Post-ROD Analysis 1997 - 2005

presented by

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at the

GTMAX MODEL REVIEW AND KNOWLEDGE ASSESSMENT WORKSHOP FOR HYDROPOWER

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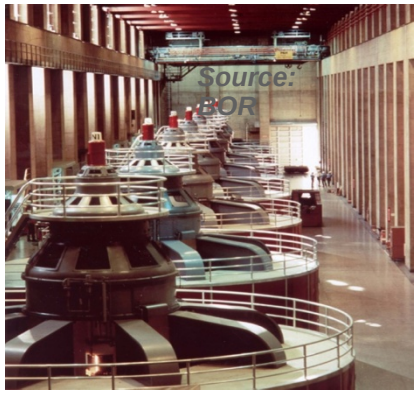
Determine Economic Impact of Operational Restrictions Imposed by the Record of Decision

- Study period is 1997 – 2005
- An economic not financial analysis
- Simulated Glen Canyon Dam (GCD) operation using Pre-ROD and Post-ROD criteria. Compared economic benefits to measure cost of ROD implementation
- The GCDEIS* estimated the economic impacts of power resource alternatives
- Annualized economic costs were estimated at $15.1 to $44.2 million (nominal $1991)
- Much has changed since the early 1990's when costs were estimated
  - Higher than projected fuel prices
  - Faster than anticipated demand growth
  - Transformed power markets

*Glen Canyon Dam Environmental Impact Statement (GCD EIS)

Glen Canyon Dam Hydropower Plant

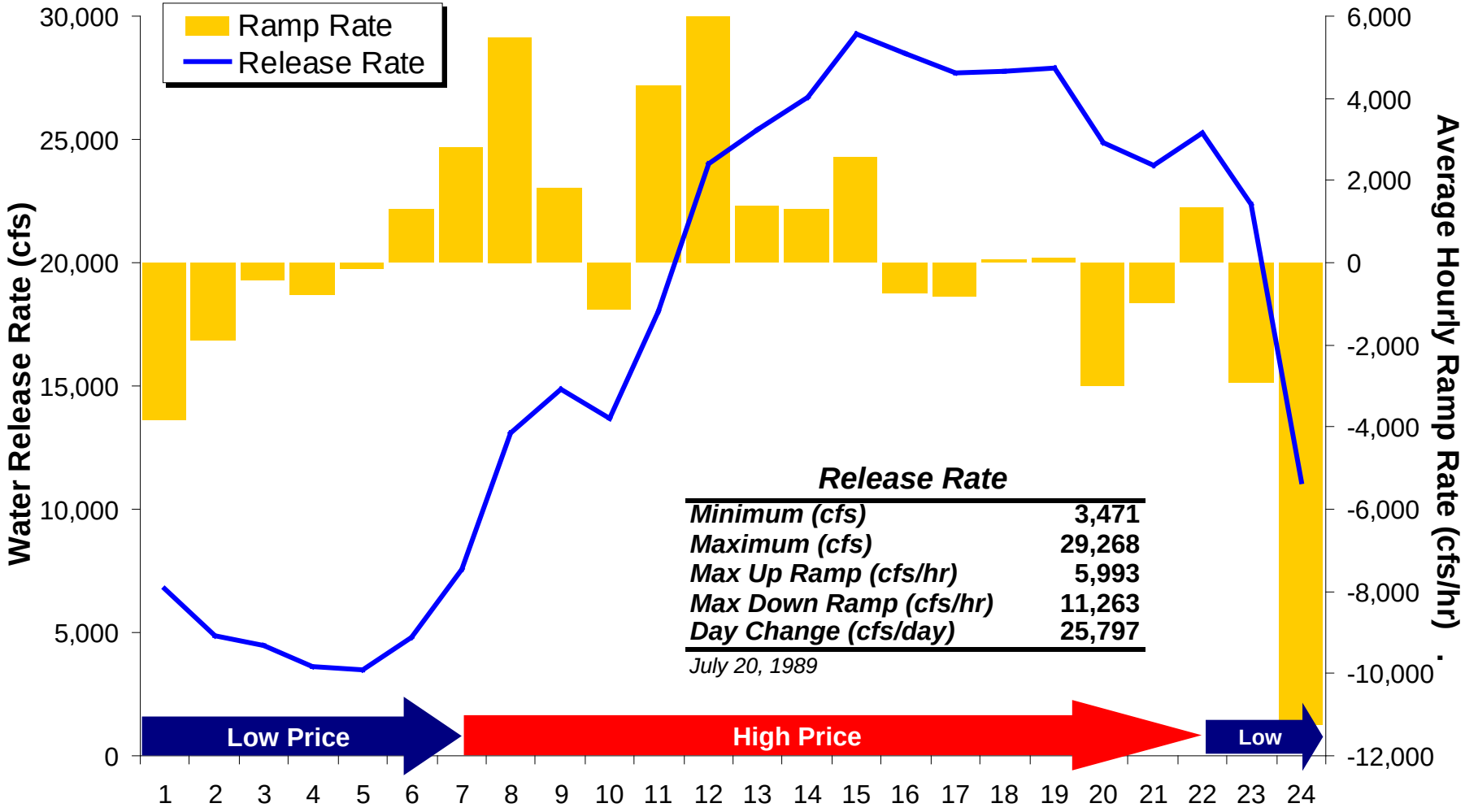
- On-line in September 1964
- ~1,320 MW operable capacity
- 8 generating units
- Operated by Reclamation
- Power & energy production is marketed by Western



