Transmission Planning in the West

Rich Bayless
Director, Interconnected Systems
PacifiCorp

FERC Staff to Staff Meeting
October 22, 2002
Denver, CO

Transmission Planning in the West

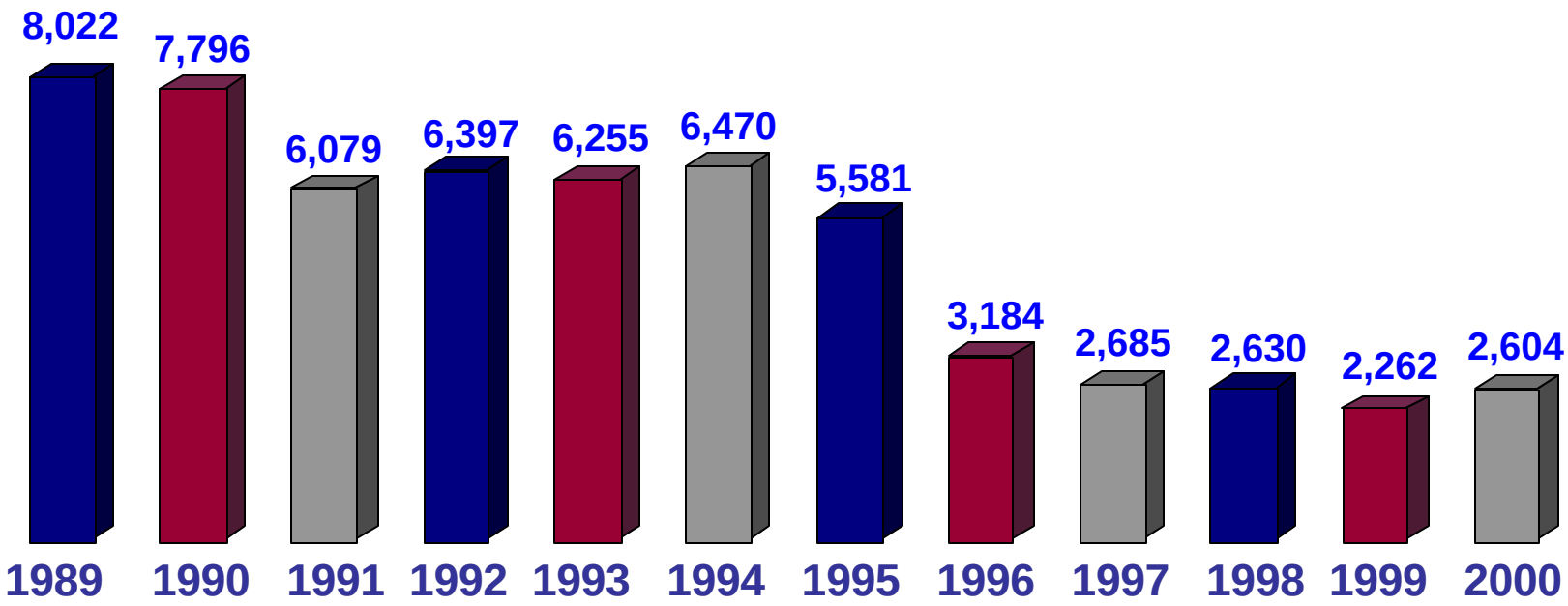
- Historically Transmission Planning in the West was done by individual utilities.
- Joint planning was performed by utilities organizing together on joint projects or to jointly agreeing to share facilities in each other's systems via contractual arrangement.
- Coordinated planning for reliability and operations was performed by several regional and sub-regional organizations to make sure that interconnected systems didn't adversely impact each other (outside of agreed to limits)
  - Examples: WECC, NWPP

Regional Planning

- Regional Planning including adequacy, economics as well as reliability was started in WSCC, WGA, CREPC, the RTA's, and CCPG several years ago using Regional Planning Processes
- States have kicked off Regional Planning
  - CREPC & WIEB
  - CaISO
  - Various State Integrated Resource Planning processes and Planning Councils
- However, other than for local load and generation connection, and reliability, little regional transmission has been built over the last 10 years.
- Some activity now, but varied
- Power Crisis of 2000 and 2001 illustrated need to add generation and transmission in the West for growth, flexibility, elimination of market power, and to facilitate new markets
- Questions are: What, Where, Who & How to Pay for it

WSCC Ten Year Plan

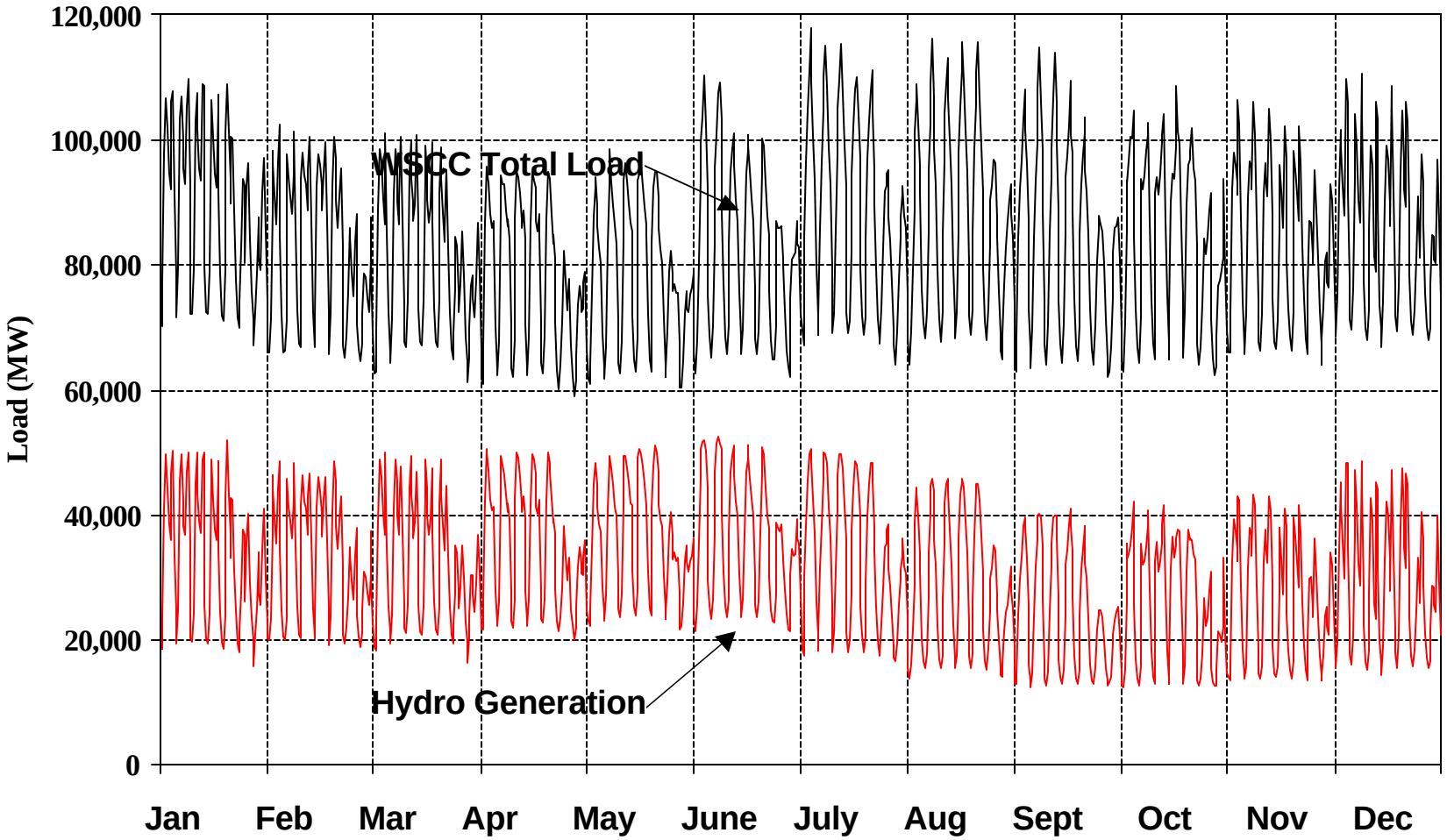
New Planned Transmission Miles in
10 Year Plan
WSCC Sig Adds Report



