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BLACK & VEATCH

Analysis of California Natural Gas Market, Supply Infrastructure, Regulatory Implications, and Future Market Conditions

CIEE Subcontract No. MNG-07-01

Natural Gas Storage Forum:
Natural Gas Storage Challenges, Opportunities and Future Options

November 15, 2007

Outline

- Infrastructure Needs to Meet Growing California Demand
- Comparison of In-state vs. Out-of-state Storage Alternatives
- Summary Observations

Daily load demand projections are needed to assess sufficiency of California's infrastructure

- Fundamental market analysis illustrates future supply and demand balance of the California market under the assumed average monthly demand profile
- California's true supply or infrastructure needs will depend on the daily load profile given the range of fluctuations in real load dispatch
- B&V evaluated the sufficiency of the existing and projected California supply portfolio using projections of future daily load requirements
- The analysis focused on different demand scenarios to highlight the possible fundamental factors that could drive additional asset and infrastructure needs for the state
- The daily demand profiles generated by B&V are dependent on publicly available historical data and weather assumptions
- The load profiles were developed as a means to illustrate the range of daily fluctuations, given monthly demand forecasts, in order to stress test California's natural gas infrastructure
- They do not take into account daily operational issues or customer consumption pattern changes and are not intended to replace or contract detailed peak load forecasts completed for the major LDCs operating in the state of California

Methodology to Create Daily Load Duration Curves

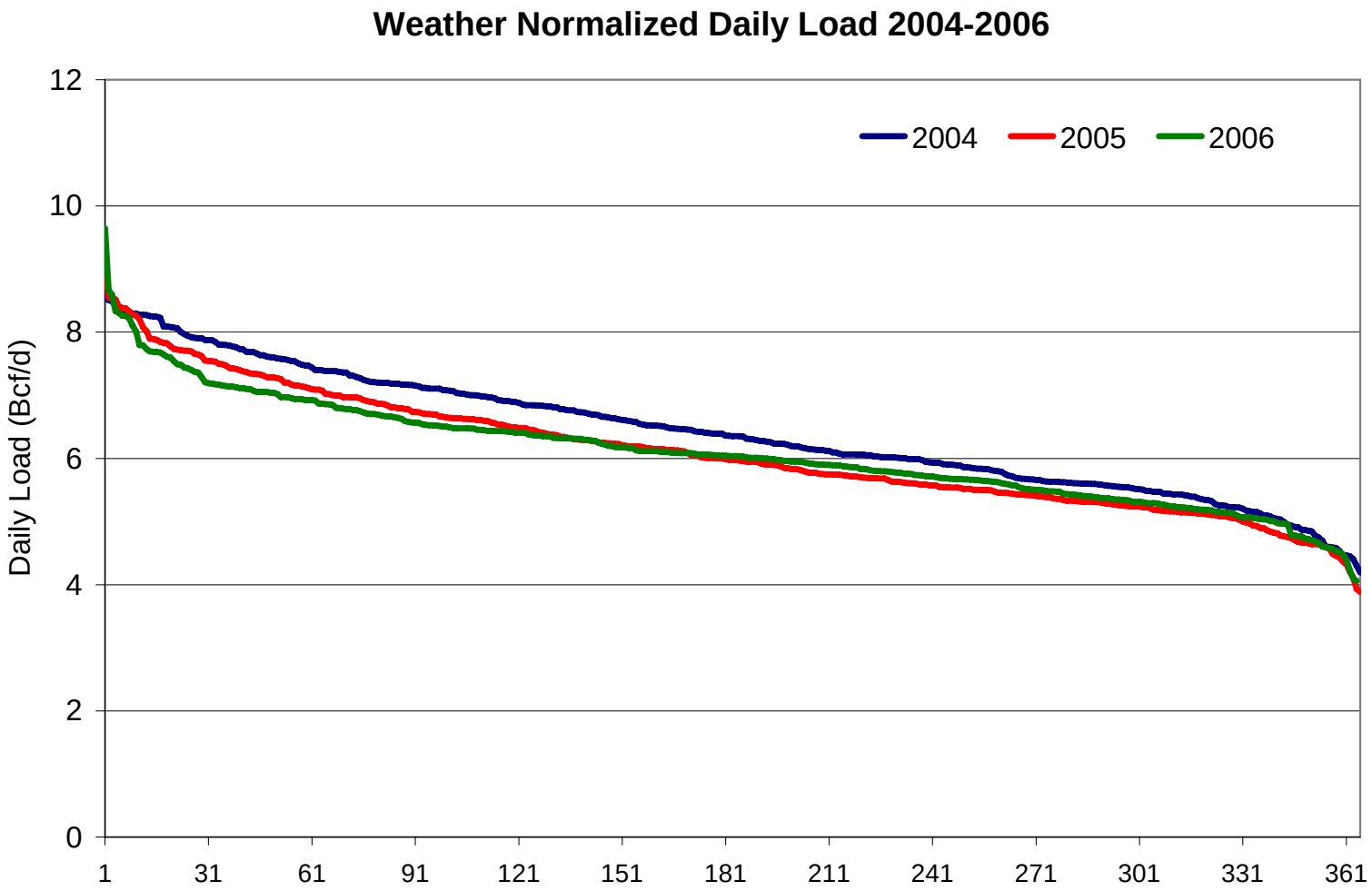
- Methodology

  a. Weather normalize historical daily load using CA HDD for winter months (Nov. – Mar.) and CA CDD for summer months (Apr. – Oct.)

  b. Construct an extreme weather daily load duration curve for the three historical years using the coldest winter and warmest summer and calculate average of the daily load to the annual average demand ratio

