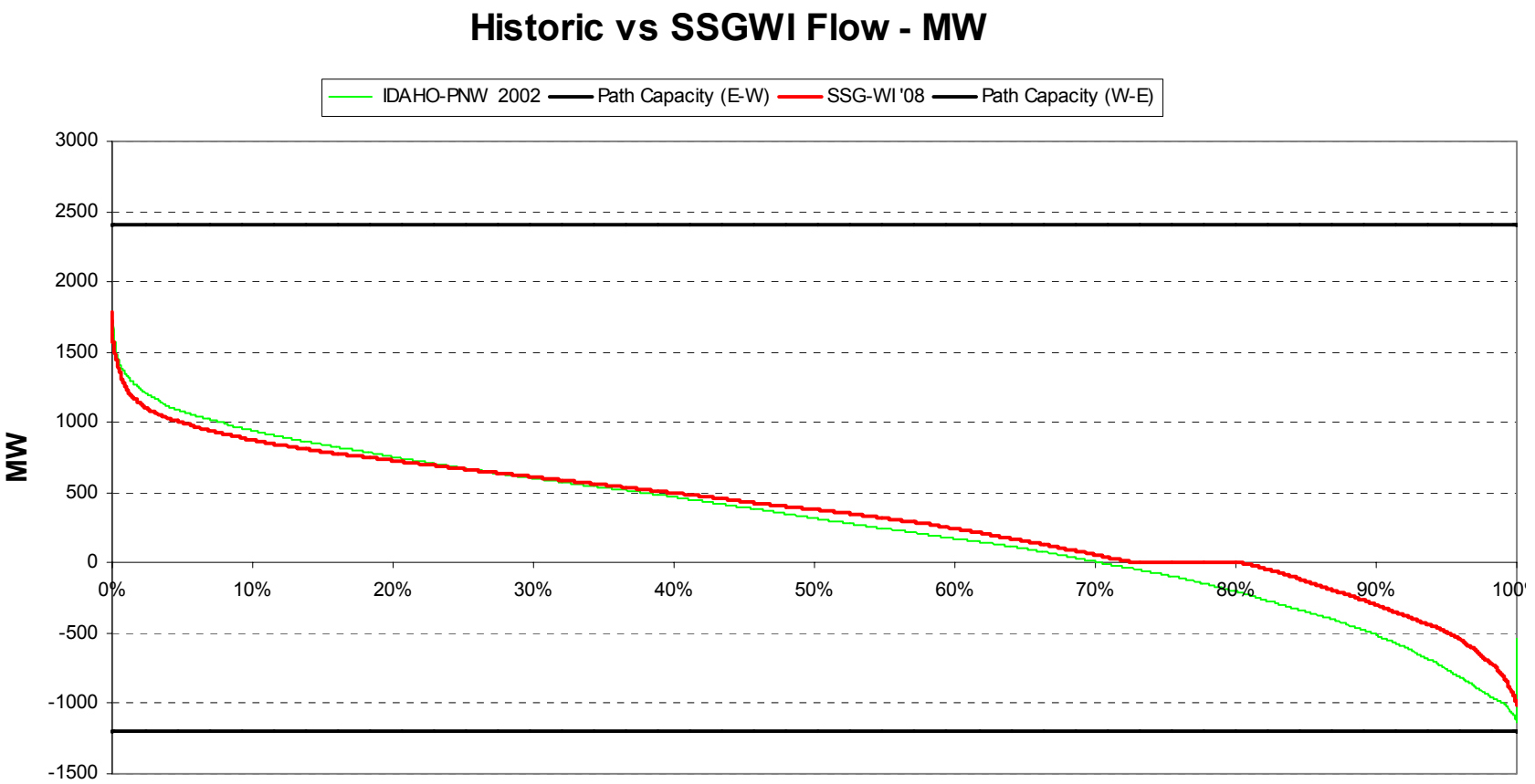
- **The objective is to compare patterns of path loading**
- **For all paths**
  - Historic actual loads are compared to 2008 base case
  - Based on $5 Gas, transmission wheeling and losses
- **Must consider modeling limitations when drawing conclusions**
  - Comparing historic actual to a forecast
  - Incremental system additions

Canada to Northwest



- This path (Washington and southern British Columbia) shows moderately high utilization; the 22% at zero flows is due to double application of wheeling charges (one counts is using 2002 actual Northwest to Canada flows to shape hydro; second count applied ~$3 BPA network wheel)
- SSG_WI 2008 with wheel and loss shows zero value between 70% to 90%; selecting to omit paying $2.96 BPA network wheel)