Characteristics

- Western Transmission System Characteristics
  - Various levels of interconnection
  - Long expensive transmission
  - Diversity in generation and load location and characteristics
  - Diurnal Flow patterns
  - Strongly and less strongly connected areas
  - Pushed to the rating limits
    - Imaginative rating and RAS methods to increase limits
    - Thermal, Stability, Voltage Collapse limitations
  - N-1 Ratings, Nomograms, Phase Shifters
  - All areas on backbone grid effect the others
  - Transmission is key to least cost utilization of diverse resources

WSCC Load & Hydro Generation



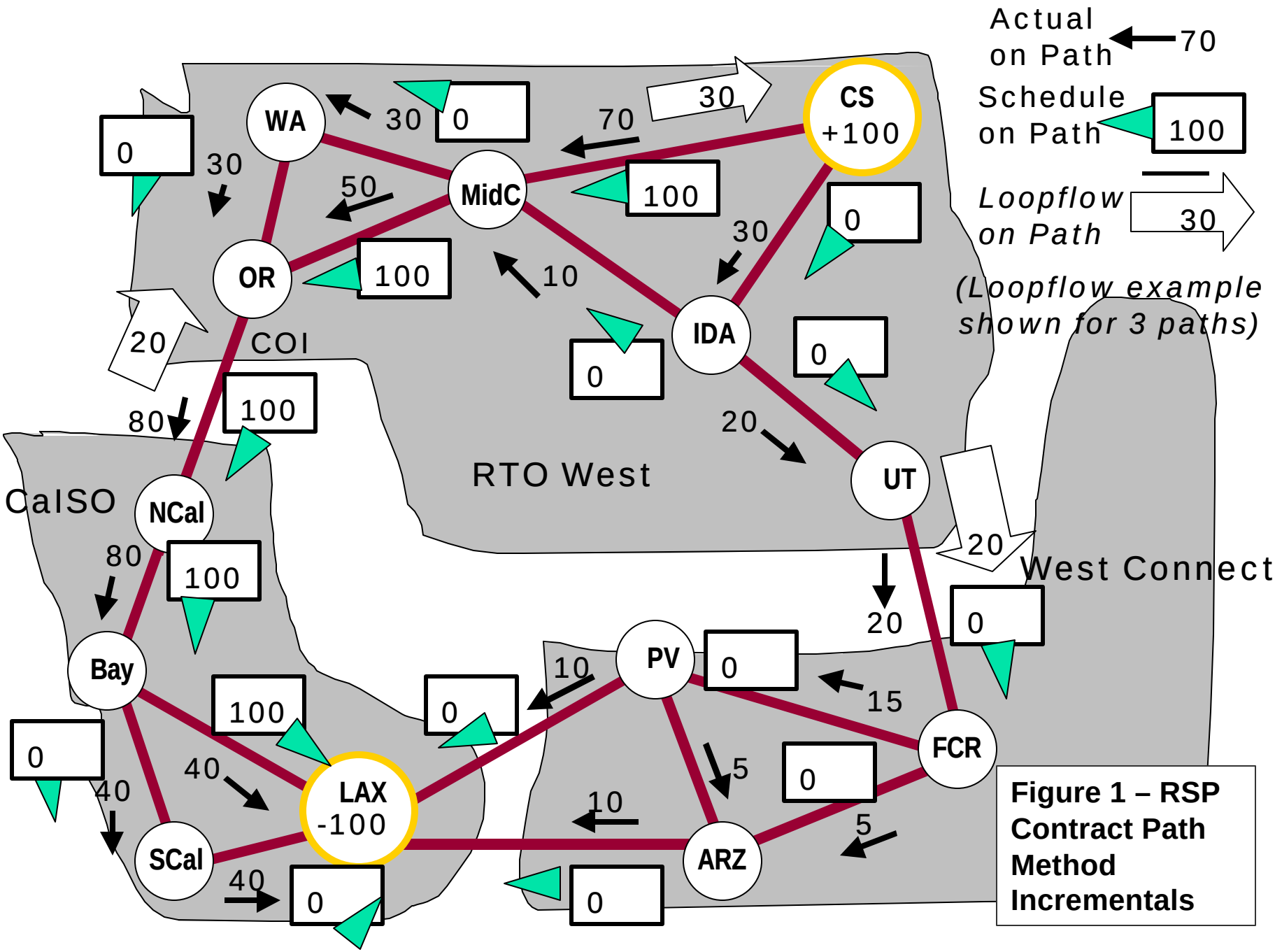
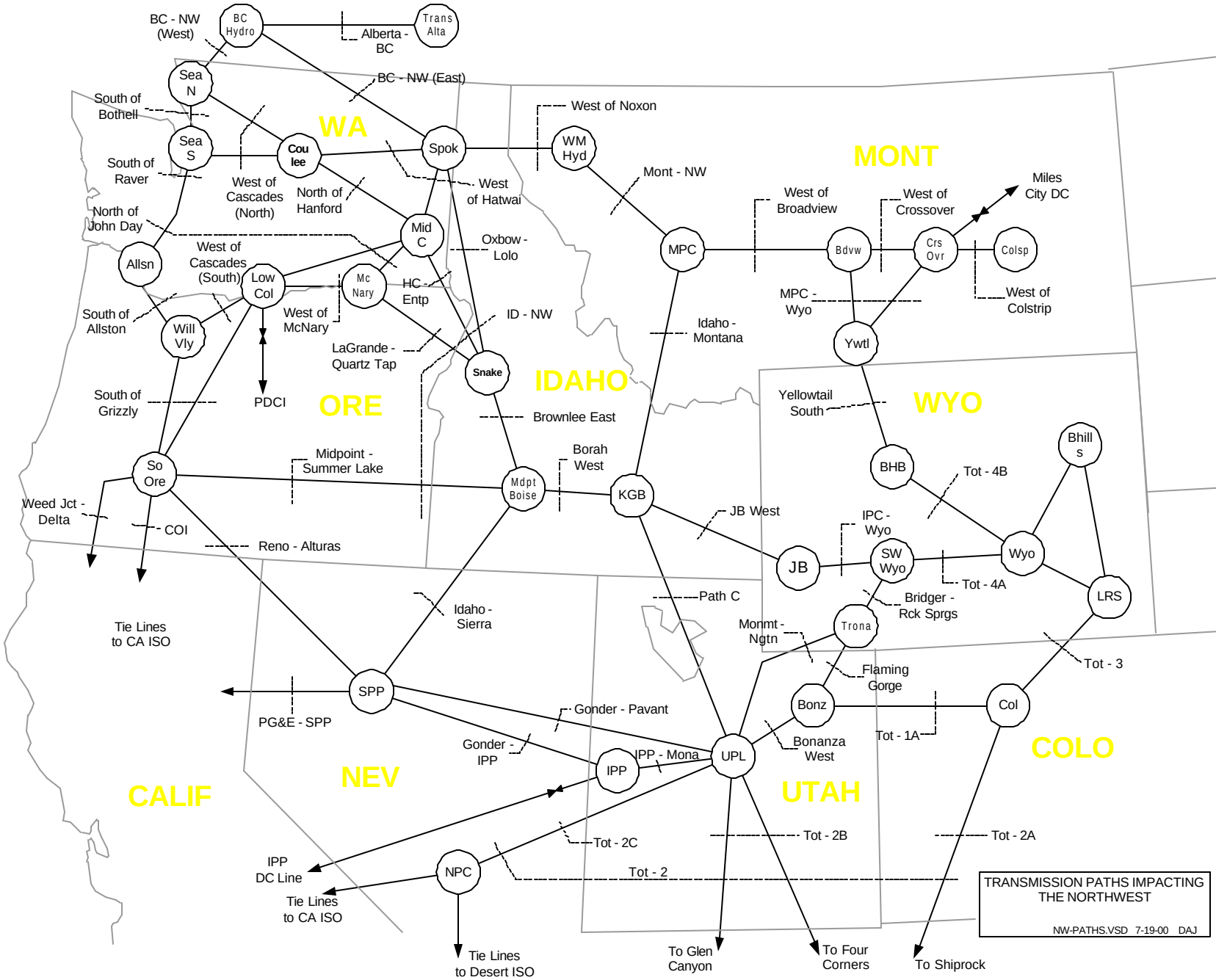