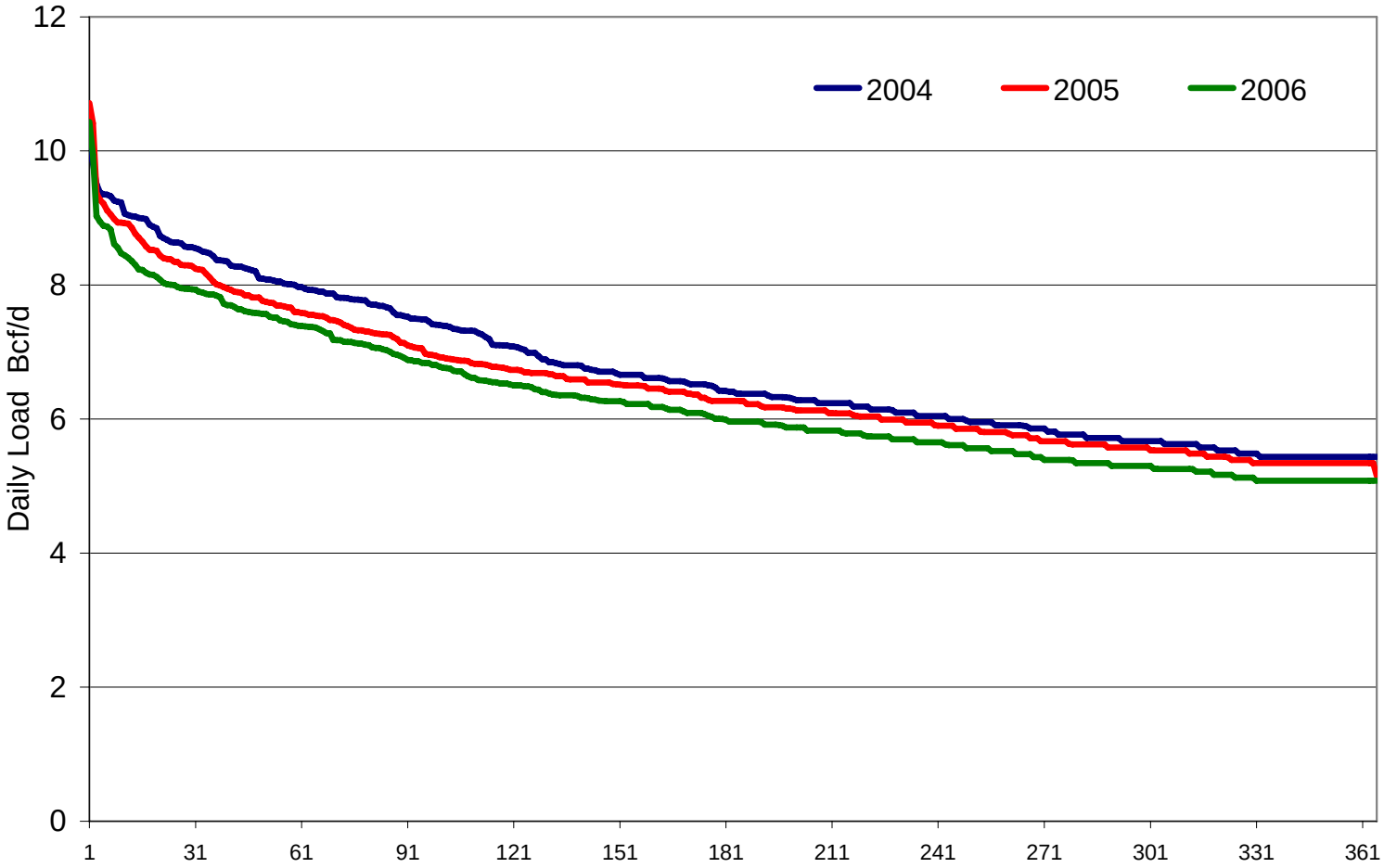
  c. Derive daily load based on forecasted annual demand and the average daily to annual average ratio from daily load

Weather Normalized Daily Load



Data Source: Energy Velocity, EIA

Adjusted Daily Load Based on Extreme Weather Assumptions



Data Source: Energy Velocity, EIA

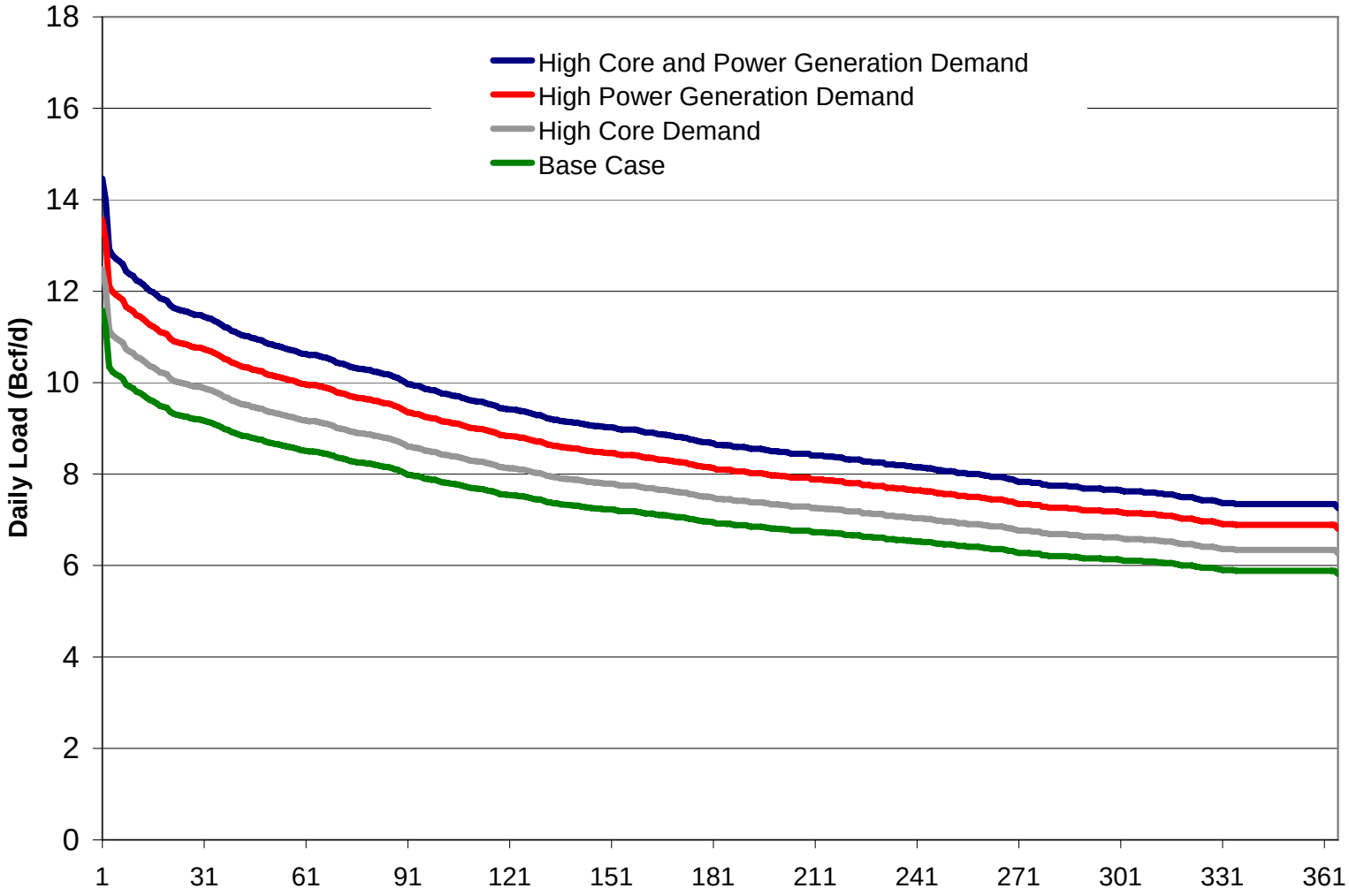
California's supply has historically been sufficient to meet daily demand

- California market is a winter-peaking market which requires storage withdrawals in winter months
- December, January and February typically have the highest demand
- Withdrawals from storage in summer peak months are sometimes required
- There was sufficient pipeline and storage capacity to meet California demand in the past three years