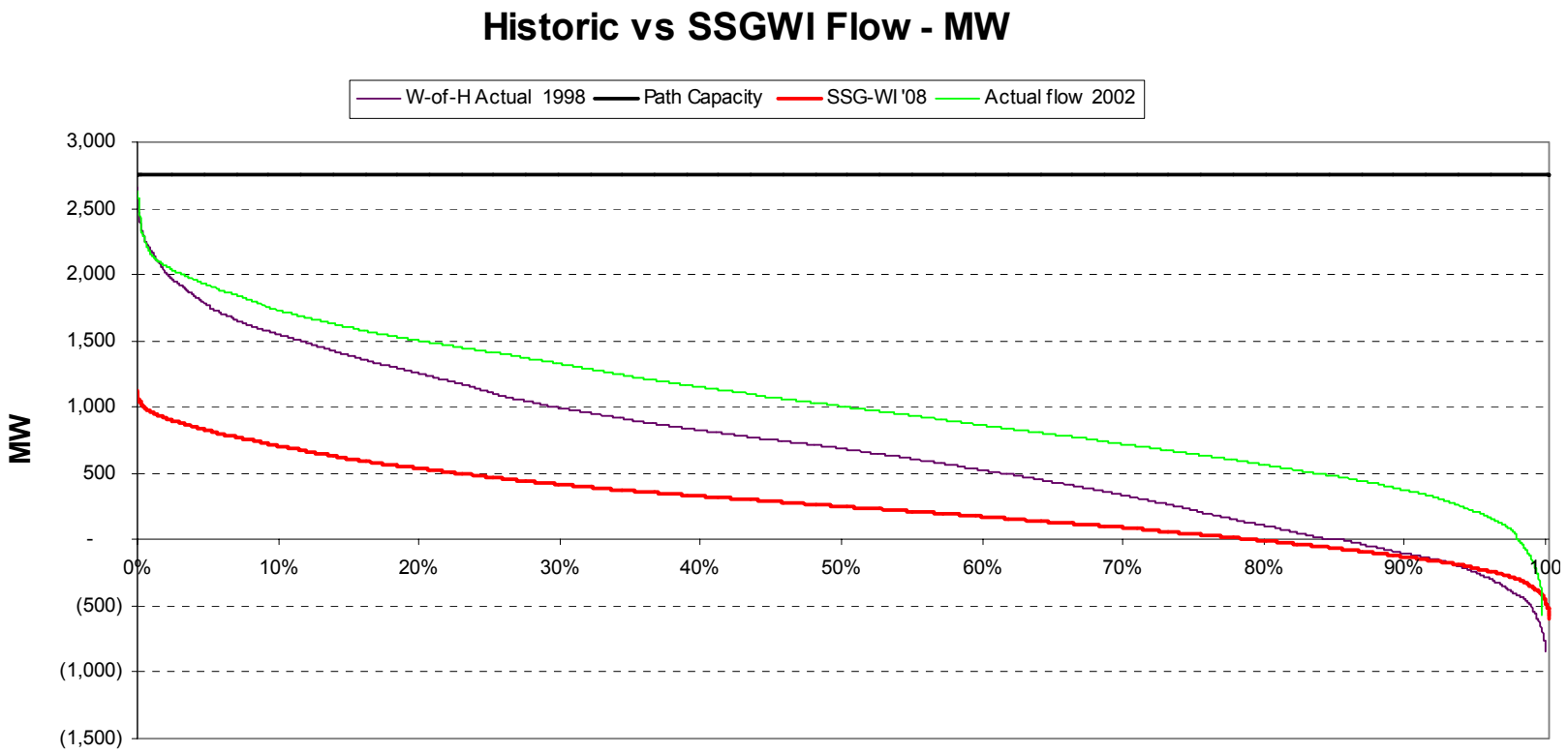
Idaho to PNW Duration Curve



- This path (Southwest Idaho and Eastern Oregon/Washington and Northern Idaho) shows moderately high utilization
- SSG_WI 2008 with wheel and loss shows close correlation with 2002 actual flow

2008 Base Case
September 2005

West of Hatwai Duration Curve

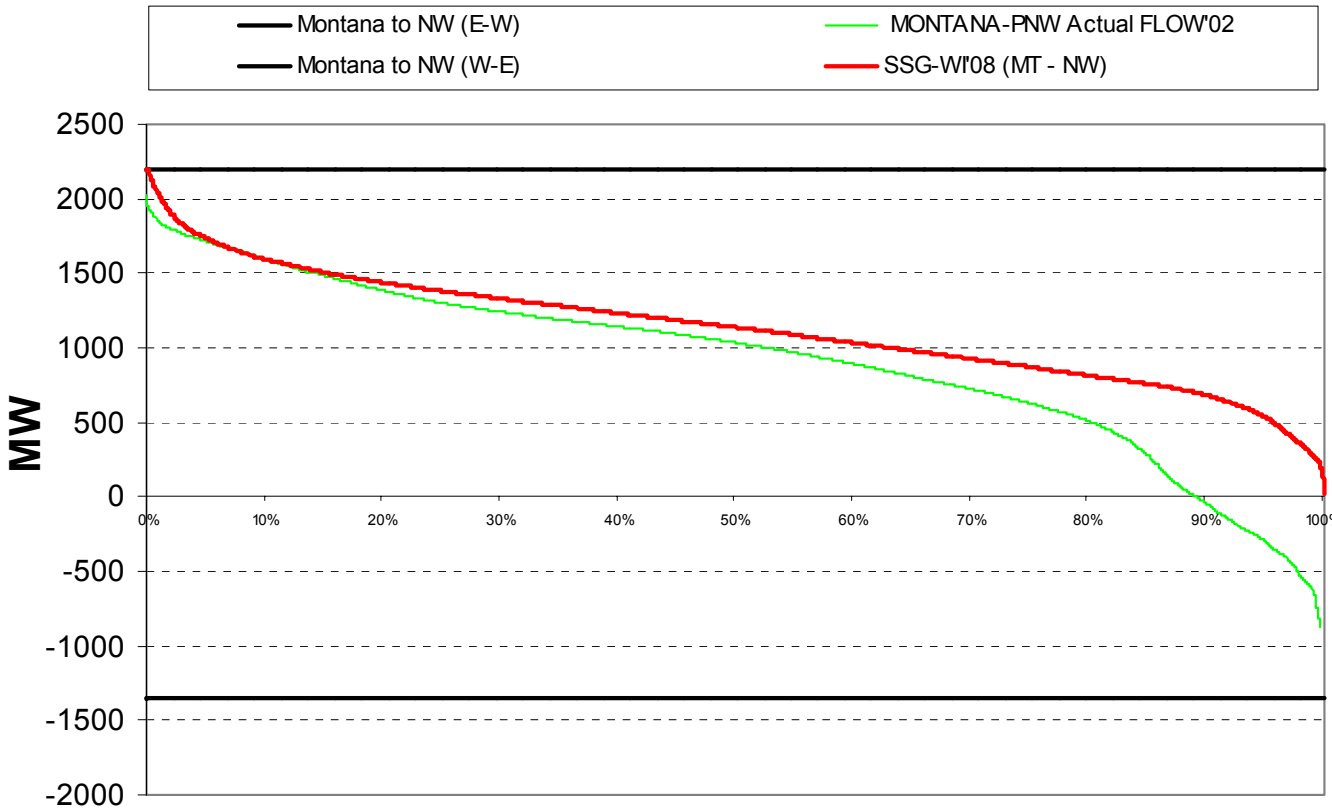


- This path (Eastern Washington) shows moderate utilization
- SSG_WI 2008 with wheel and loss holds the shape but shows lower flow than historic