Figure 1 – RSP Contract Path Method Incrementals


BC - NW (West)
BC Hydro
Trans Alta
Alberta - BC
BC - NW (East)
Sea N
South of Bothell
WA
Sea S
Cou lee
Spok
West of Noxon
WM Hyd
MONT
South of Raver
West of Cascades (North)
North of Hanford
West of Hatwai
Mont - NW
West of Broadview
West of Crossover
Miles City DC
North of John Day
Mid C
Oxbow - Lolo
MPC
Bdvw
Crs Ovr
Colsp
Allsn
West of Cascades (South)
Low Col
Mc Nary
HC - Entp
MPC - Wyo
West of Colstrip
South of Allston
West of McNary
ID - NW
Idaho - Montana
Will Vly
Ywtl
LaGrande - Quartz Tap
Snake
IDAHO
South of Grizzly
PDCI
ORE
Yellowtail South
WYO
Brownlee East
Bhill s
So Ore
Midpoint - Summer Lake
Borah West
BHB
Tot - 4B
Mdpt Boise
KGB
Weed Jct - Delta
JB West
IPC - Wyo
COI
Reno - Alturas
JB
SW Wyo
Wyo
Tot - 4A
LRS
Path C
Bridger - Rck Sprgs
Idaho - Sierra
Tie Lines to CA ISO
Monmt - Ngtn
Trona
Flaming Gorge
Tot - 3
SPP
Bonz
Col
PG&E - SPP
Gonder - Pavant
Tot - 1A
Gonder - IPP
IPP - Mona
UPL
Bonanza West
COLO
NEV
IPP
CALIF
UTAH
Tot - 2C
Tot - 2B
Tot - 2A
IPP DC Line
NPC
Tot - 2
Tie Lines to CA ISO
Tie Lines to Desert ISO
To Glen Canyon
To Four Corners
To Shiprock
TRANSMISSION PATHS IMPACTING THE NORTHWEST
NW-PATHS.VSD 7-19-00 DAJ

WGA Transmission Study - Purpose

- Energy Crisis of 2000 & 2001 caused Western Governors to take action
  - Joint ROW and siting issues cooperation
  - Transmission Expansion Study
- Identify Conceptual Transmission Plan for Main Grid Expansion for West
  - **To Eliminate Major Bottlenecks that contribute to present & future Energy Crisis**
  - **Facilitates Regional Economic 10 Year Load & Resource Growth**
  - **Facilitates Emerging Market Design and De-Regulation**

WGA Study Results

- WSCC needs 50,000 MW of new generation over next 10 years to meet growth to 160,000 MW Peak and 960,000 Energy GWh in 2010.
- 25,000 MW of new Gas Fired Generation is underway close to loads, doesn't need much new transmission.
  - 2004 Transmission is committed for some new generation
- Transmission Expansion Estimates were developed to facilitate two Generation Expansion Scenarios for the remaining 25,000 MW:
  - Additional Gas Generation Expansion (mostly close to load), or
  - Additional Generation Remote from load, from Coal & Renewables