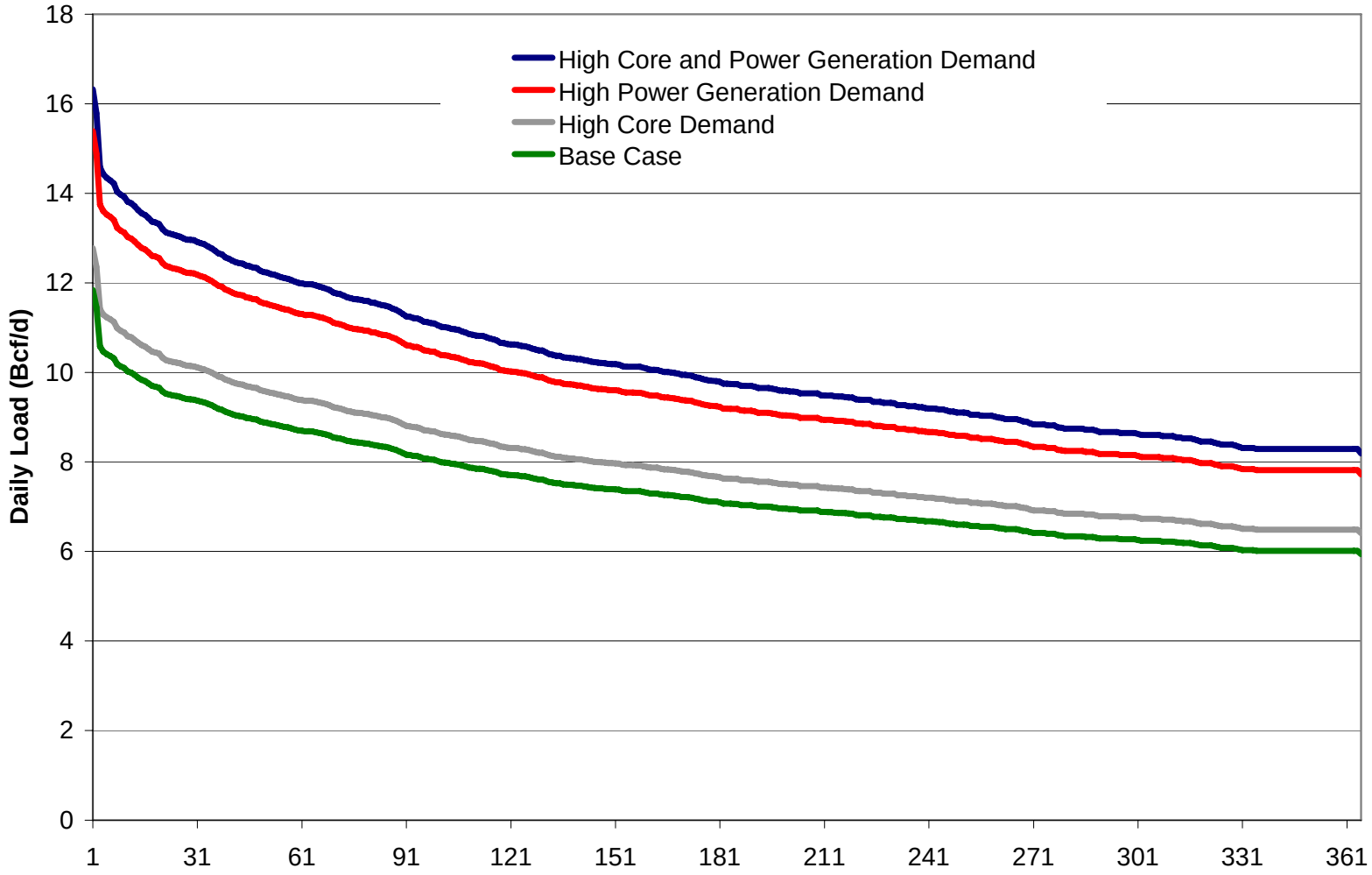
Development of peak demand scenarios to test adequacy of California natural gas supply assets

- We tested the sufficiency of CA supply and infrastructure under four demand cases
  - Base Case: Normal Weather Pattern; the State meets its renewable goals; industrial demand flat
  - High Core Demand: the State experiences a 30-year cold weather pattern
  - High Power Generation Demand : the State does not meet its renewable goals
  - High Core and Power Generation Demand: the State does not meet renewable goals and experiences extreme weather conditions

Scenarios for Daily Load in California - 2015



Scenarios for Daily Load in California - 2020



Estimated Daily Demand Load Requirement for 2015

	Base Case	High Core Demand	High Power Generation Demand	High Core and Power Generation Demand
Estimated Demand/Supply Needs (Bcf)	2,641	2,847	3,093	3,298
Interstate Pipeline Capacity (Bcf/d) (100% Peak Util)	8.1	8.1	8.1	8.1
LNG (Bcf/d)	0.5	0.5	0.5	0.5
Estimated in-state Production Access to Demand (Bcf/d)	0.4	0.4	0.4	0.4
Estimated Demand/Supply Needs Served by Pipeline, LNG and In-state Production (Bcf)	2,618	2,786	2,956	3,075
Estimated Supply Resource Needs Above Pipeline Capacity, LNG and In-state Production (Bcf)	23	61	137	223
Storage Capacity (Bcf)	289	289	289	289
Additional Supply Resources Beyond Expected Storage Capacity	0	0	0	0
Est.Storage Deliverability (Bcf/d)	7.0	7.0	7.0	7.0
Max. Deliverability Needs above Pipeline Capacity, LNG and In-state Production (Bcf/d)	2.59	3.49	4.56	5.46
Average Deliverability Needs above Pipeline Capacity, LNG and In-state Production (Bcf/d)	0.64	0.87	1.24	1.46