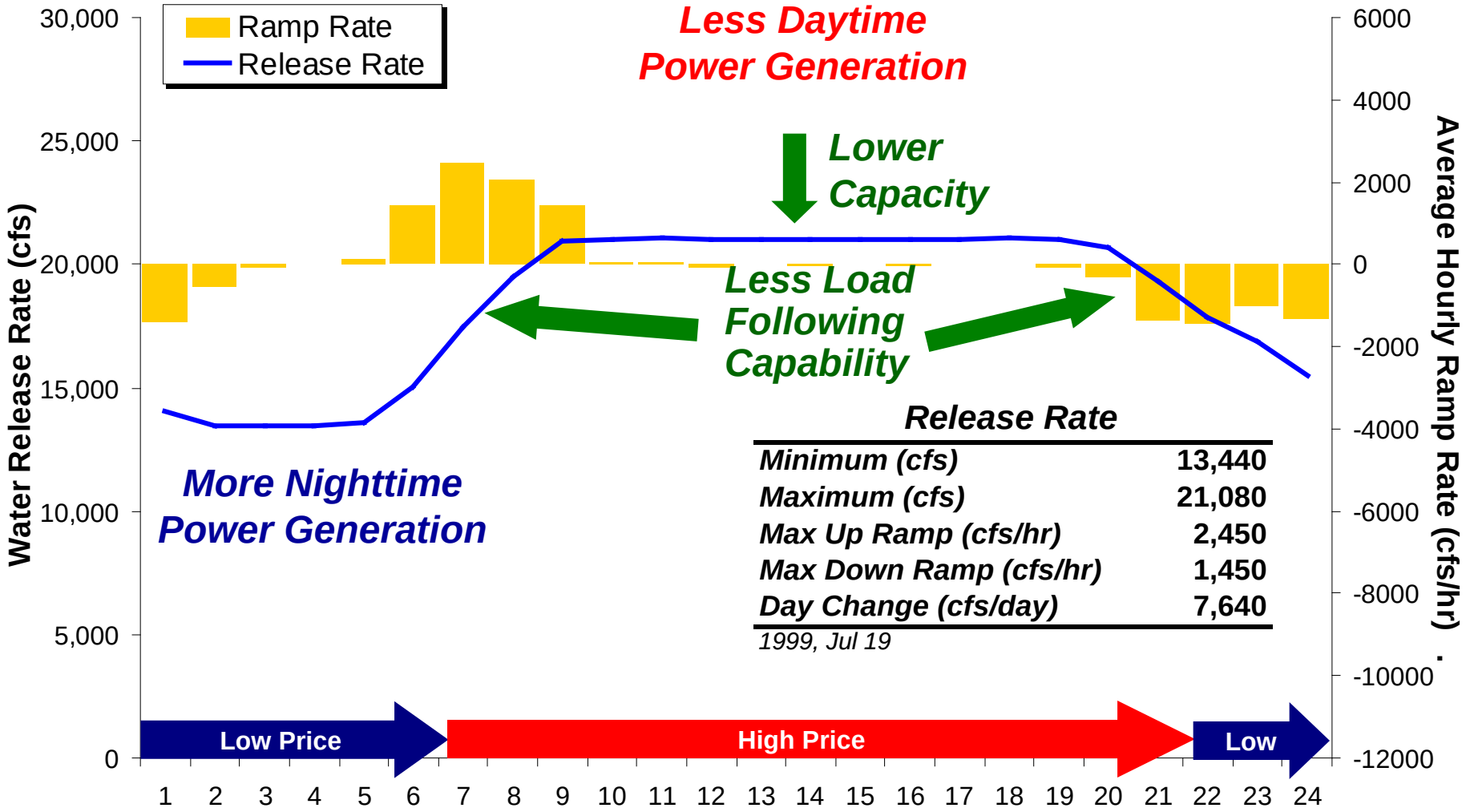
Ancillary Services
Spinning reserves
Regulation
Black start
etc…

Operational Constraint	Historic Flows (Pre-1991)	ROD Flows (Post 1997)
Minimum release (cfs)	3,000 summer 1,000 rest of year	8,000 - 7 am - 7 pm 5,000 at night
Maximum release (cfs)	31,500	25,000
Daily fluctuations (cfs/24 hrs)	28,500 summer 30,500 rest of year	5,000; 6,000; or 8,000 depending on release volume
Ramp rate (cfs/hr)	Unrestricted	4,000 up 1,500 down