2008 Base Case
September 2005

Montana to PNW Duration Curve

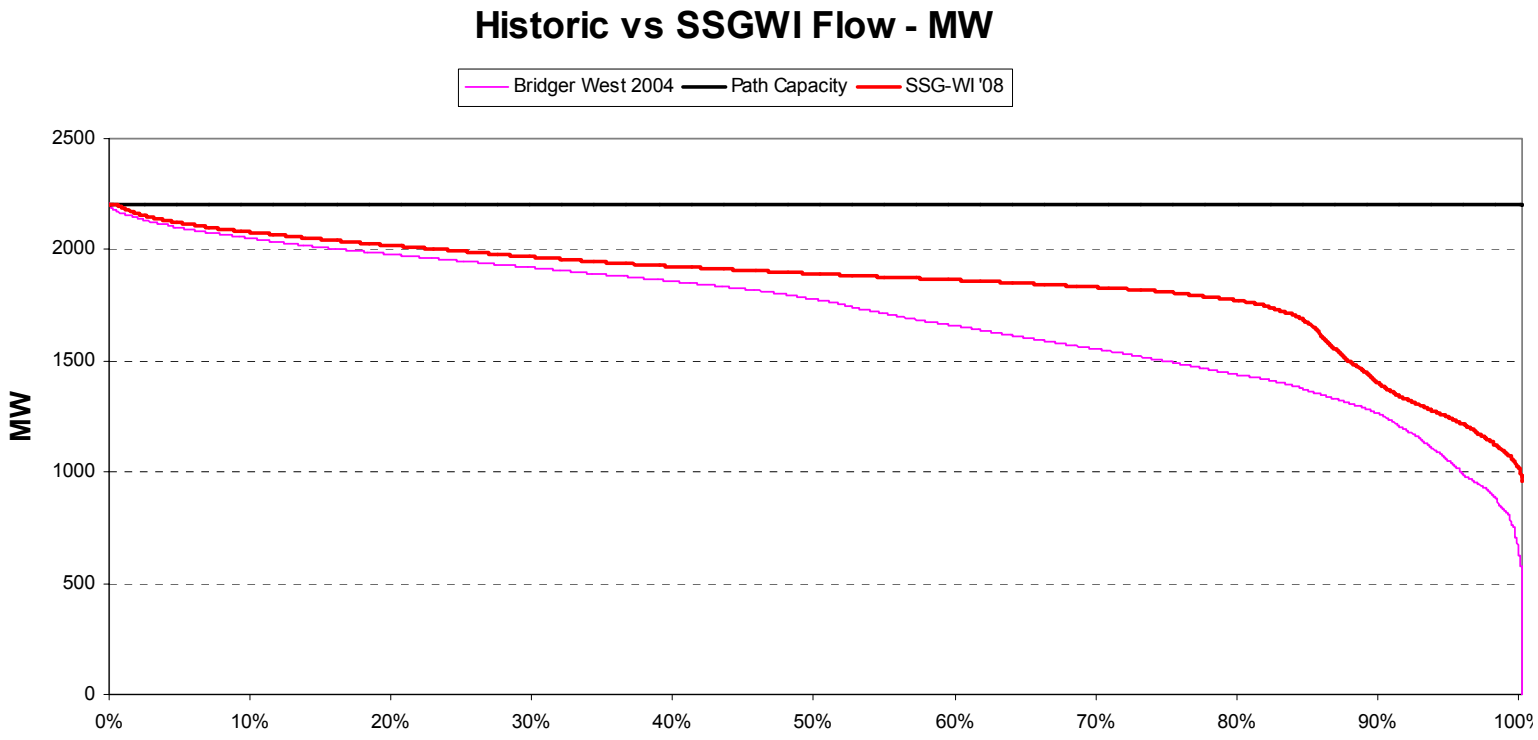
Historic vs SSGWI - MW



- This path (lines between western Montana and the Northwest) shows moderately high utilization
- SSG_WI 2008 with wheel and loss holds the shape and correlates with historic

2008 Base Case
September 2005

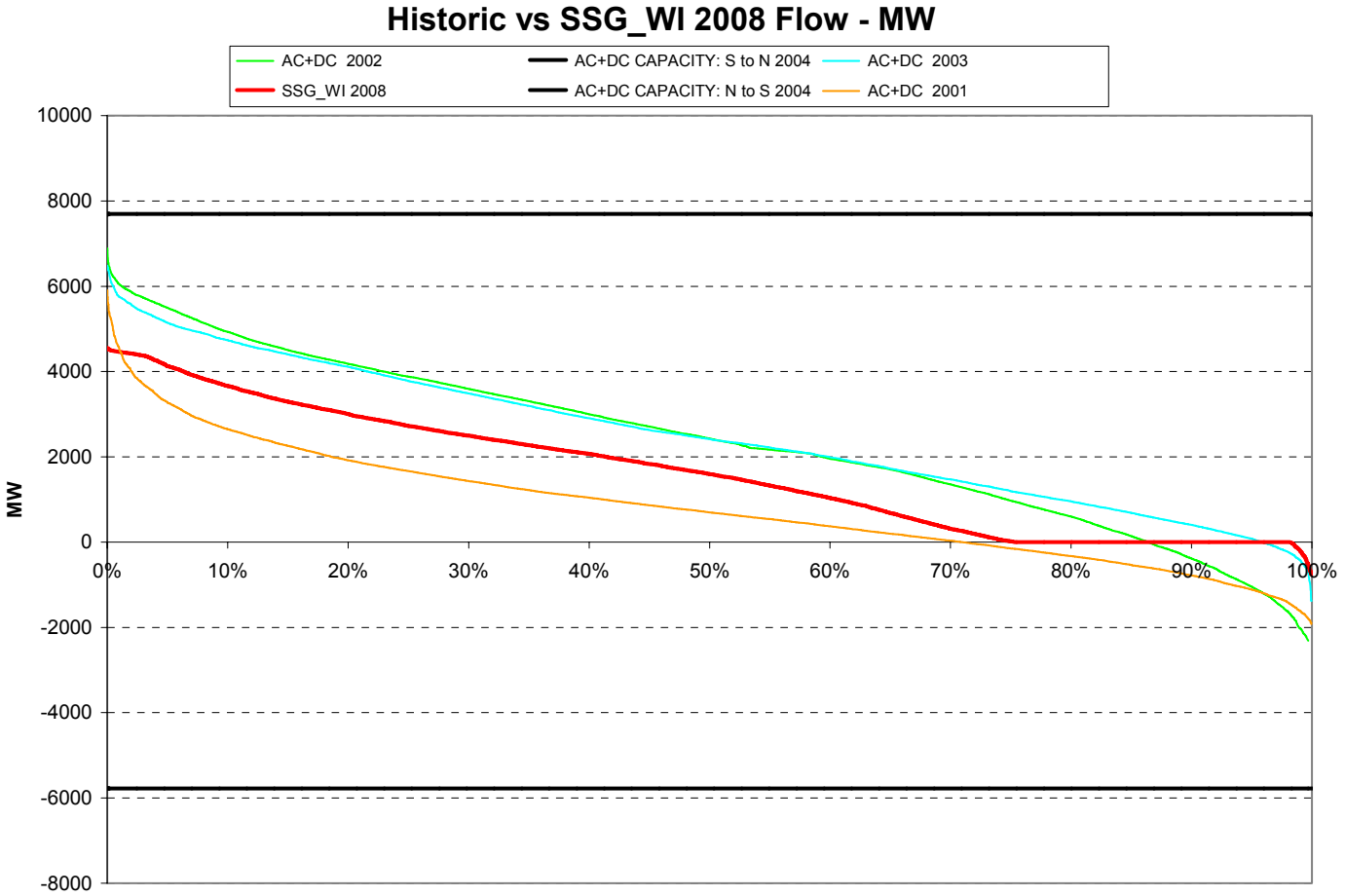
Bridger West



- This path (Border between Southeast Idaho and Southwest Wyoming) shows moderately high utilization
- SSG_WI 2008 with wheel and loss holds the shape and correlates with historic