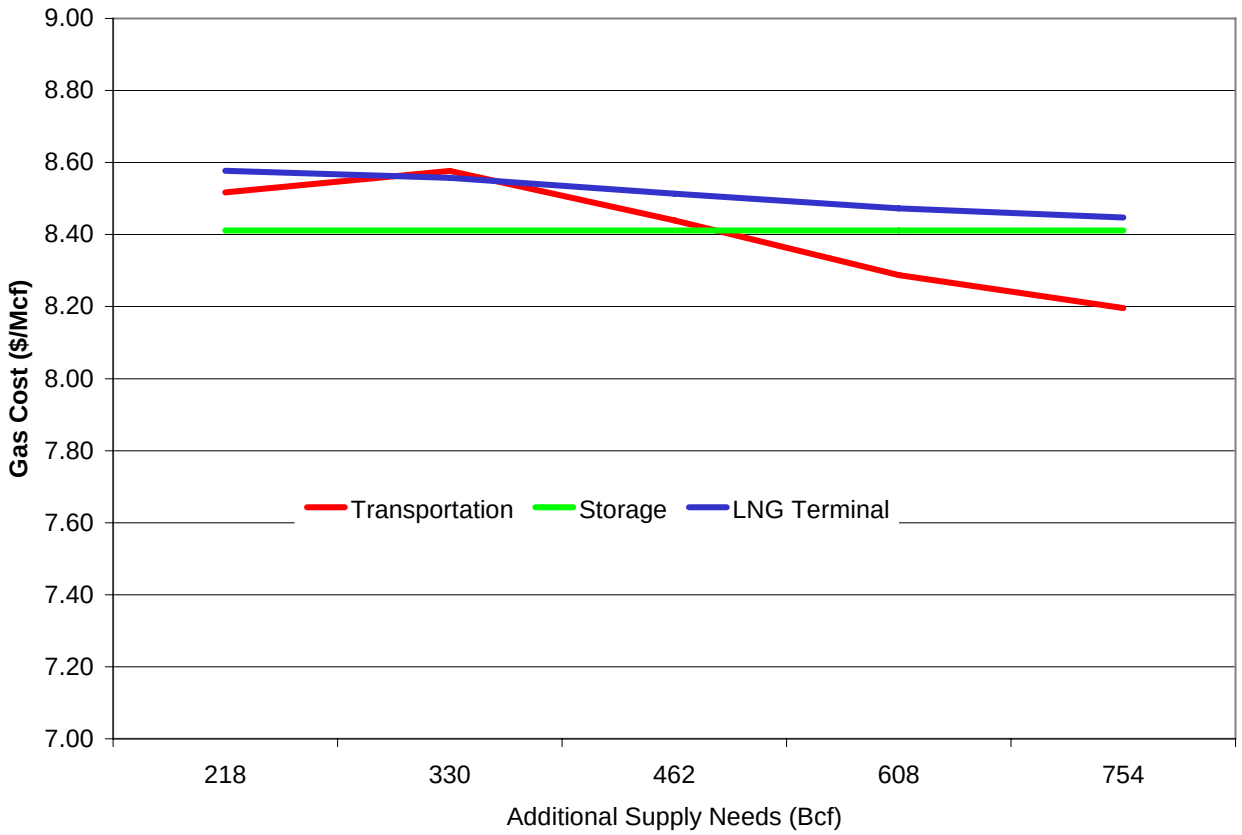
- Analysis indicates that California has sufficient infrastructure to meet its supply needs in 2015 under baseline conditions as well as sufficient supply resources when planning to meet high demand scenarios.

Estimated Daily Demand Load Requirement for 2020

	Base Case	High Core Demand	High Power Generation Demand	High Core and Power Generation Demand
Estimated Demand/Supply Needs (Bcf)	2,701	2,913	3,510	3,723
Interstate Pipeline Capacity (Bcf/d) (100% Peak Util)	8.1	8.1	8.1	8.1
LNG (Bcf/d)	0.5	0.5	0.5	0.5
Estimated in-state Production Access to Demand (Bcf/d)	0.4	0.4	0.4	0.4
Estimated Demand/Supply Needs Served by Pipeline, LNG and In-state Production (Bcf)	2,669	2,835	3,171	3,236
Estimated Supply Resource Needs Above Pipeline Capacity, LNG and In-state Production (Bcf)	31	79	339	487
Storage Capacity (Bcf)	289	289	289	289
Additional Supply Resources Beyond Expected Storage Capacity	0	0	51	199
Est.Storage Deliverability (Bcf/d)	7.0	7.0	7.0	7.0
Max. Deliverability Needs above Pipeline Capacity, LNG and In-state Production (Bcf/d)	2.84	3.78	6.39	7.33
Average Deliverability Needs above Pipeline Capacity, LNG and In-state Production (Bcf/d)	0.72	0.94	1.67	1.87

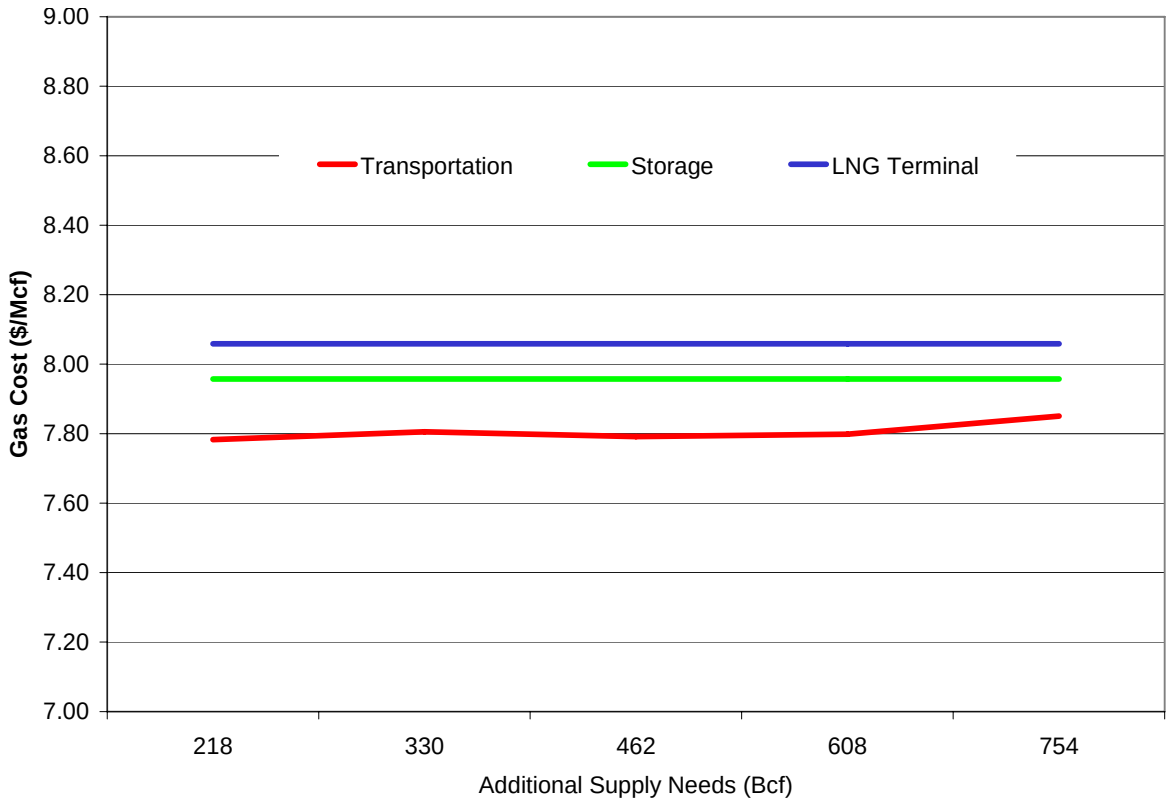
- By 2020, while California's infrastructure needs are sufficient to meet baseline conditions, additional supply of 50-200 Bcf will be needed in high demand scenarios, from a planning perspective

Relative competitiveness of supply assets varies depending on the factors driving the supply need – High Power Generation Demand and High Core Demand