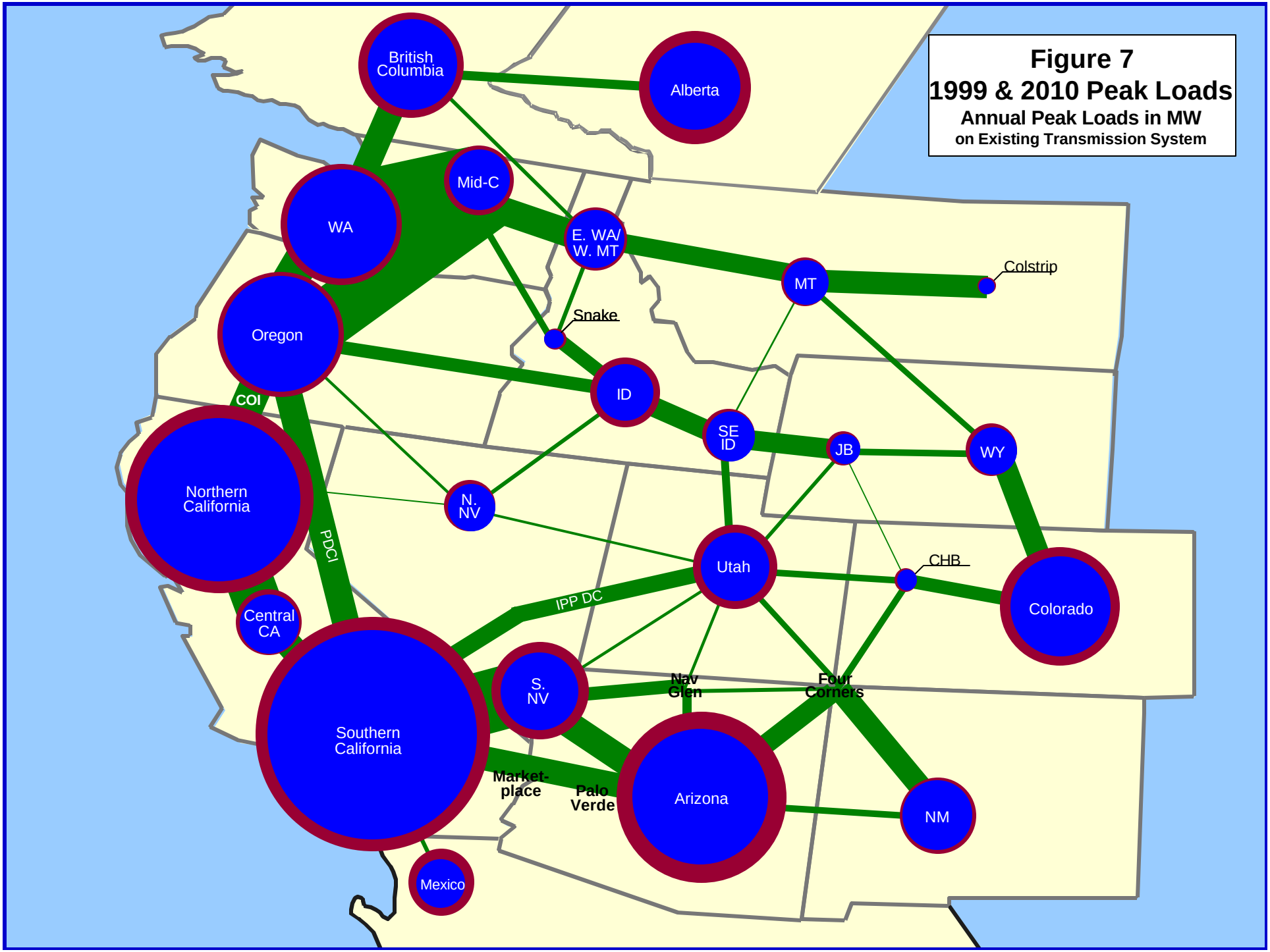


Figure 7
1999 & 2010 Peak Loads
Annual Peak Loads in MW
on Existing Transmission System
British Columbia
Alberta
Mid-C
WA
E. WA/ W. MT
MT
Colstrip
Snake
Oregon
ID
COI
SE ID
JB
WY