Operations Before ROD – Large Release Fluctuations in Response to Market Prices

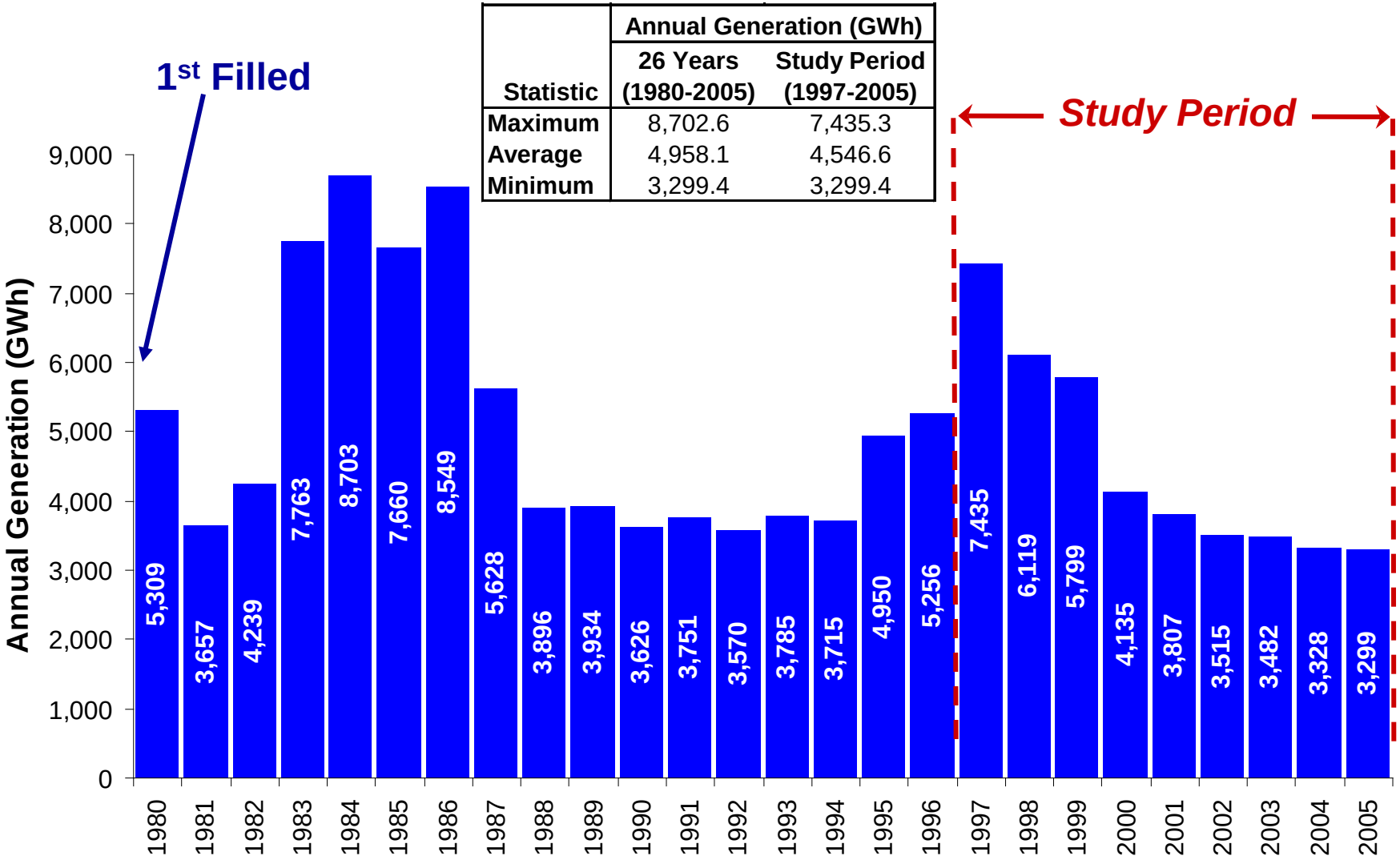


Operations After ROD - Economic Value of the Hydropower Resource Has Been Reduced