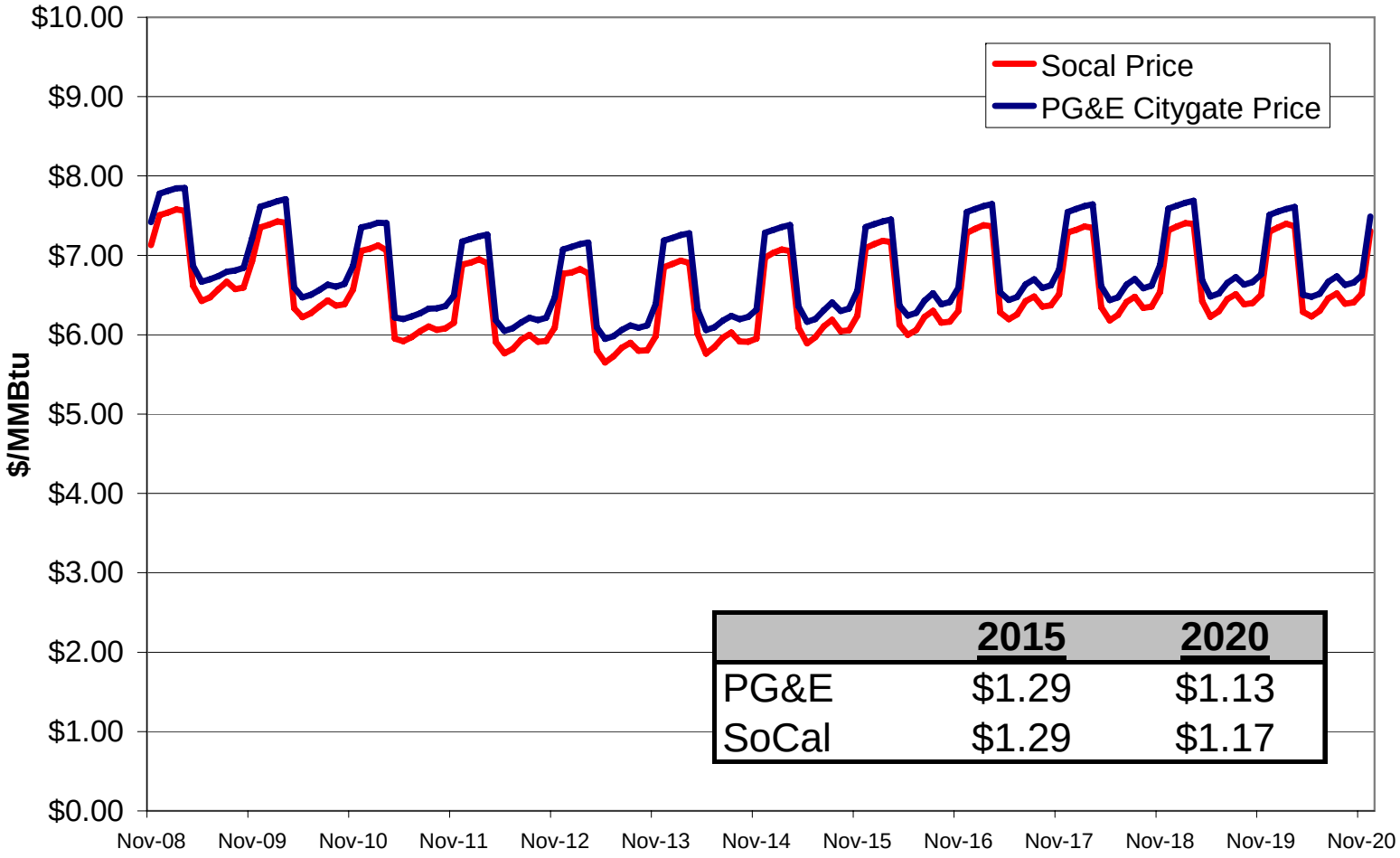
- Storage is more competitive than the transportation alternative since high core demand increases peak demand in winter and the incremental pipeline capacity is less than 100% utilized in summer.
- The cost of LNG supply is highly dependent on the ex-terminal price that the LNG importers are willing to offer to purchasers.

Relative competitiveness of supply assets varies depending on the factors driving the supply need – High Power Generation Demand



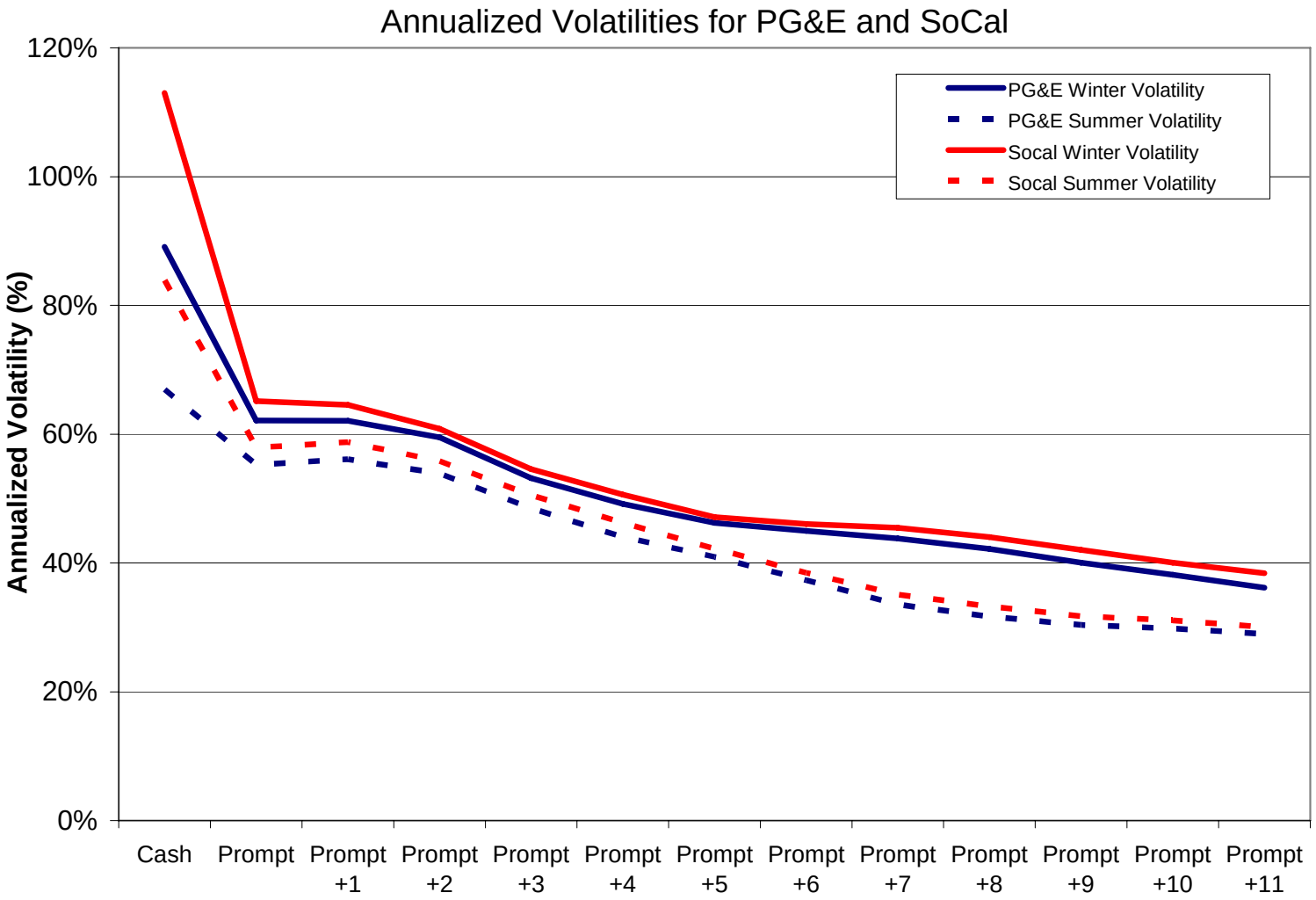
- The additional demand for power generation peaks in summer and makes the daily load flatter over time. Additional pipeline capacity is 100% utilized.
- Per unit storage cost is relatively high compared to the cost of pipeline capacity.
- The difference between Henry Hub and California prices is not sufficient to make LNG supply more attractive.