Northern California
N. NV
PDCI
Utah
CHB
IPP DC
Colorado
Central CA
S. NV
Nav Glen
Four Corners
Southern California
Market-place
Palo Verde
Arizona
NM
Mexico

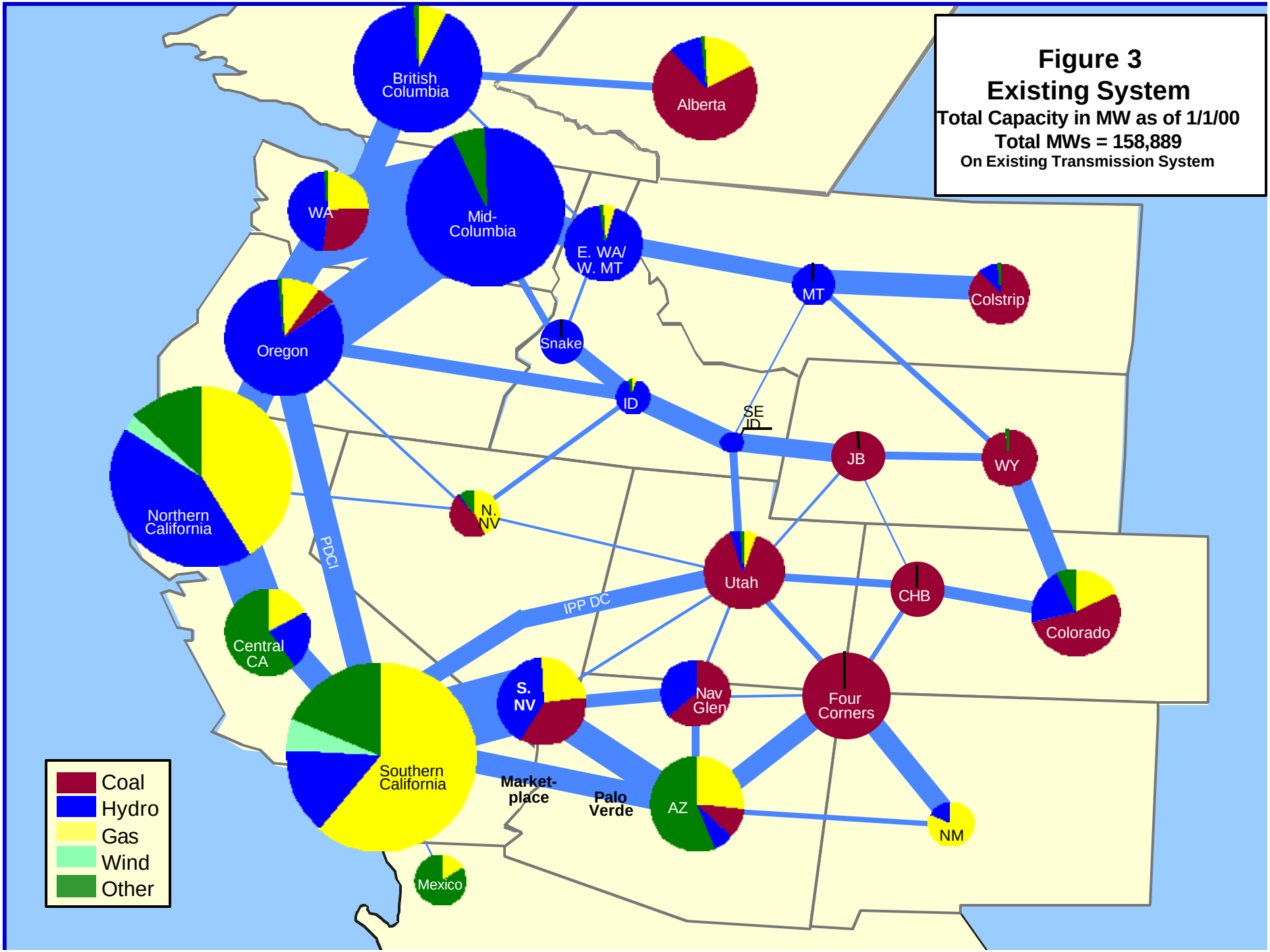
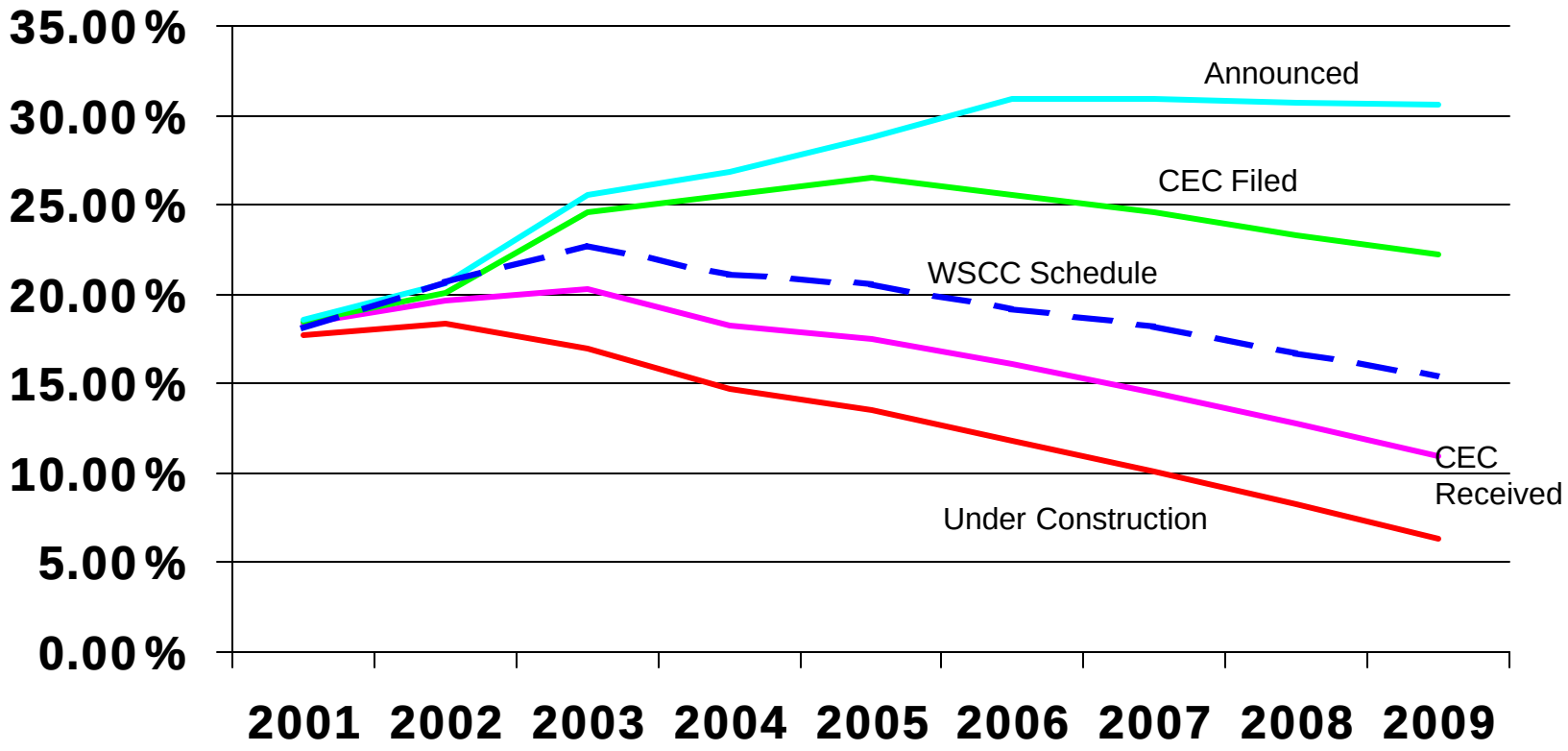