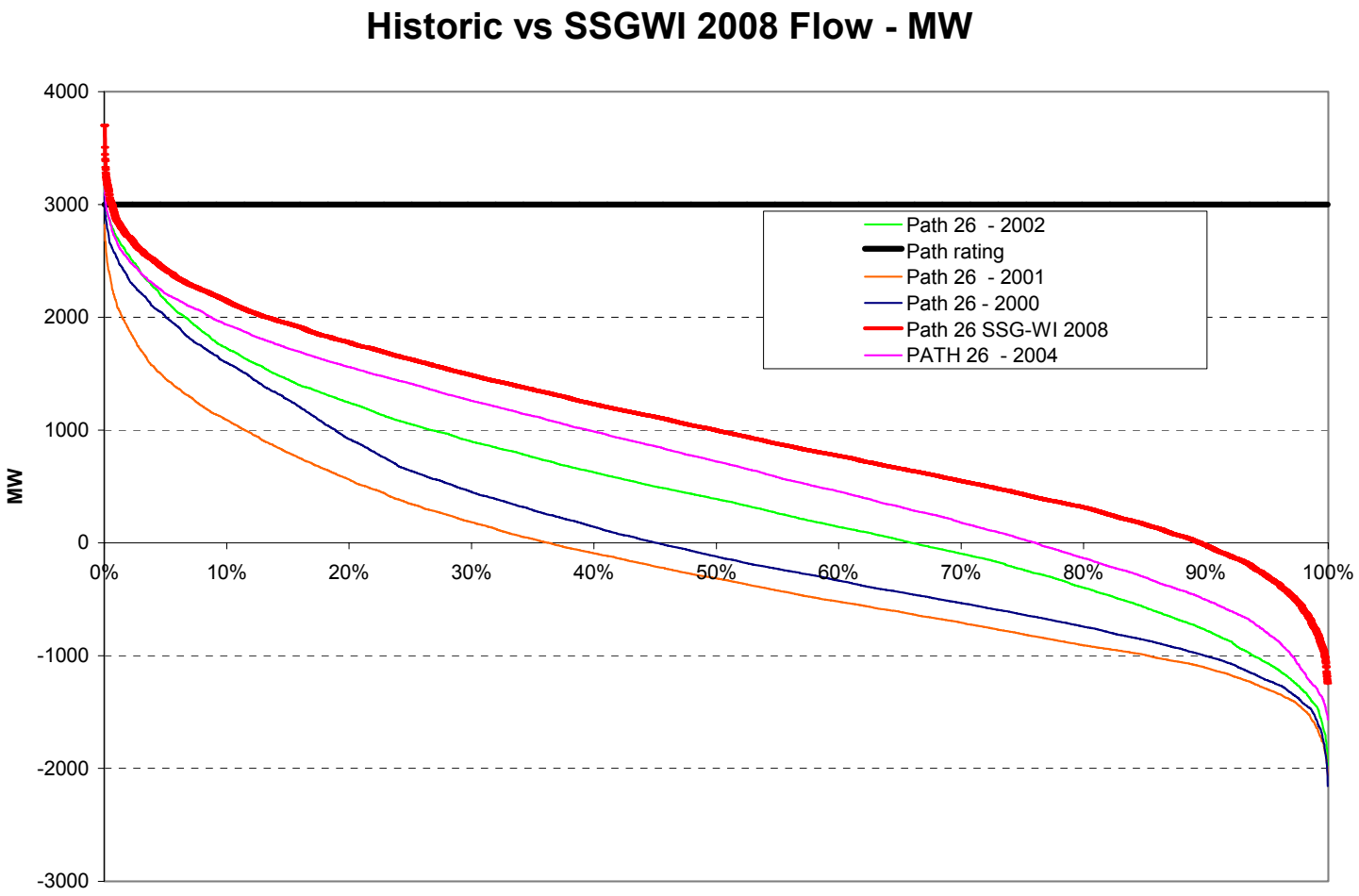
2008 Base Case
September 2005

COI + PDCI Duration Curve



- This path (PACI in combination with PDCI) shows moderate utilization
- SSG_WI 2008 with wheel and loss holds the shape and correlates with historic