Fundamentals supporting storage development in California remain strong – SoCal and PG&E forecasted seasonal spreads



	2015	2020
PG&E	$1.29	$1.13
SoCal	$1.29	$1.17

The uncertainty in equilibrium prices at SoCal & PG&E increases the expected price volatility over time



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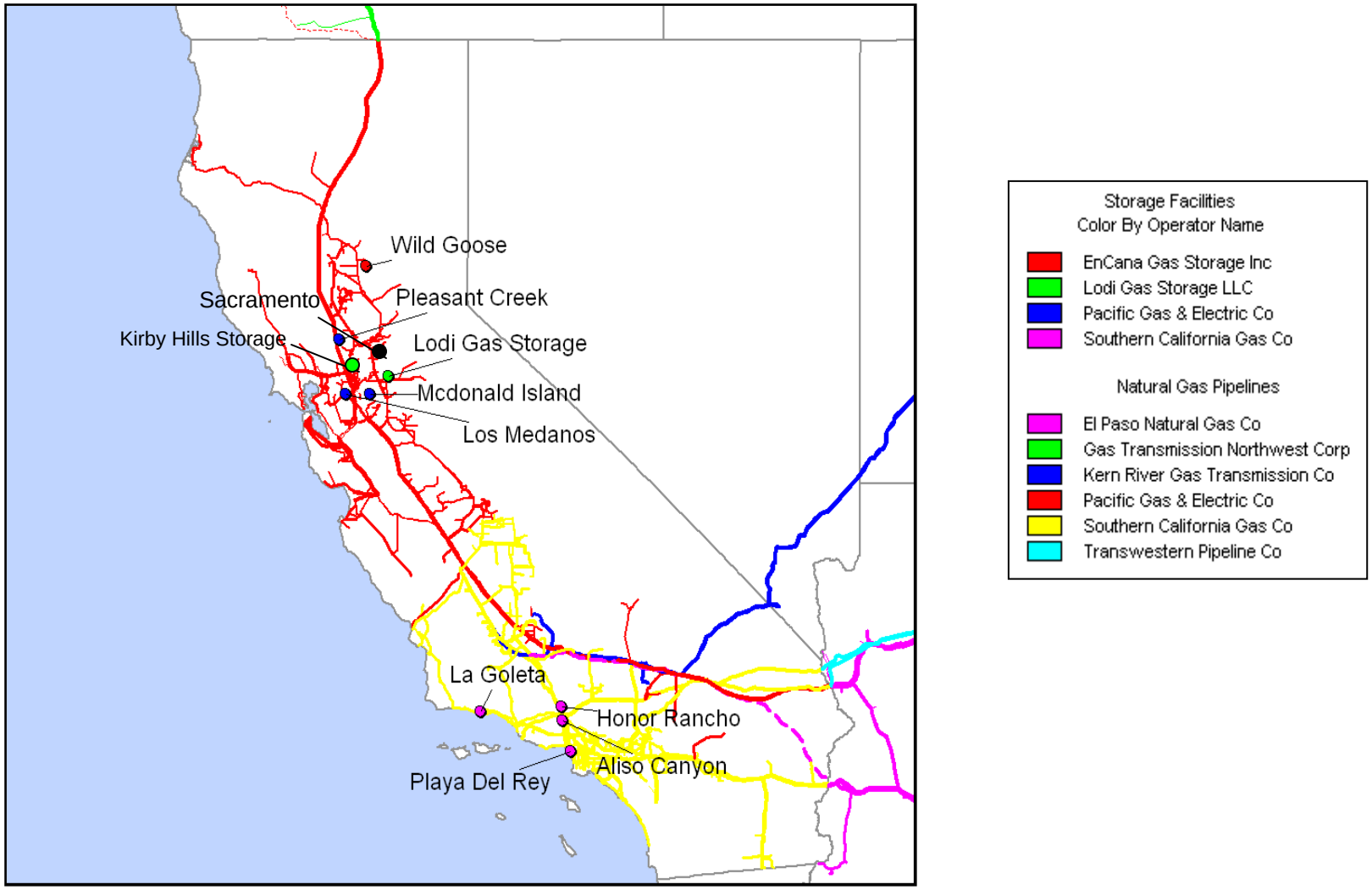
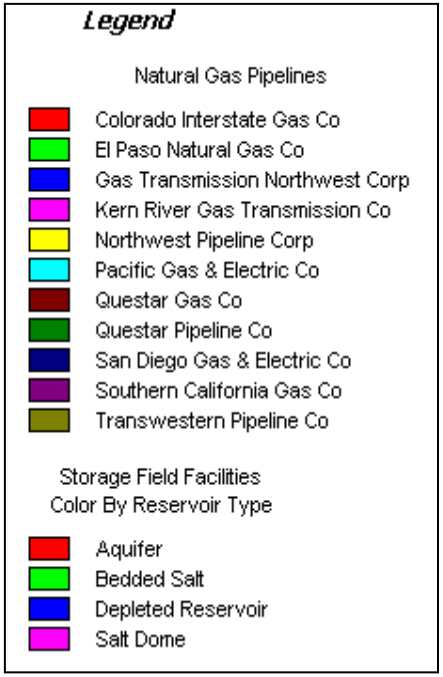
Underground Storage in California Consists of Depleted Reservoirs Operated by the LDCs and Independent Facilities



Source: Energy Velocity

Out of State Storage Facilities Were Identified Based Upon the Available Pipeline Network and Potential for Serving California.