Figure 3
Existing System
Total Capacity in MW as of 1/1/00
Total MWs = 158,889
On Existing Transmission System
British Columbia
Alberta
WA
Mid-Columbia
E. WA/ W. MT
MT
Colstrip
Oregon
Snake
ID
SE ID
JB
WY
Northern California
N. NV
PDCI
Utah
CHB
Colorado
IPP DC
Central CA
S. NV
Nav Glen
Four Corners
Southern California
Market-place
Palo Verde
AZ
NM
Mexico
Coal
Hydro
Gas
Wind
Other

WSCC Capacity Margins

72,000 MW Proposed



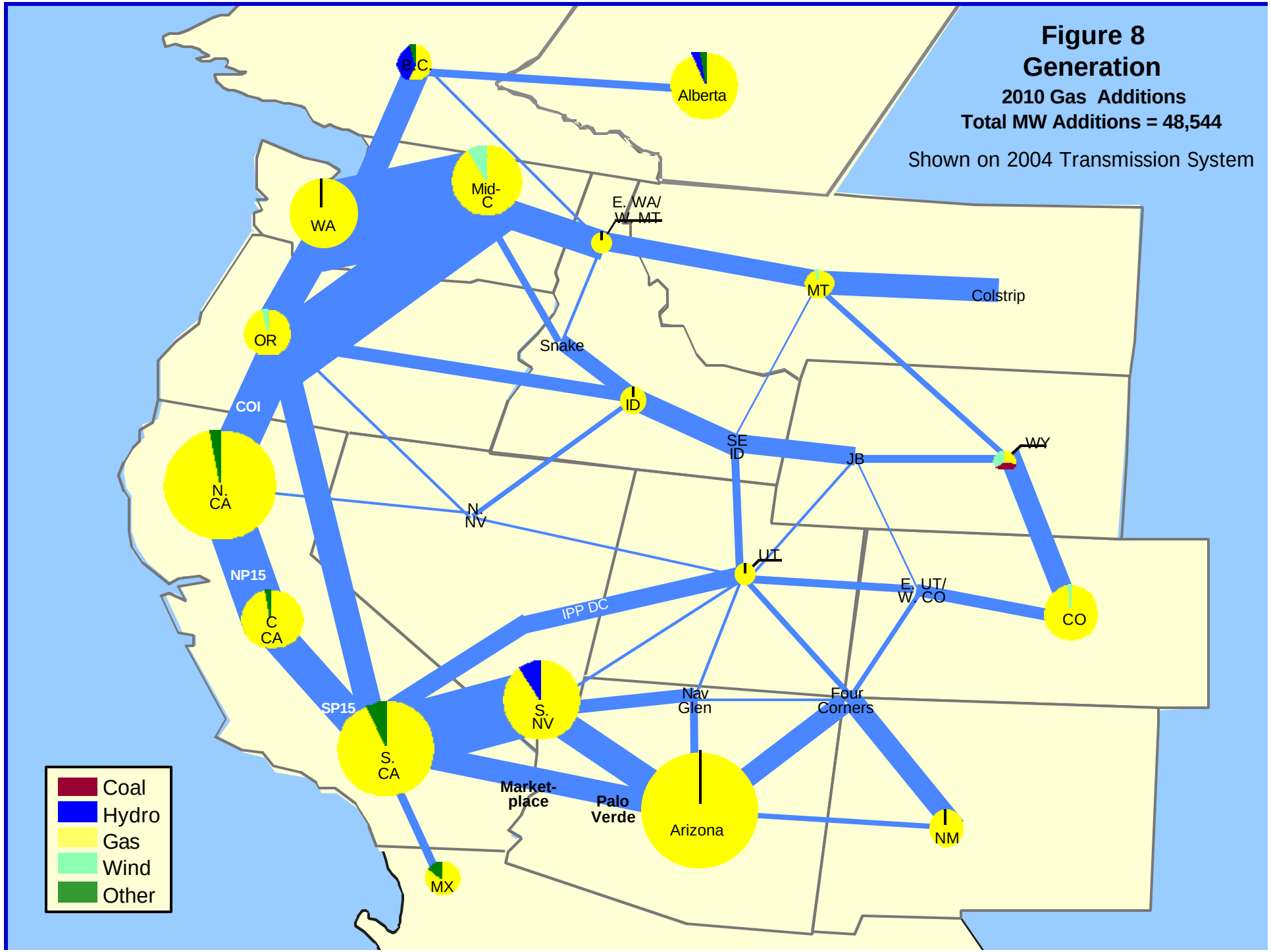


Figure 8
Generation
2010 Gas Additions
Total MW Additions = 48,544
Shown on 2004 Transmission System
B.C.
Alberta
Mid-C
WA
E. WA/ W. MT
MT
Colstrip
OR
Snake
ID
COI
SE ID
JB
WY
N. CA
N. NV
UT
NP15
E. UT/ W. CO
IPP DC
C CA
CO
Nav Glen
Four Corners
S. NV
SP15
S. CA
Market-place
Palo Verde
Arizona
NM
MX
Coal
Hydro
Gas
Wind
Other

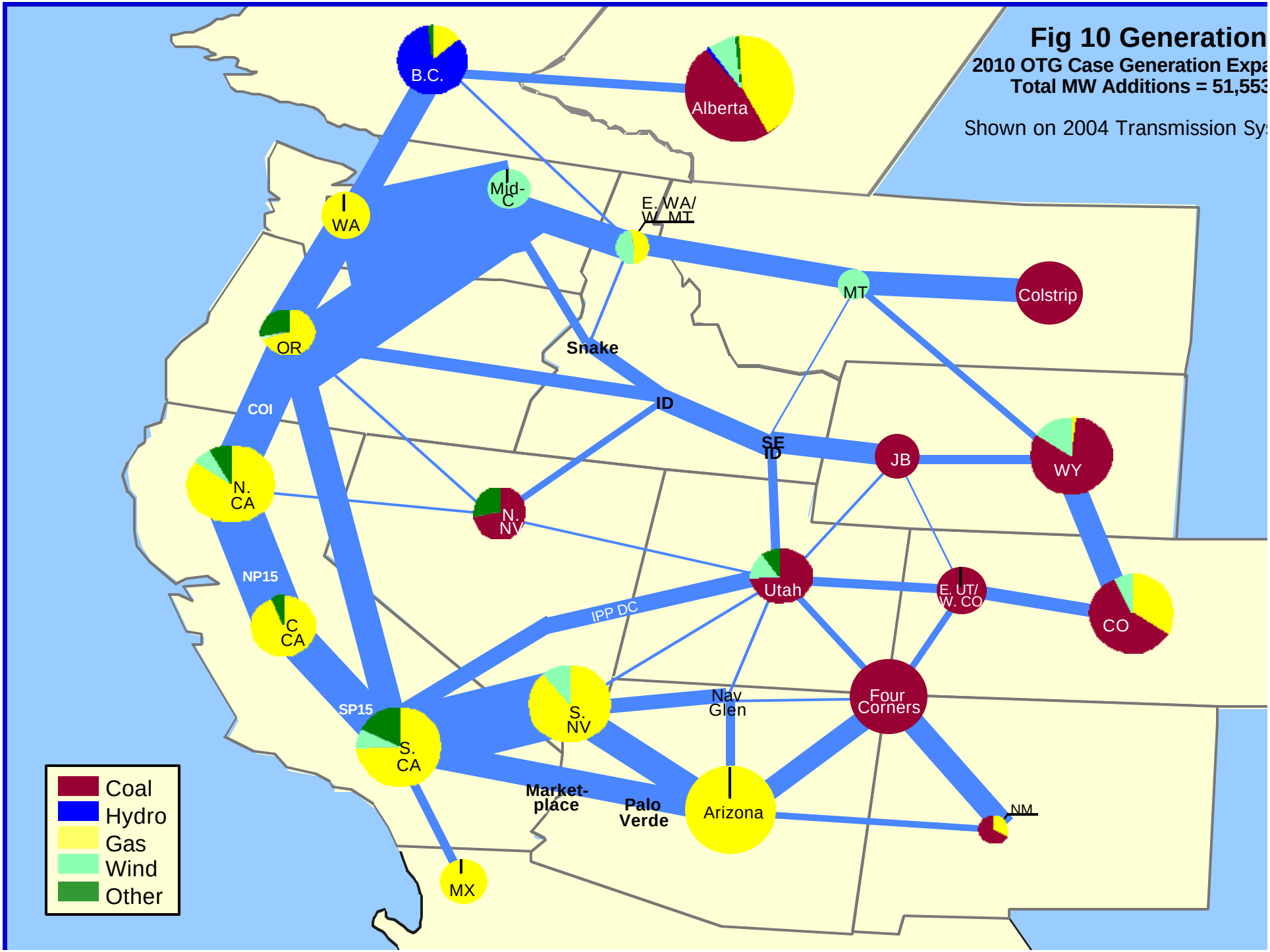


Fig 10 Generation
2010 OTG Case Generation Expa
Total MW Additions = 51,553
Shown on 2004 Transmission Sy
B.C.
Alberta
Mid-C
WA
E. WA/
W. MT
MT
Colstrip
OR
Snake
ID
COI
SE ID
JB
WY
N. CA
N. NV
NP15
Utah
E. UT/
W. CO
CO
IPP DC
C CA
SP15
S. NV
Nav
Glen
Four
Corners
S. CA
Market-
place
Palo
Verde
Arizona
NM
MX
Coal
Hydro
Gas
Wind
Other

Figure 21

Approximate Capital and Fixed O&M Cost Comparison

For New Combined Cycle Gas Generation and New Coal Generation

			Combined Cycle Gas Plant	Coal Plant
New Construction Heat Rate		BTU/kWh	7,000	10,000
Installed Generator Capital Cost		$/kW	$500	$1,200
	Annualized at 10%, 30 Year Life	$/kW-Yr	$53	$127
Fixed O&M per year		$/kW-Yr	$30	$50
	Total Fixed Costs per Year	$/kW-Yr	$83	$177
Fixed Cost at 85% Capacity Factor		$/MWh	$11.15	$23.77
Fuel Costs				
	Gas	$4.68 per mmBTU	$/MWh	$32.76	
	Coal*	$0.73 per mmBTU	$/MWh		$7.33
Total Cost for Plant assuming 85% CF		$/MWh	$43.91	$31.10