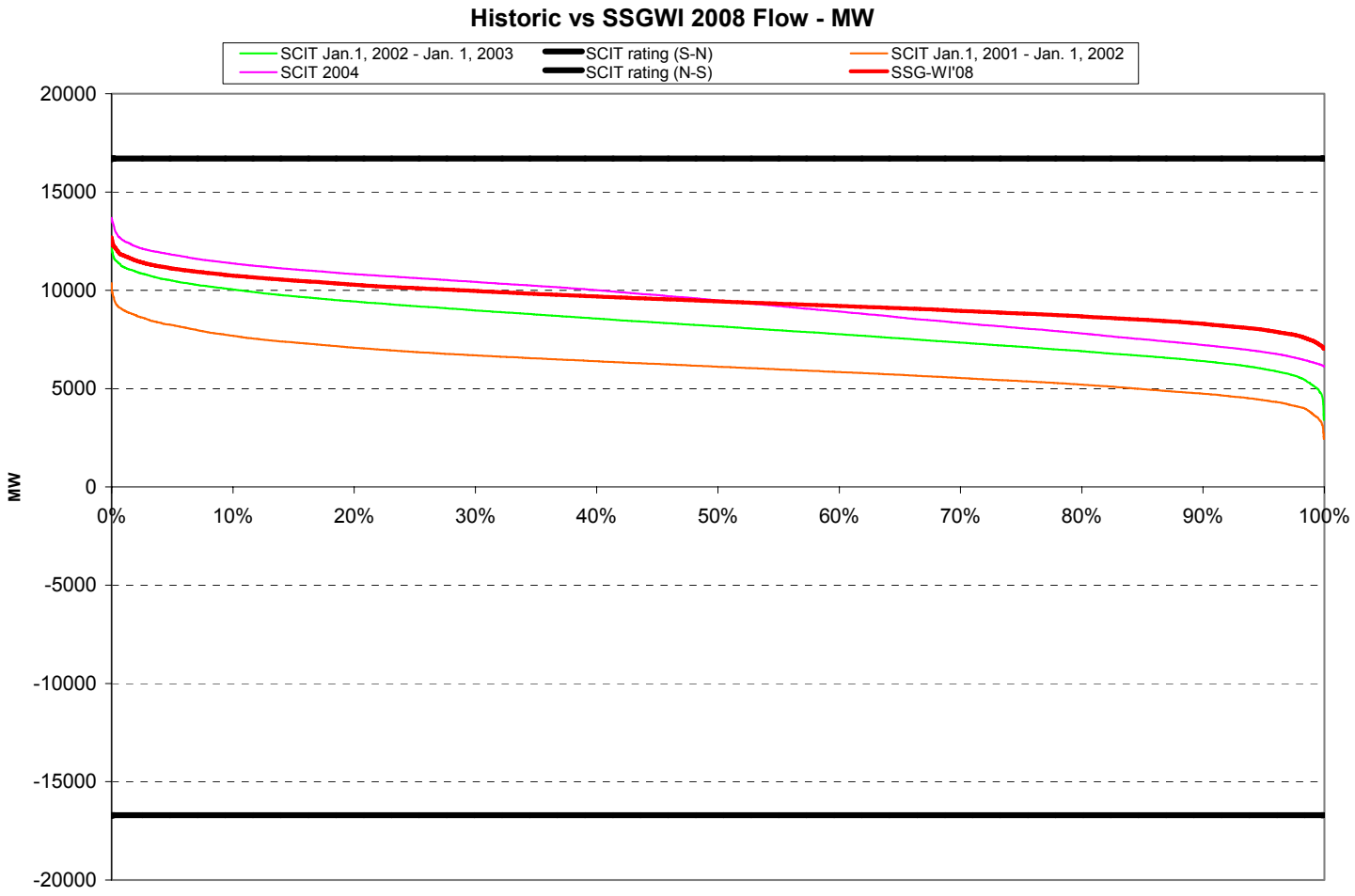
Path 26 Duration Curve



- This path (**Between PG&E and Southern California Edison; Midway to Vincent 3-500 kV lines**) shows moderately high utilization
- SSG_WI 2008 with wheel and loss holds the shape and correlates with historic

2008 Base Case
September 2005

SCIT Duration Curve

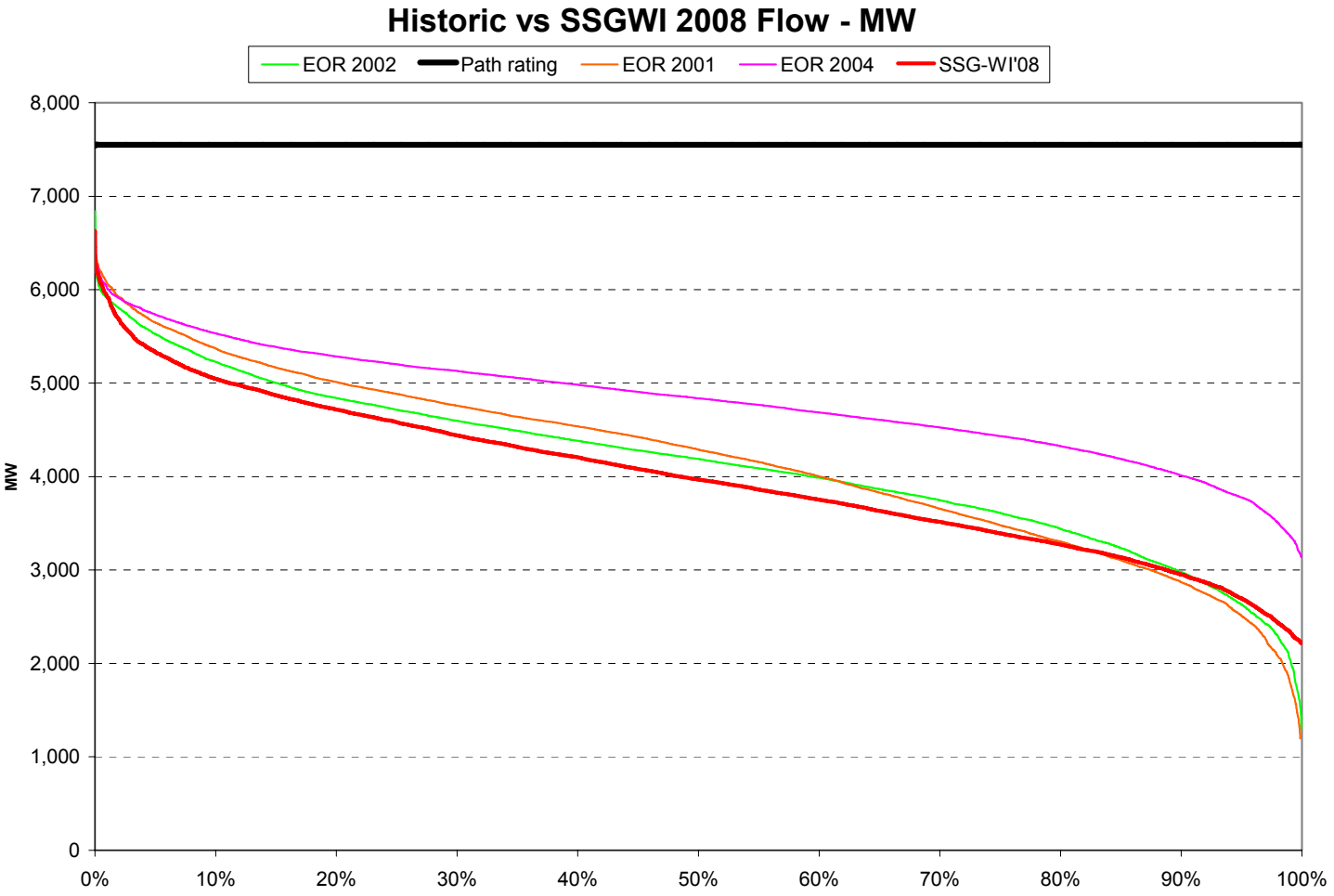


- This path (Sum of Midway, PDCI, IPP, North of Lugo, and WOR) shows moderate utilization
- SSG_WI 2008 with wheel and loss holds the shape and correlates with historic