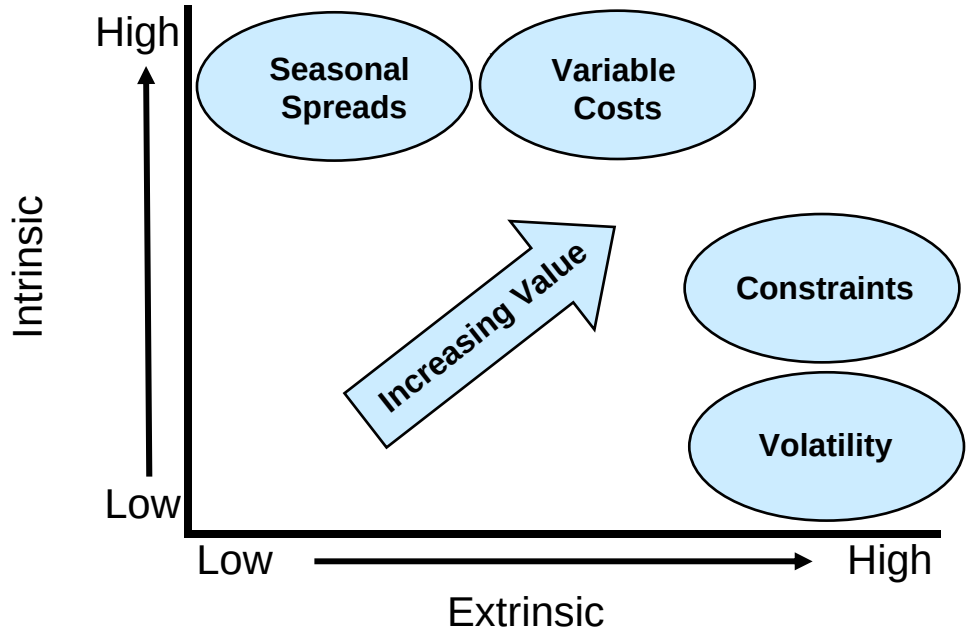
Source: Energy Velocity; B&V Research

Storage Valuation Advisor™ Overview – Optimization and valuation for natural gas storage assets

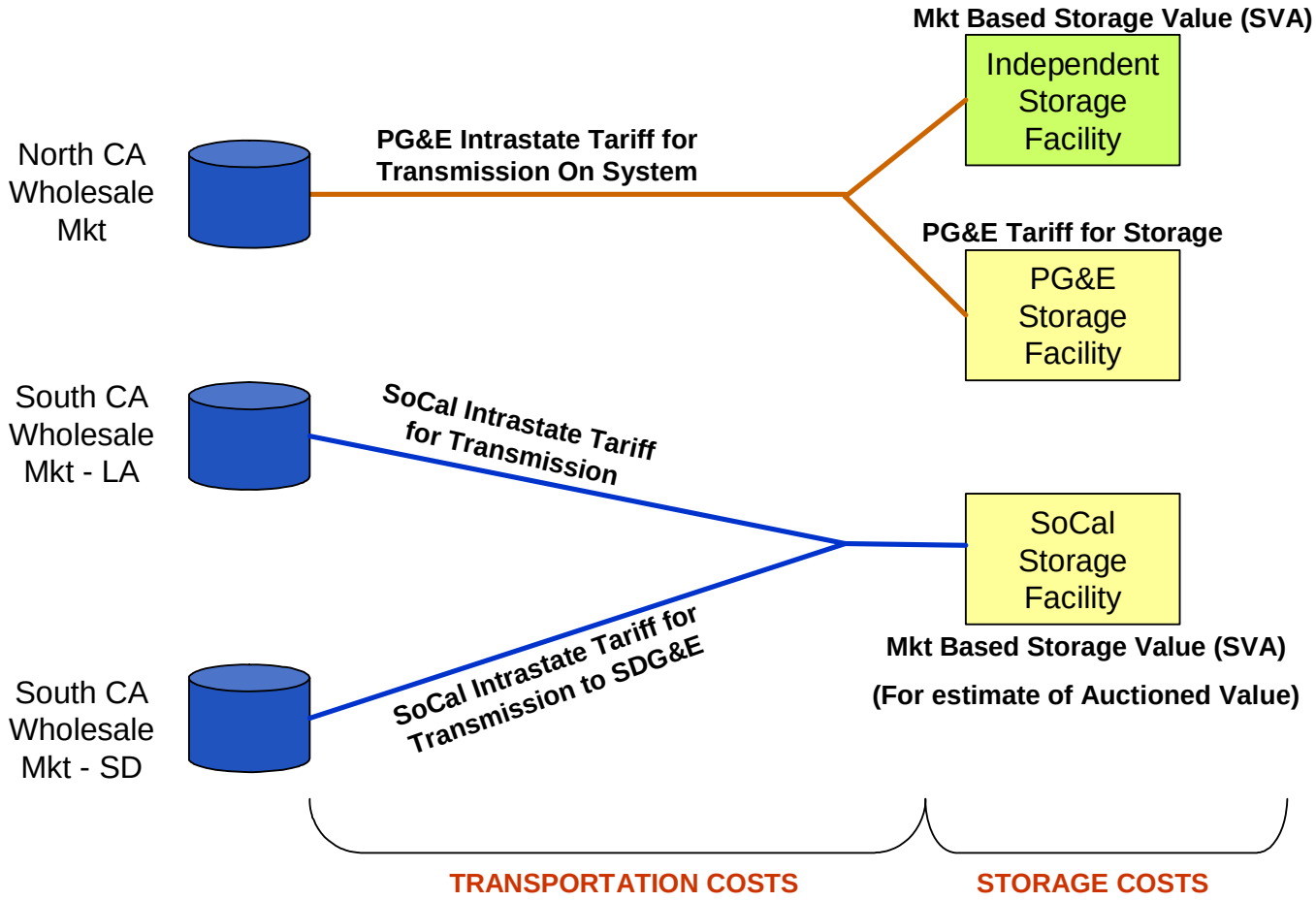
- Storage Valuation Advisor™ (SVA) software values the intrinsic and extrinsic value of a storage asset
  - Estimates market value of storage capacity by treating storage as a time spread option
  - Uses a Monte Carlo framework – in each step there is an optimization
  - Identifies “extrinsic” or “optionality” value that exists in forward markets (in excess of currently observed seasonal spreads)
  - Considers all physical or contractual constraints
  - Physical storage asset acts as the physical hedge, around which forward trading is performed (assumes 100% hedged approach)
  - Profit that can be earned through the inherent optionality is driven by the movement of forward prices
  - Total value (intrinsic + optionality) represents a view of the total real option value of operating a storage asset over a given period of time