*Coal Prices range from $0.16 per mmBTU mine mouth to $1.50 per mmBTU railed

Transmission Expansion Costs

- Transmission Added for All Gas Generation Expansion:
  - $2 Billion Initial (2010 $) = $0.22 Billion Annually
  - Could be more or less depending on Gas Locational Price assumptions (study used flat $4.68 per mmbtu across the region). Doesn't include Gas Pipeline expansion costs.
- Transmission Added for the Remote, Other Than Gas Generation Expansion:
  - $8 to 12 Billion Initial = $0.88 Billion Annually
  - Will be less by $1 to 4 Billion Initial = $0.11 to 0.44 Annual
    - Worst Case distribution of remote resources: Transmission Bookend
    - Chicken & Egg: The first Transmission Super Hwy built will influence later generation location and reduce transmission costs
    - Incremental Addition Study will identify best altenative

Savings from OTG Generation

- Annual Fuel Savings to Region if Other than Gas Fired Generation with Transmission Scenario is developed (2010 $):
  - Normal Conditions $3.4 Billion
  - Low Hydro Conditions $3.6 Billion
  - High Gas Prices Condition $5.4 Billion
- For Normal Condition Case
  - Additional Fixed Cost of Coal Fired above Gas Fired new generation approximately $1.4 Billion annual (not including Gas Delivery)
  - Additional cost of OTC transmission above Gas transmission = $0.7 Billion annually
- Congestion Savings
  - From Transmission added in OTG Case = $1.4 Billion. Congestion savings between OTC Generation cases with and without OTC Transmission added.

Relative Market Price Change

- Production Cost Model Used
  - Assumes perfect competition and dispatch
  - Represents the Floor on Market Prices
- Estimated Market (Spot Price), Annual Average $$ per MWh (2010 $), Weighted by Load Area
  - Gas Expansion Case: $36.00
  - OTG Expansion (Gen & Trans) Case: $29.00
  - Price Reduction with OTG & OTG Xmssn $ 7.00
- Customers benefit from reductions in market or spot prices
- Low Operating Cost Plants have much better chance of staying in business, and making cost recovery and profit. Units will be dispatched if at or below spot price (locational).

Options to Finance OTG Transmission

1. Spread Costs over all Users
   - $0.88 Billion / 960000 Annual GWh = $0.92 per MWh
   - (0.9 mils/kW-hr)
2. Guarantee Portion of Congestion Savings to Developers
   - 175,000 GWh Annual OTG new gen. possible with Transmission adds
   - Annual Congestion Savings from Transmission in OTG Case = $1.4 Billion. Spread evenly on new gen = $1.4 / 175,000 = $8 per MWh) Apply part to offset cost risk.
   - Transmission Expansion Cost = $0.88 / 175,000 GWh = $5.00 MWh. Need to offset this risk- free rider problem. When added to $31 Annual Cost of Coal Plant = $36; Economics are marginal comparing to Spot Price Floor.
3: Open Season and Specific Users Pay:
   - $0.88 / 175,000 GWh = $5.00 MWh (marginal if OTG has to pay)

Other Considerations

- Market Power
  - More transmission brings more generation into the available pool and reduces market power of local generation
- Fuel Diversity and Fuel Savings
- Merchant Plants must recover fixed costs during operating hours and thereby will have higher prices if they run less.
  - Once on, lower cost fueled generation will run more hours and price pressure less (or profitability higher).
  - Conversely, higher fuel price generation will run less and have to raise prices to cover fixed costs in hours running.
- Spinning and Standby Reserves will be a large issue
  - Who pays for and where are they carried
  - Fit Remote Base load with local Demand Side - more study needed

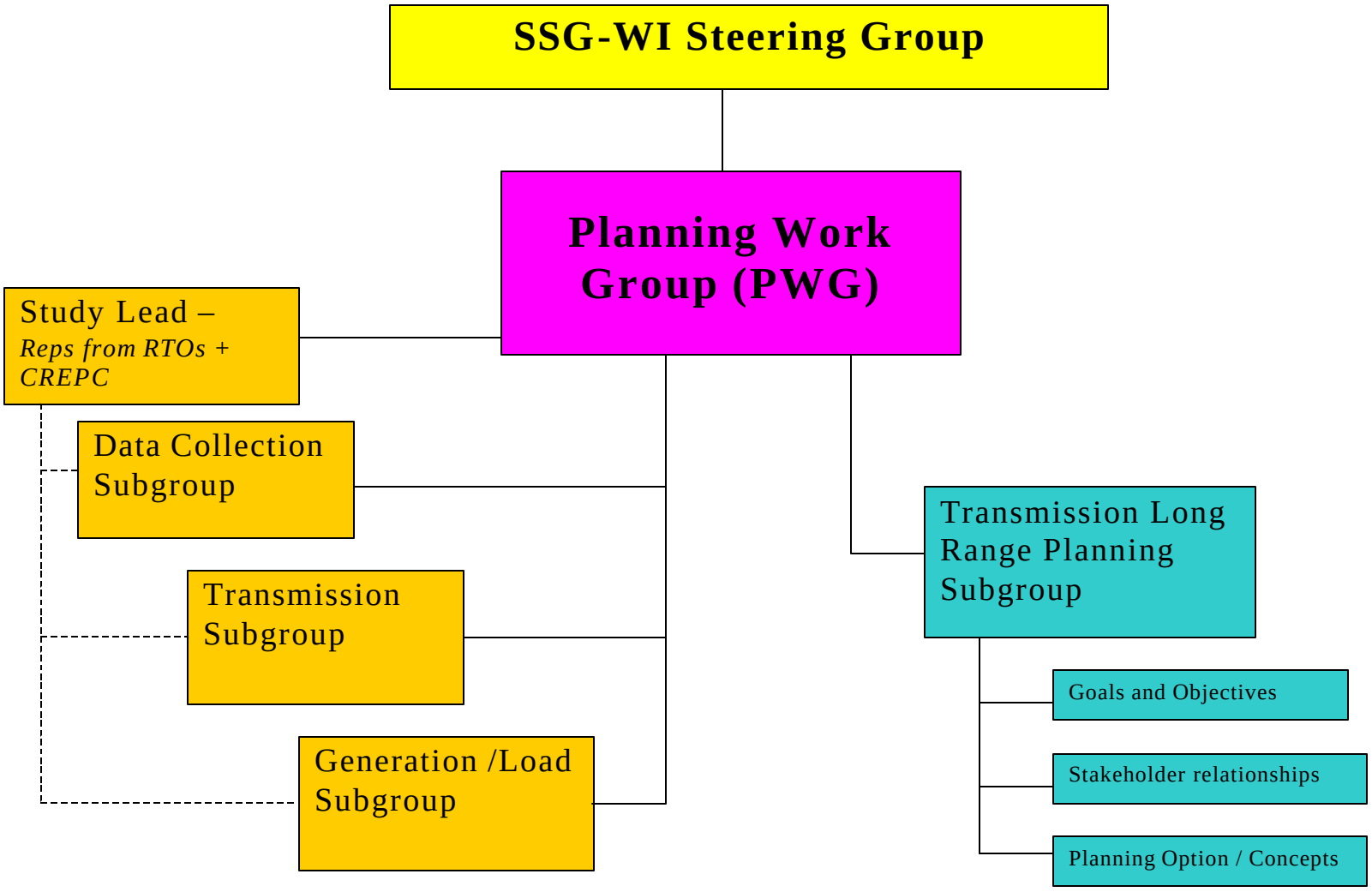
Other Considerations

- Remote Wind
  - Need a method for financing AC Transmission Infrastructure required for remote wind and/or improving the capacity factor
- AC Expansion
  - Synergistic and beneficial to many generation and load expansion scenarios
- HVDC
  - Economic for dedicated low cost fuel plants with high cap factors.
  - If AC infrastructure is not built, DC could move low fuel cost plants to high price markets without AC expansion benefits.
  - More Study Needed