2008 Base Case

September 2005

East of the River Duration Curve

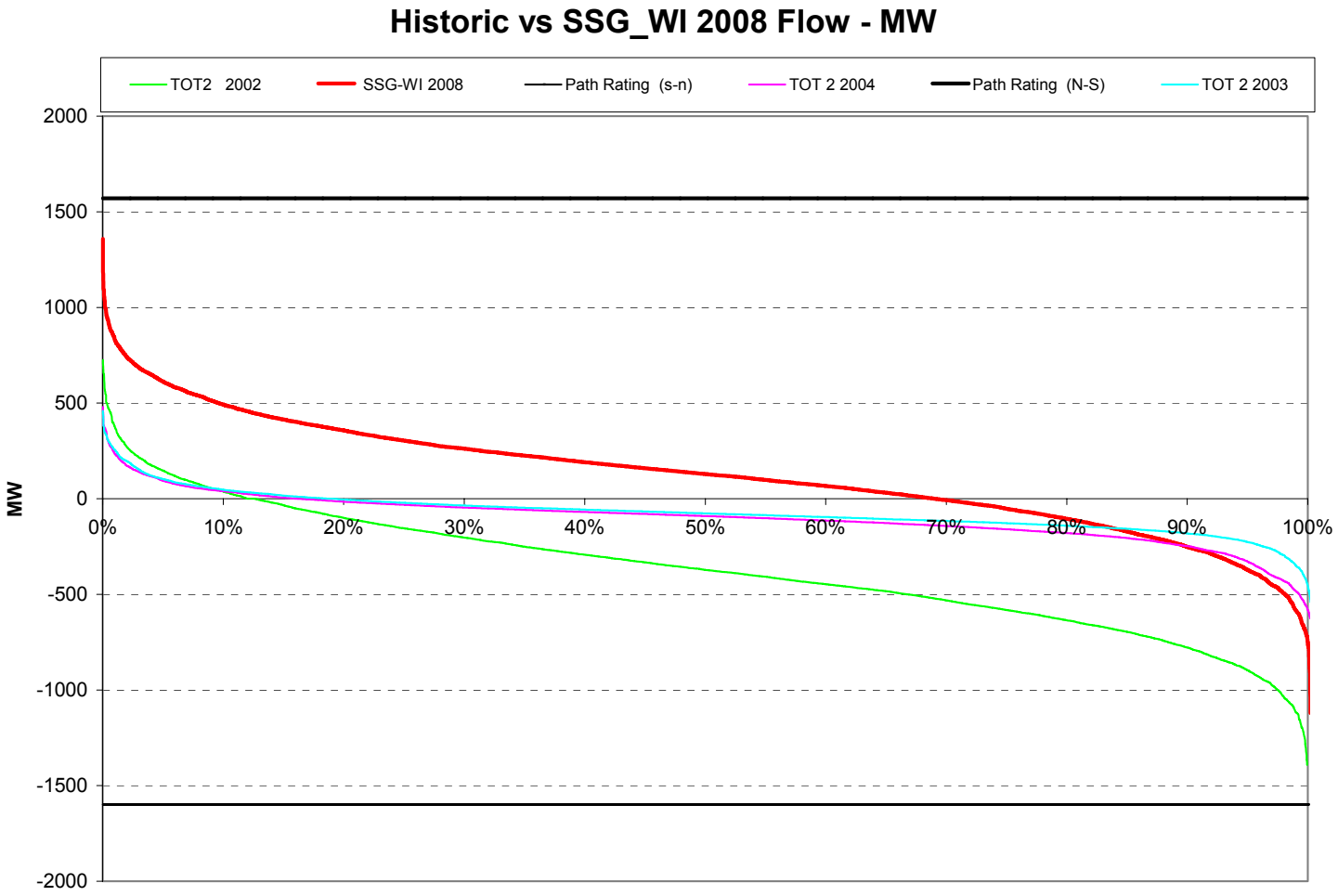


- This path (western Arizona) shows moderate utilization
- SSG_WI 2008 with wheel and loss holds the shape and correlates with historic

2008 Base Case

September 2005

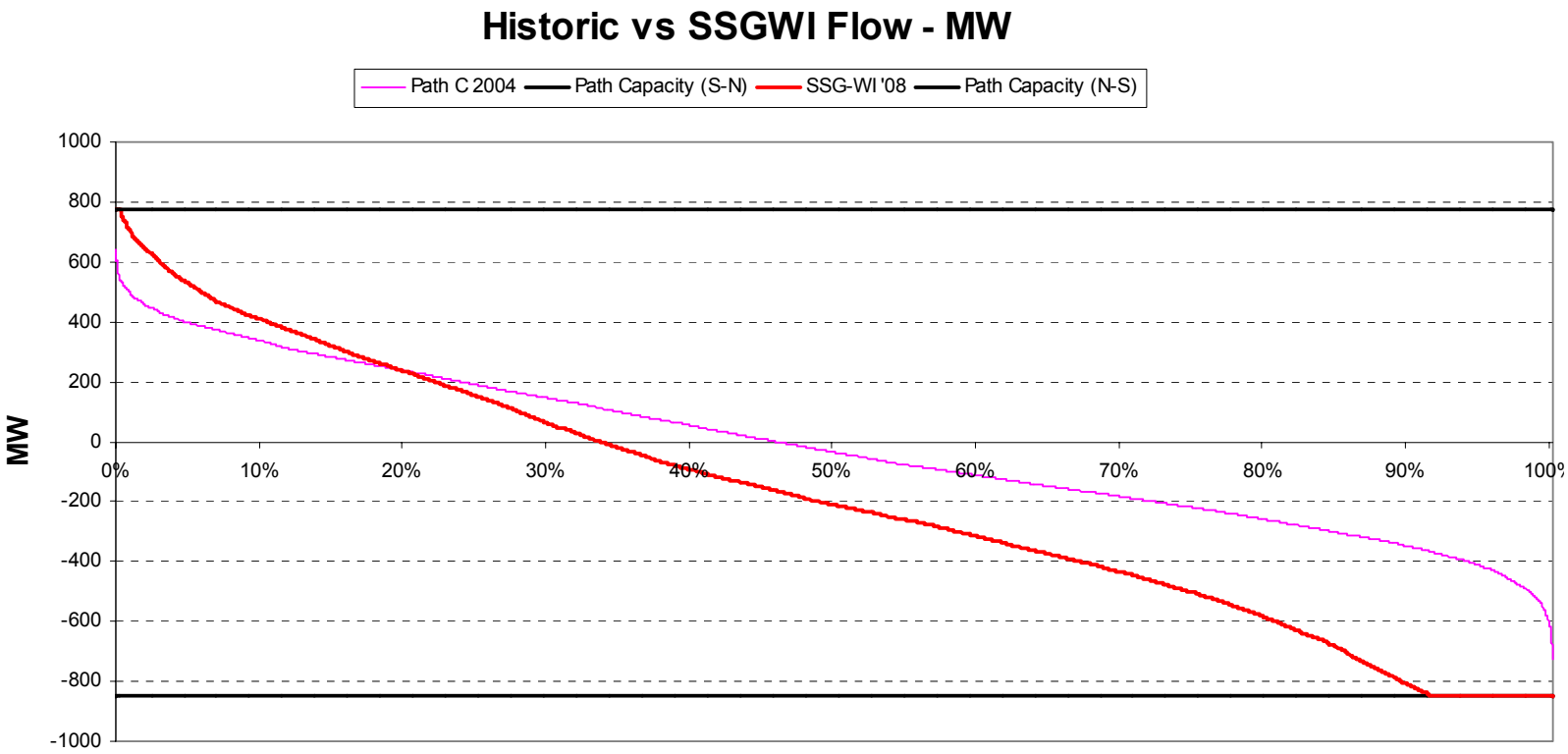
TOT2 (A+B+C) Duration Curve



- This path (southern CO, southern Utah to N. Arizona and southern Utah to South-East Nevada) shows moderate utilization
- SSG_WI 2008 with wheel and loss holds the shape and correlates with historic