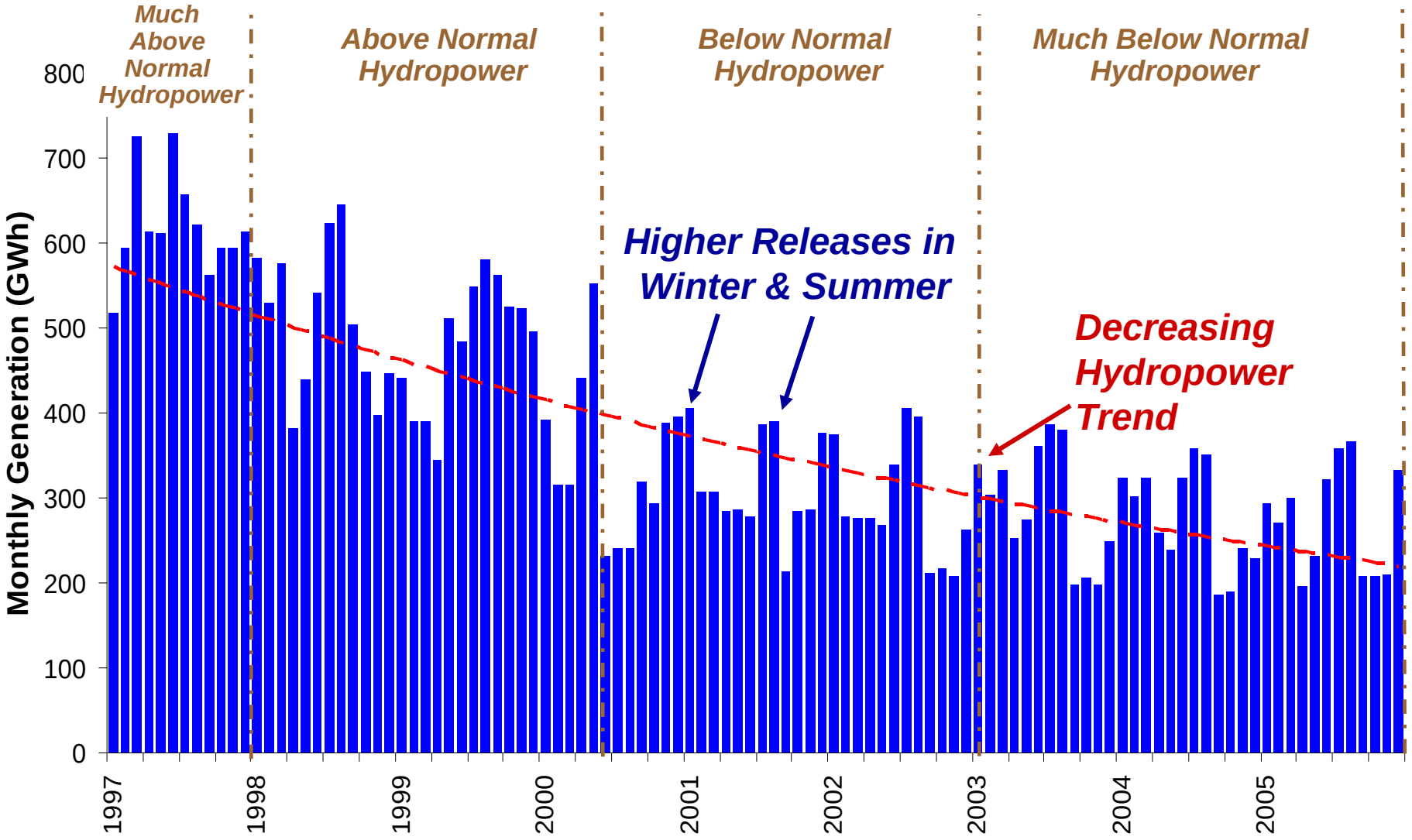


The Study Period Contains a Wide Range of Hydropower Conditions

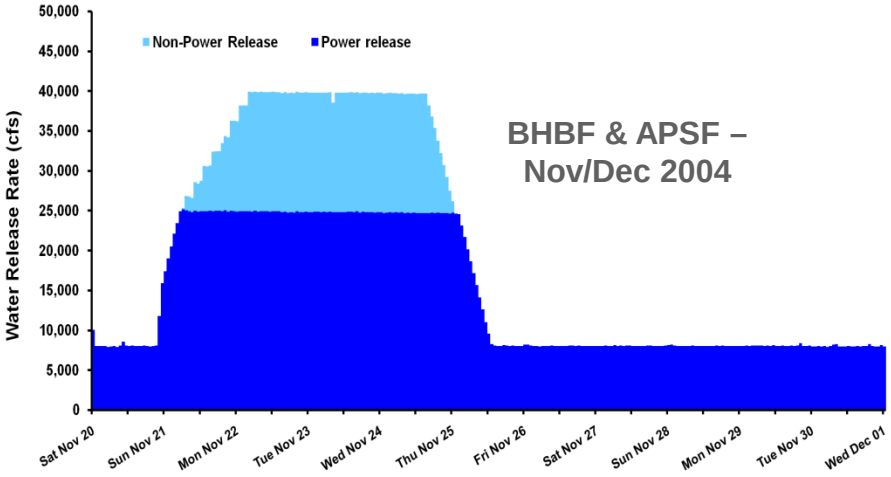
Statistic	Annual Generation (GWh) 26 Years (1980-2005)	Annual Generation (GWh) Study Period (1997-2005)
Maximum	8,702.6	7,435.3
Average	4,958.1	4,546.6
Minimum	3,299.4	3,299.4