Conclusions

- Both Expansion Scenarios appear to be economic
  - At this point neither is out of running
  - Depends on pricing and fixed cost recovery
  - Heavily dependent on Gas Forecast
- On a global perspective, cost of OTG transmission is minimal, good hedge for Region
- However if cost risk is not spread, incentives are needed for transmission developers
- Region benefits if more OTG generation comes on, but it won't if it must take all transmission cost risk
  - New transmission reduces congestion costs for competitors as well as developer - Free Rider Problem
- More Accurate look is needed - SSGWI Planning & Governor Letter

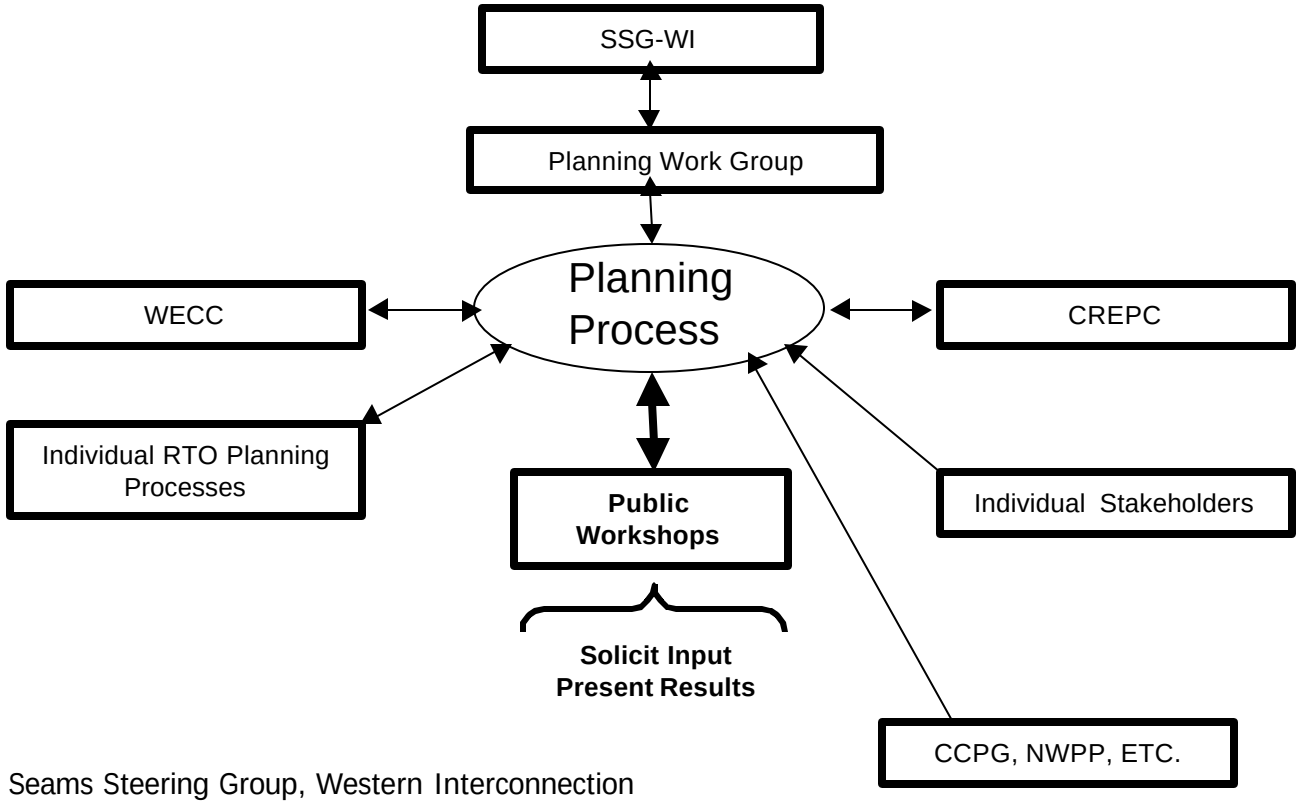
Planning Work Group Organization



SSGWI PWG

- SSG-WI Transmission Planning Process is a proactive, inclusive, interconnection-wide, least-cost transmission planning effort
- Goal is “to…facilitate seamless grid planning across the Western Interconnection as if there were a single RTO instead of three.”
- Scope: will deal with congestion issues that impact the marketing of energy between RTOs or regions, including congested paths within a region that have an impact on the ability to market between regions
- Issues:
  - How to select incrementally best projects
  - Determine how & who to pay for them

SSG-WI Planning Process



Acronyms

- SSG-WI - Seams Steering Group, Western Interconnection
- WECC - Western Electricity Coordinating Council
- CREPC - Committee on Regional Electric Power Cooperation
- CCPG - Colorado Coordinated Planning Group
- NWPP - Northwest Power Pool

SSGWI PWG - Implementation

- Transmission Expansion Evaluation WG
  - Follow-on from WGA Report "Conceptual Plans for Electricity Transmission in the West" August 2001
  - Task is to evaluate the congestion costs associated with alternative generation expansion scenarios, and to evaluate transmission expansion options that mitigate uneconomic congestion and improve market efficiency
  - Objective is to evaluate integrated resource expansion options, rank these on a least-cost basis, and identify where possible the beneficiaries of such developments
- Transmission Long Range Planning WG
  - Objective: to develop a long-range vision for the evolution of the Western Interconnection transmission system
  - Has groups looking at fundamentals (e.g. build to enhance competition? to meet environmental policy aims?); at process (including stakeholders); and at transmission development options.

Participants

- RTOs (RTO West, CaISO, WestConnect)
- States
- Generators
- Marketers
- Transmission Dependent Utilities
- WECC

Work Scope & Schedule

- Scope
  - Benchmark the model – ***2002 case***
  - Assess system condition with currently planned facilities – ***2008 case***
  - Assess system conditions, potential for congestion and effectiveness of alternative solutions for various generation scenarios (coal, gas, renewable development) – ***2013 case***
  - Long range development considerations– ***15+ years***
  - Study data and results are public information

- Schedule
  - Complete 2008 studies – end of December 2002
  - Complete 2013 studies – May 2003
  - Report - June 2003

Fit with SMD Requirements

- SMD Planning Requirements:
  - Region Wide Planning
  - Resource Adequacy Requirement and Allocation
  - ITP responsibilities, coordination, and backstop role
  - Regional Planning Process
  - Regional Transmission Plan
  - Multi-State Entities
  - Regional State Advisory Committee