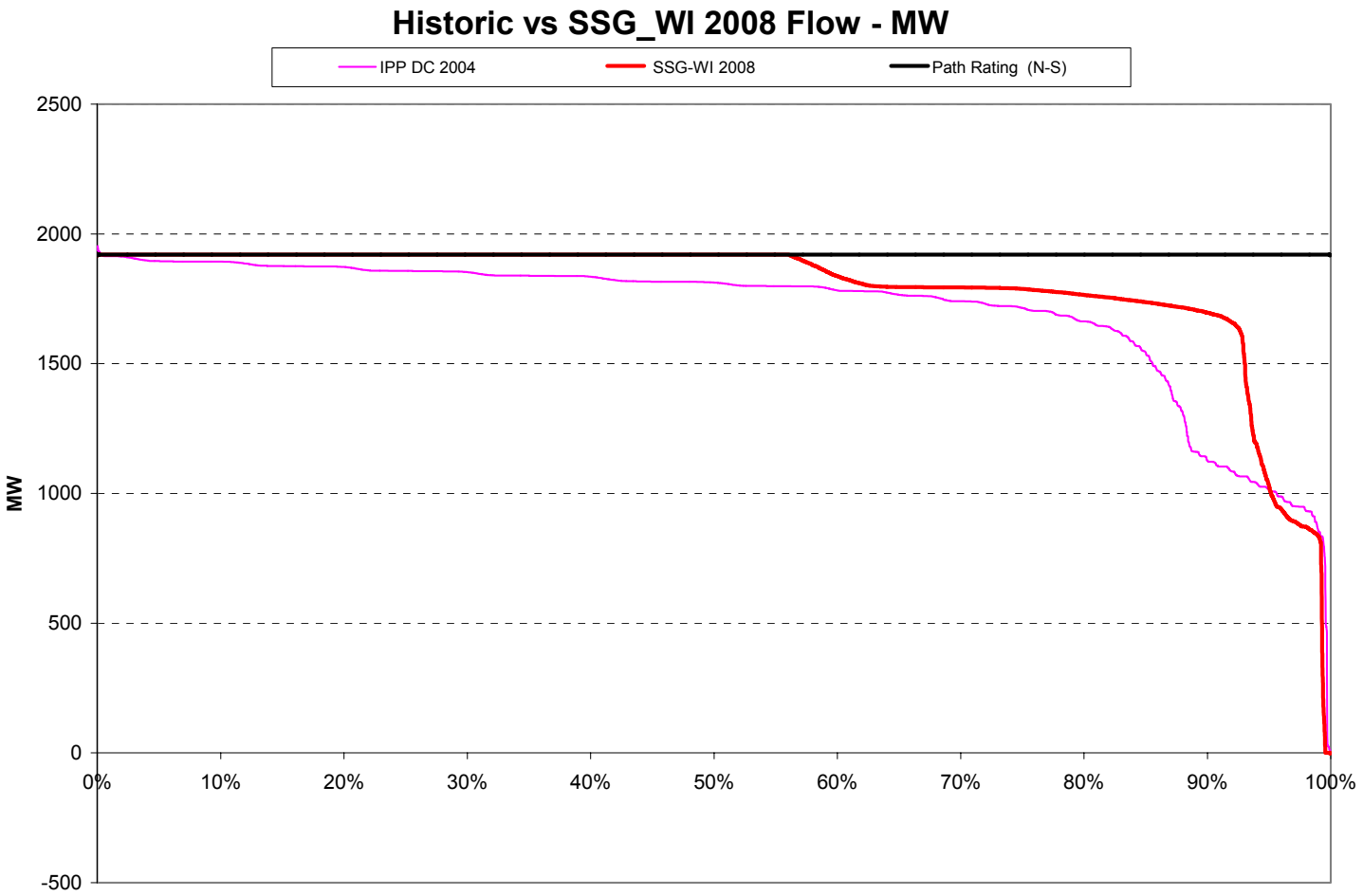
2008 Base Case
September 2005

Path C



- This path (Northern Utah/southern Idaho) shows moderately high utilization; 10% of the time at limit in the south to north direction
- SSG_WI 2008 with wheel and loss holds the shape and correlates with historic