General Downward Hydropower Production



Experiments Performed at GCD

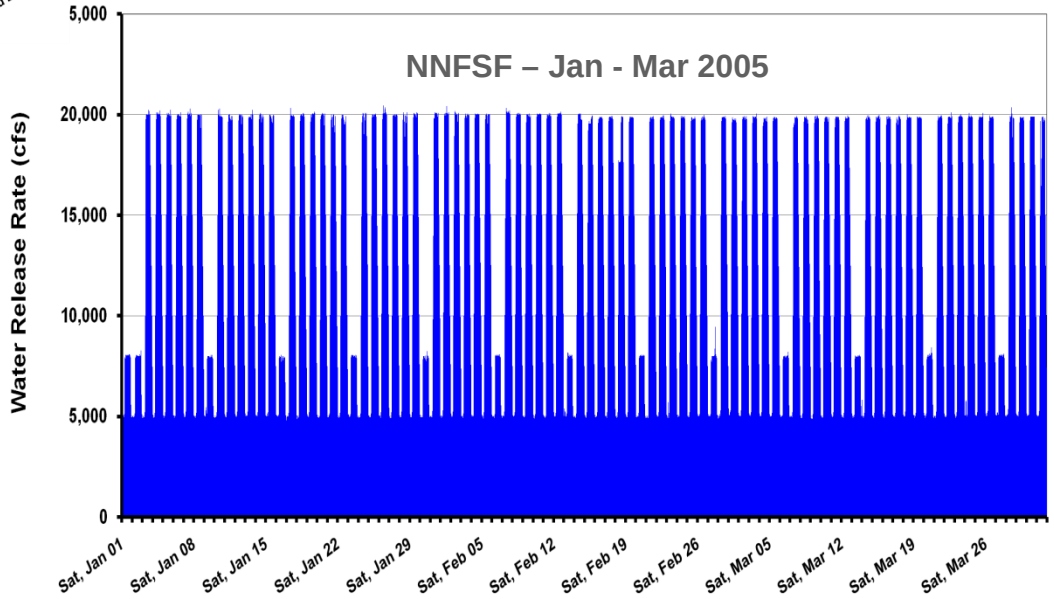


BHBF & APSF – Nov/Dec 2004

- ROD created the Glen Canyon Dam Adaptive Management Program to conduct scientific studies and achieve environmental objectives
- Experiments have significant impact on power generation – water is spilled, shifting time of generation from day to night and on-peak to off-peak hours

Types of Experiments

- Beach/Habitat Building Flow (BHBF)
- Non-Native Fish Suppression Flow (NNFSF)
- Habitat Maintenance Flow (HMF)
- Low Summer Steady Flow (LSSF)
- Aerial Photography Steady Flow (APSF)



Overview of the Modeling Process

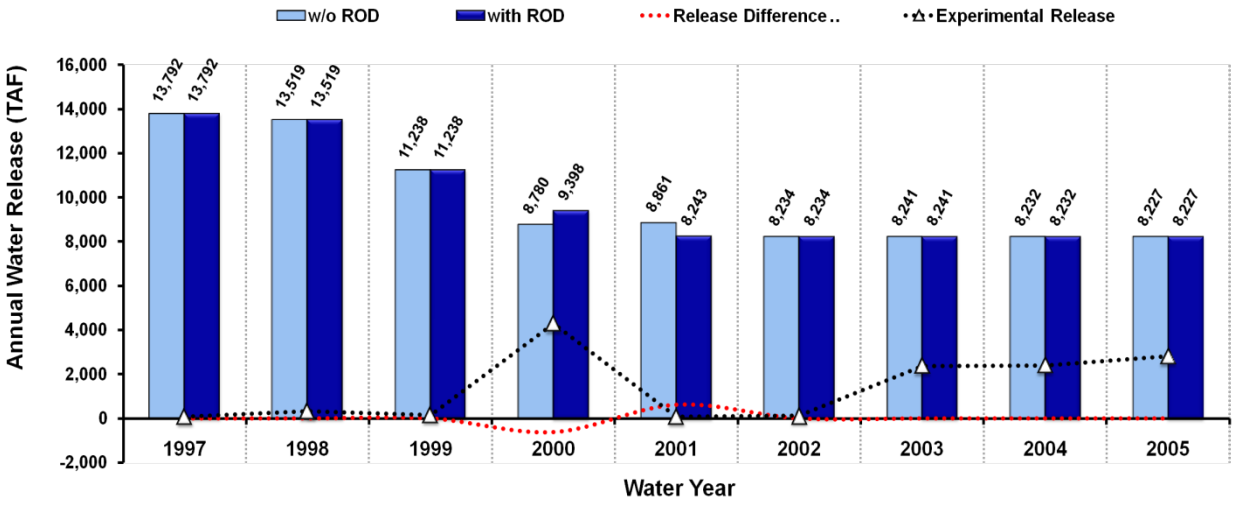
SLCA/IP
Hourly
Firm Loads

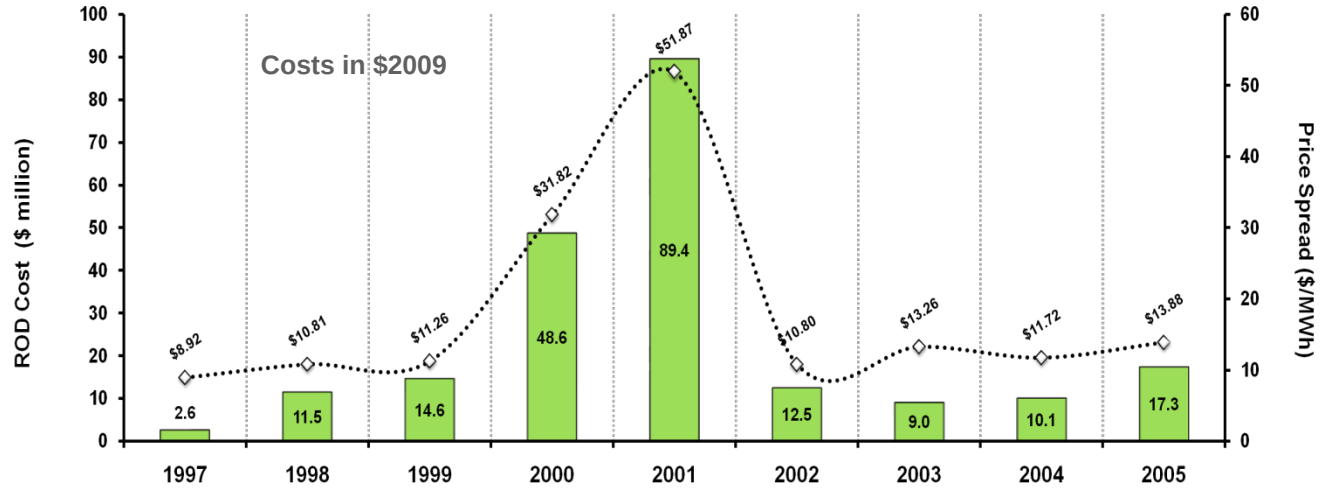
- Ran 2 GTMax simulations; one with ROD, one without ROD
- Data obtained from publicly available sources such as Energy Information Administration, Federal Energy Regulatory Commission, and Western Power Operations & Maintenance Form 59
- Electricity market price data for various hubs obtained from Intercontinental Exchange and CRSP Management Center – used as surrogate for economic value of energy
- Western constructed data on customer contracts that would have been in effect without the ROD for all facilities within Salt Lake City Integrated Projects (SLCA/IP)