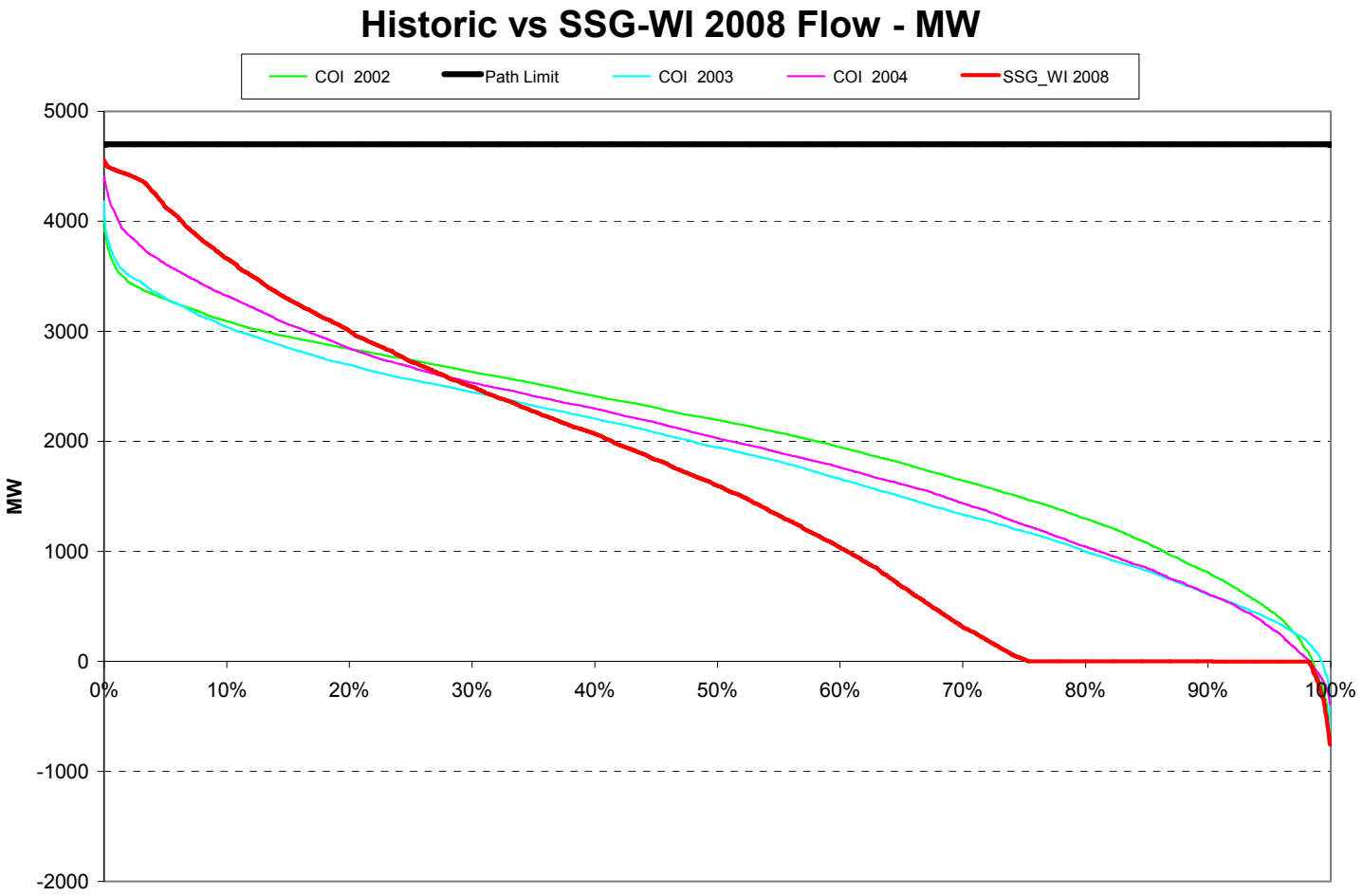
IPP DC



- This path (Intermountain to Adelanto station in southern California) shows moderately high utilization; 55% of the time at limit in the north to south direction.
- SSG_WI 2008 with wheel and loss holds the shape and correlates with historic

2008 Base Case
September 2005

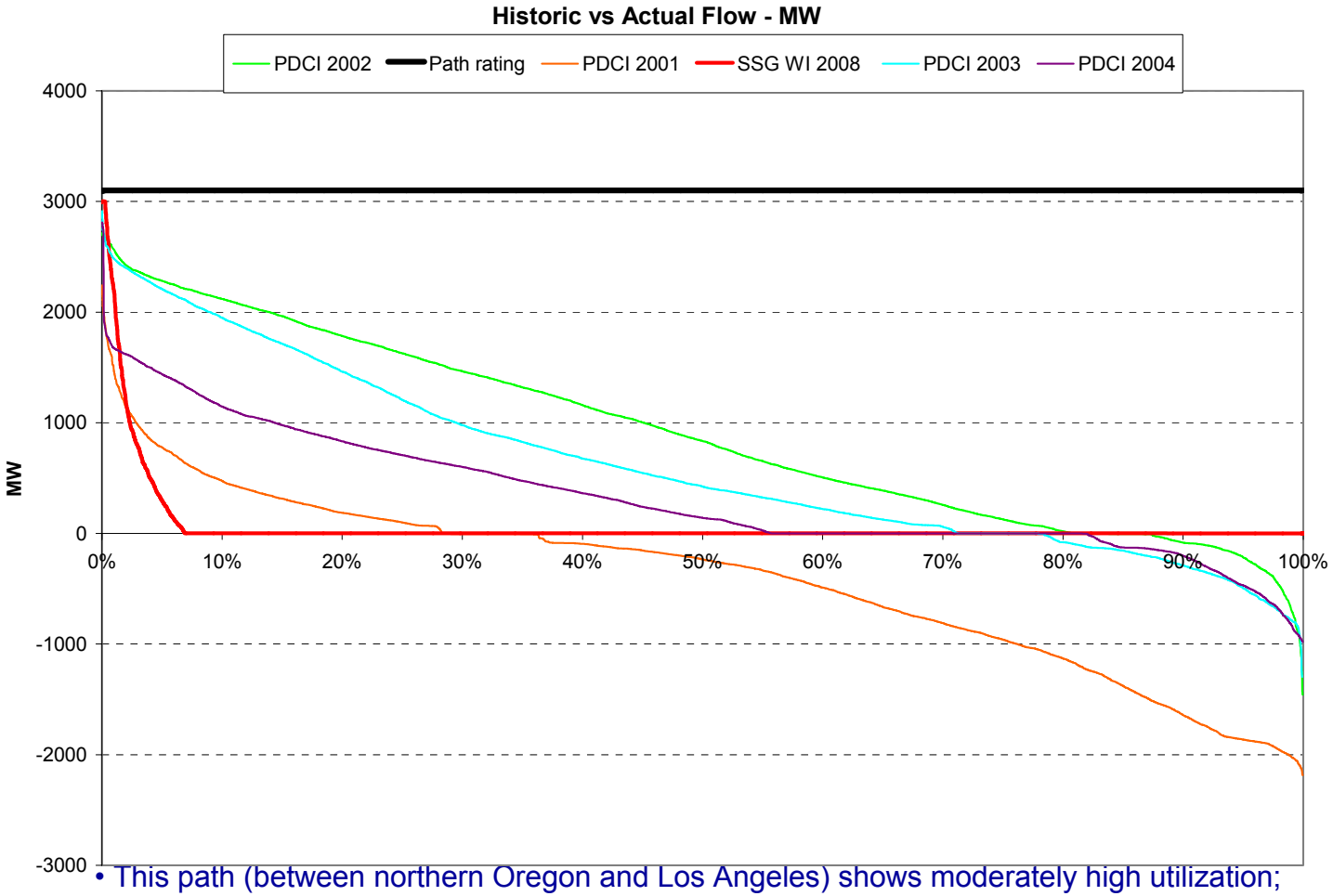
COI



- This path (between Oregon and northern California) shows moderately high utilization; the flow is 25% of the time at zero in the northern direction is due to an imbalance in modeling wheel charges.
- SSG_WI 2008 with wheel and loss holds the shape and correlates with historic

2008 Base Case
September 2005

PDCI



- This path (between northern Oregon and Los Angeles) shows moderately high utilization; the flow is 90% of the time at zero is due to overstatement of wheel charges in the case between LADWP and southern California.
- SSG_WI 2008 with wheel and loss holds the shape and correlates with historic.