Comparison of Assumptions used in Both Scenarios

Scenario Element	Without ROD	With ROD
Operating Criteria	Prior to stringent environmental constraints defined in Table 2.2	Post-ROD operating criteria defined in Table 2.2
SLCA/IP Contract Terms	Constructed by Western Staff; based on post-1978 marketing approach	Effective April 1998, post-1989 marketing with replacement resource process modifications
Dispatch Objectives & Goals	• Maximize economic value of SLCA/IP resources with market purchases of low-priced energy for increased sales during high-priced hours • No restriction on daily release levels during weekends	Same as Without ROD, as long as ROD criteria are satisfied.
Experimental Flows	Do not occur	Specified in ROD and occur as historically recorded
AHP Values	Same as With ROD scenario	Historical Values
Minimum Schedule Requirement	Same as With ROD scenario	Historical Values

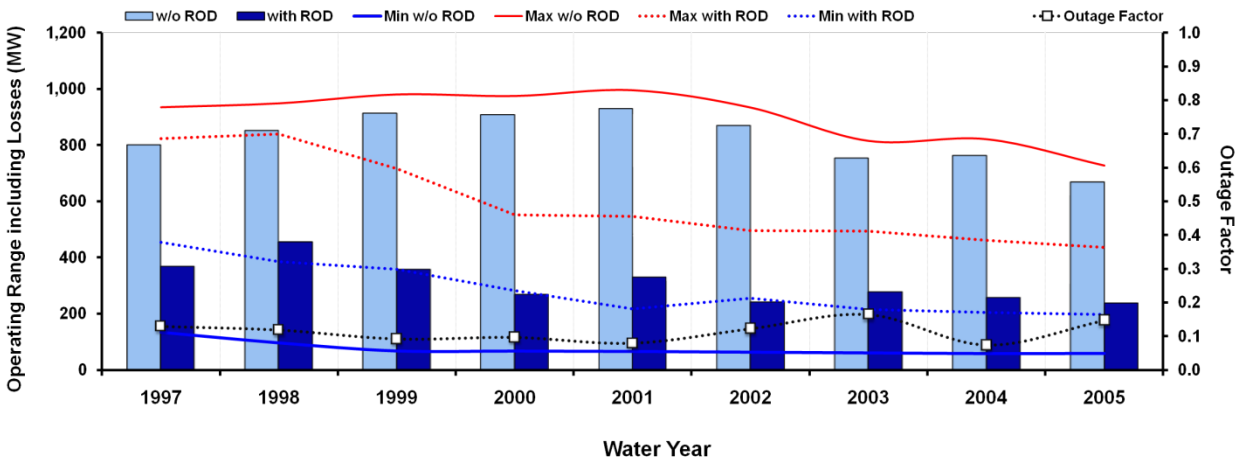
Results – Energy Costs

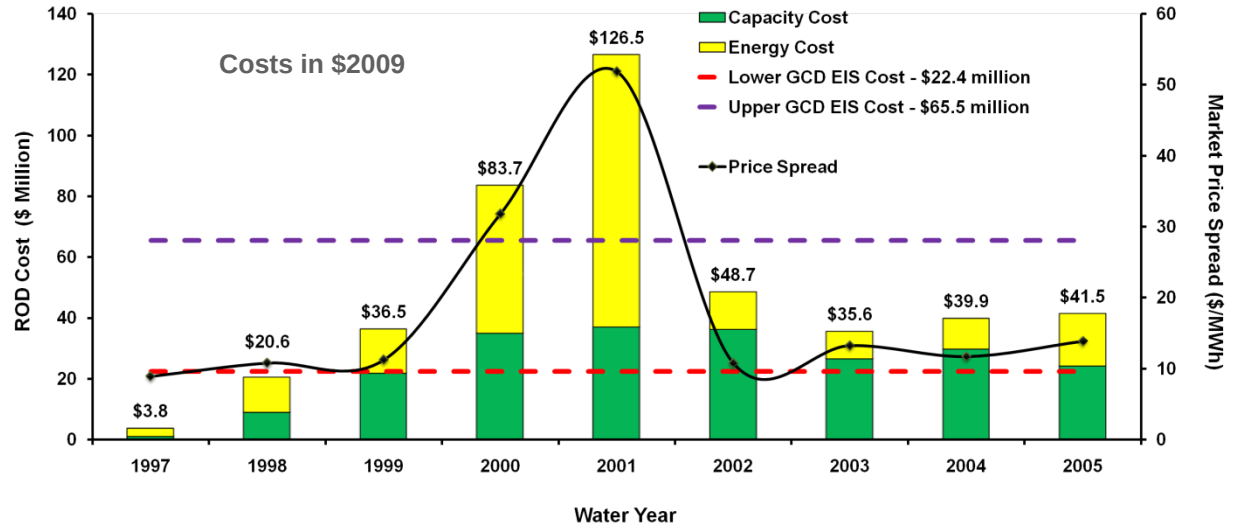




- Costs follow price spreads.
- Different water releases in 2000 and 2001 due to LSSF
- Large price spikes in 2000 and 2001 because of California energy crisis.
- Some experiments increased flows on-peak; decreased off-peak. Note NNFSF occurred in 2003.
- Cost increase in 2004 despite drop in price spread – outage rate cut in half from 2003. More energy in on-peak hours w/o ROD.
- Cost increase in 2005; water spilled during BHBF.

Results – Capacity & Energy Costs

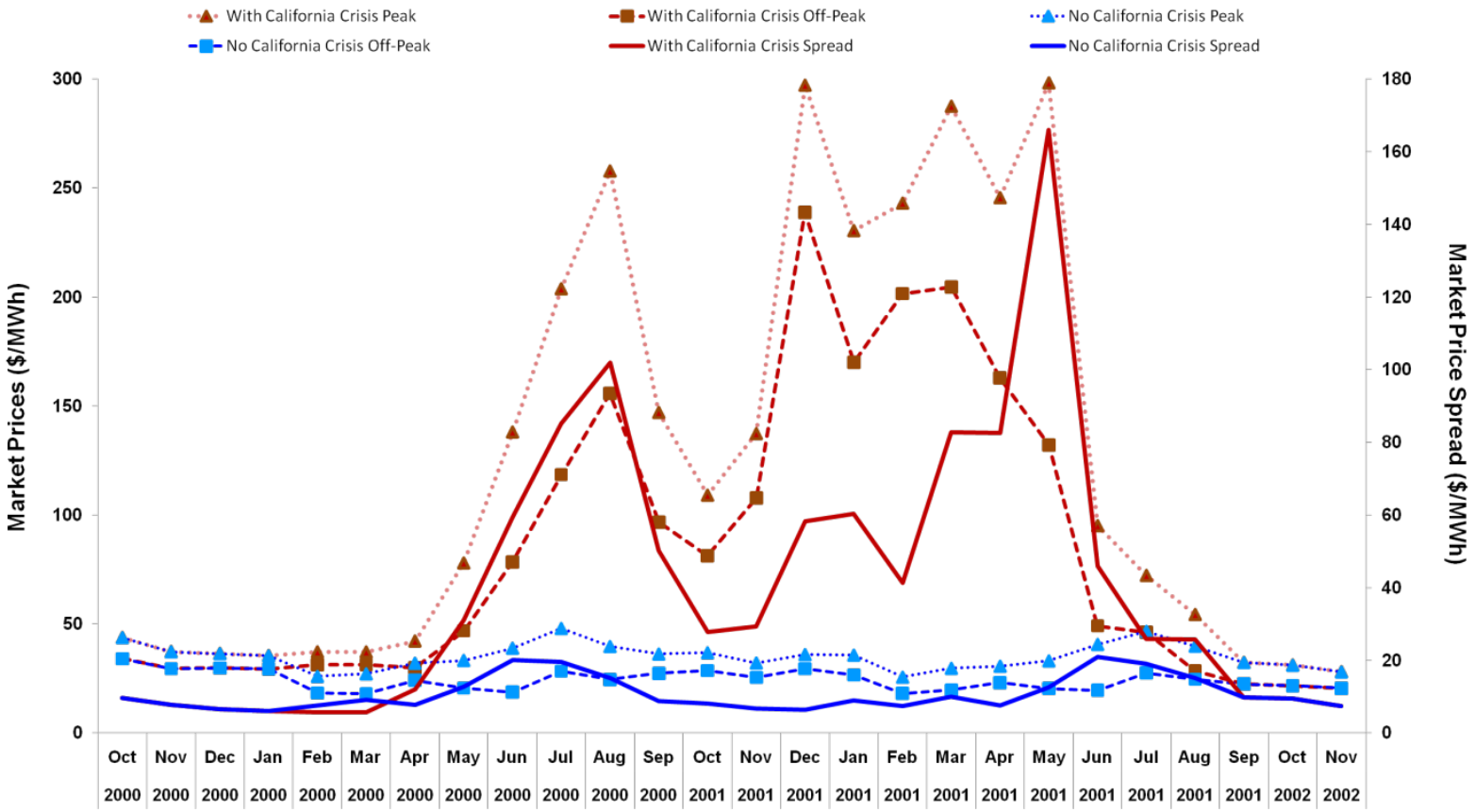




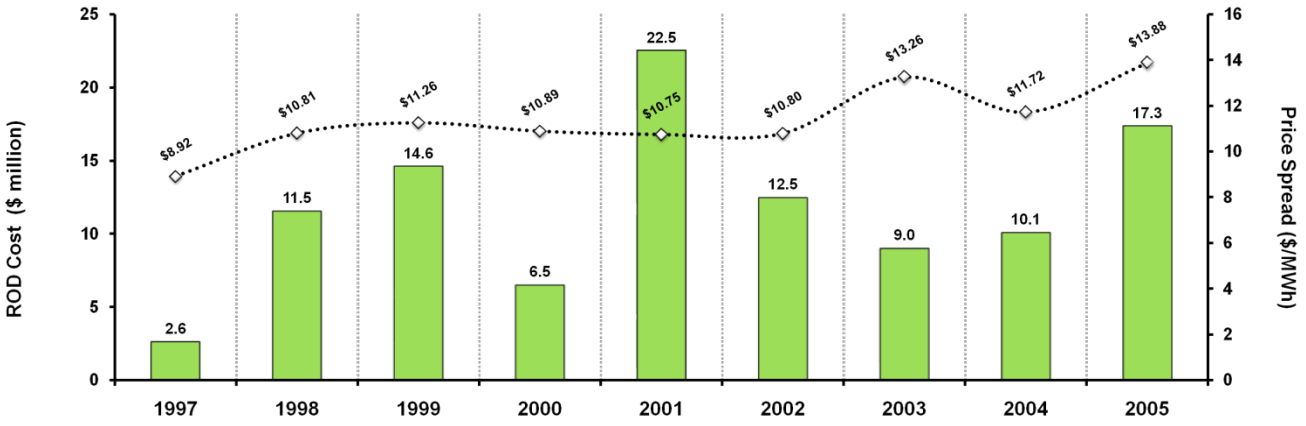
- Capacity valued at $83/kW; from Shortage Criteria EIS
- Capacity costs largest in 2000 to 2002; max capacity difference between with & w/o ROD.
- Highest total cost in 2000 and 2001 during California energy crisis.
- Capacity is largest share of total cost except in 2000 and 2001.
- Compare to costs in GCD EIS – convert from $1991 to $2009.
- Costs in 2000 and 2001 are much higher than GCD EIS range.
- Average annual ROD cost from current study is $50 million; within range as calculated in GCD EIS.
- Total cost over $435 million

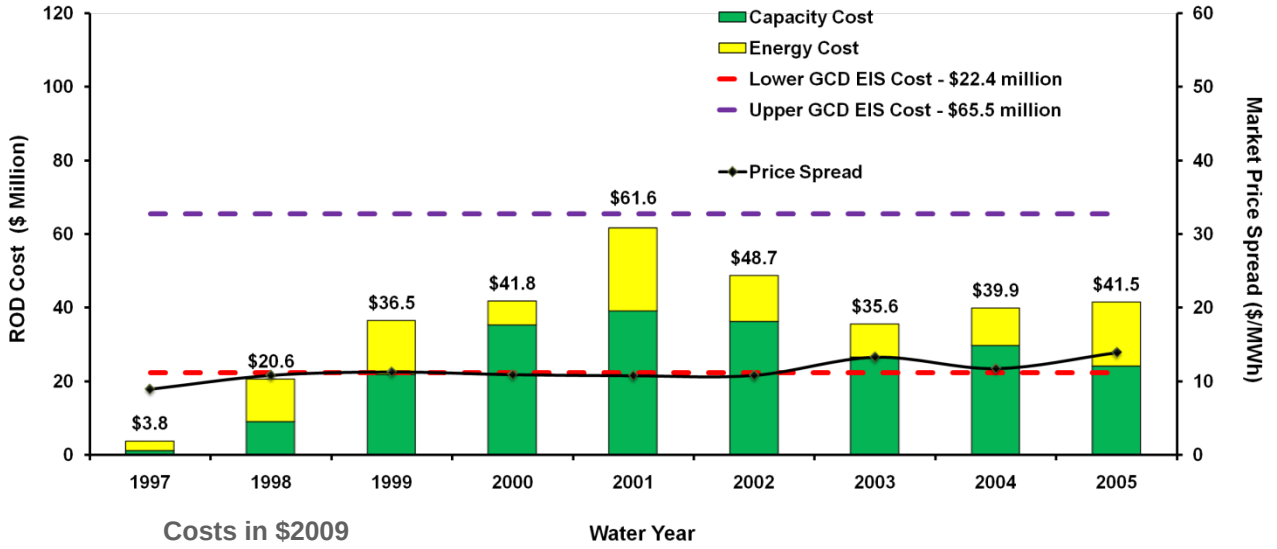
Electricity Prices During California Energy Crisis Fluctuated Wildly

- Interpolation method used to “smooth out” wild swings and remove effect of California energy crisis
- Simulation rerun for 2000 and 2001 as a sensitivity study



Sensitivity Study Results





- Energy costs are shown at left; only costs in 2000 and 2001 differ from previous figure
- Cost in 2000 is half that in 1999 because of LSSF; despite no change in price spread.
- Substantial increase in 2001 cost because less water released for with ROD case compared to w/o ROD to compensate for higher release in 2000. Again no change in price spread between 2000 and 2001.
- Average cost of $38 million is within range calculated in GCD EIS.
- Total study period cost is $330 million


Thank you for your attention
Source: BOR