Key drivers of storage value have been incorporated in the analysis

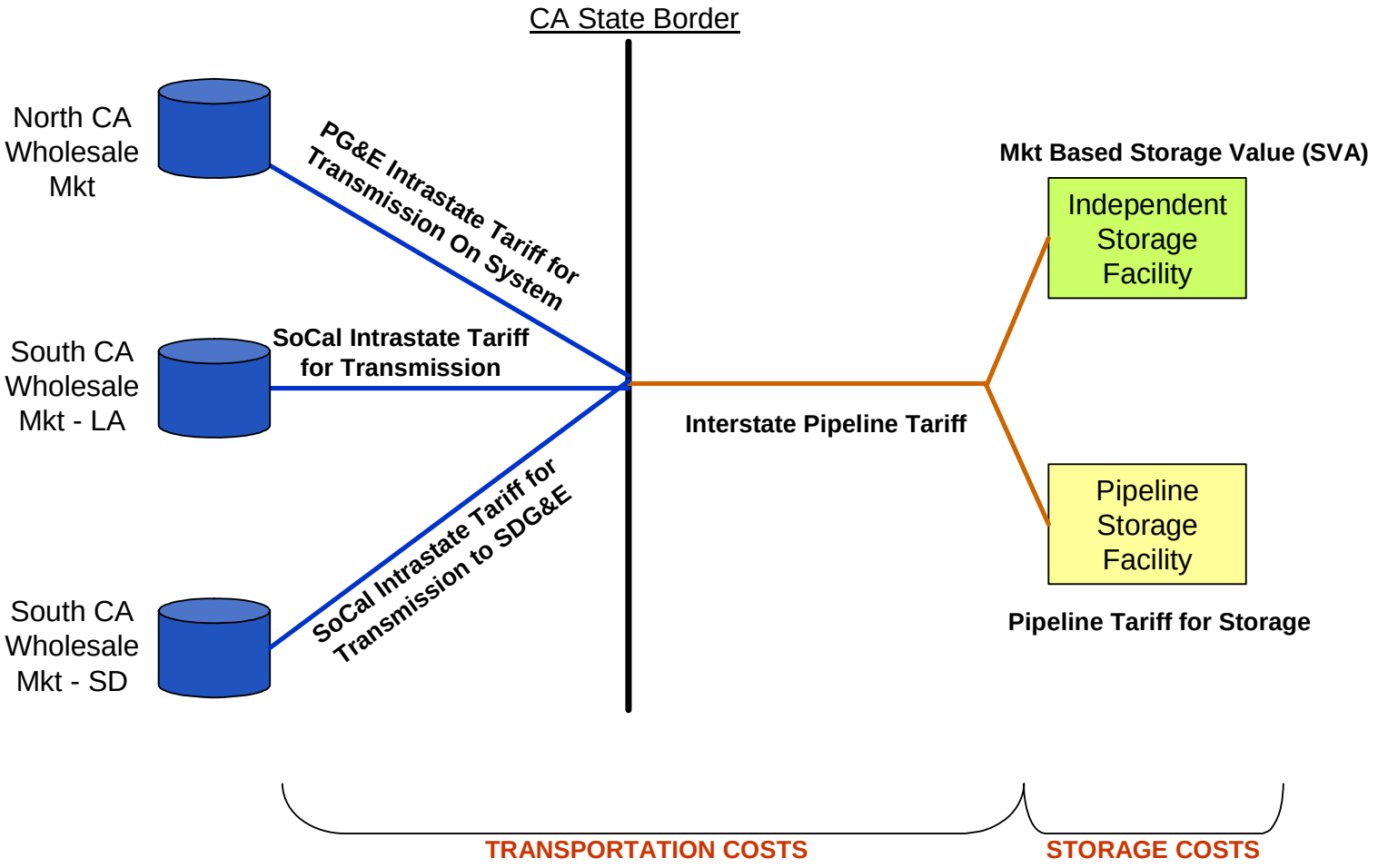
To properly value and optimize storage assets, the unique characteristics of the storage asset and applicable market must be considered.



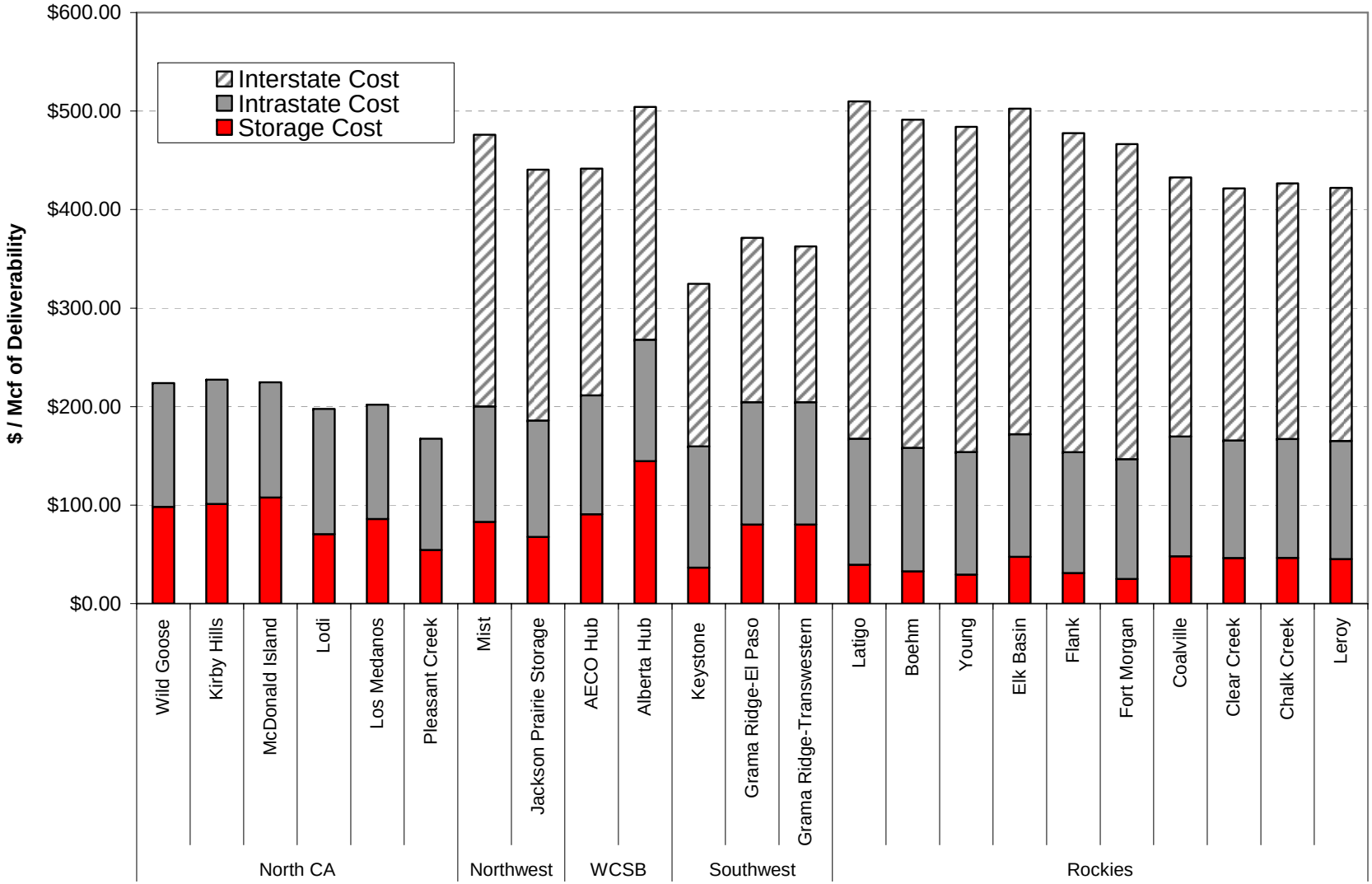
Cost components for in-state storage



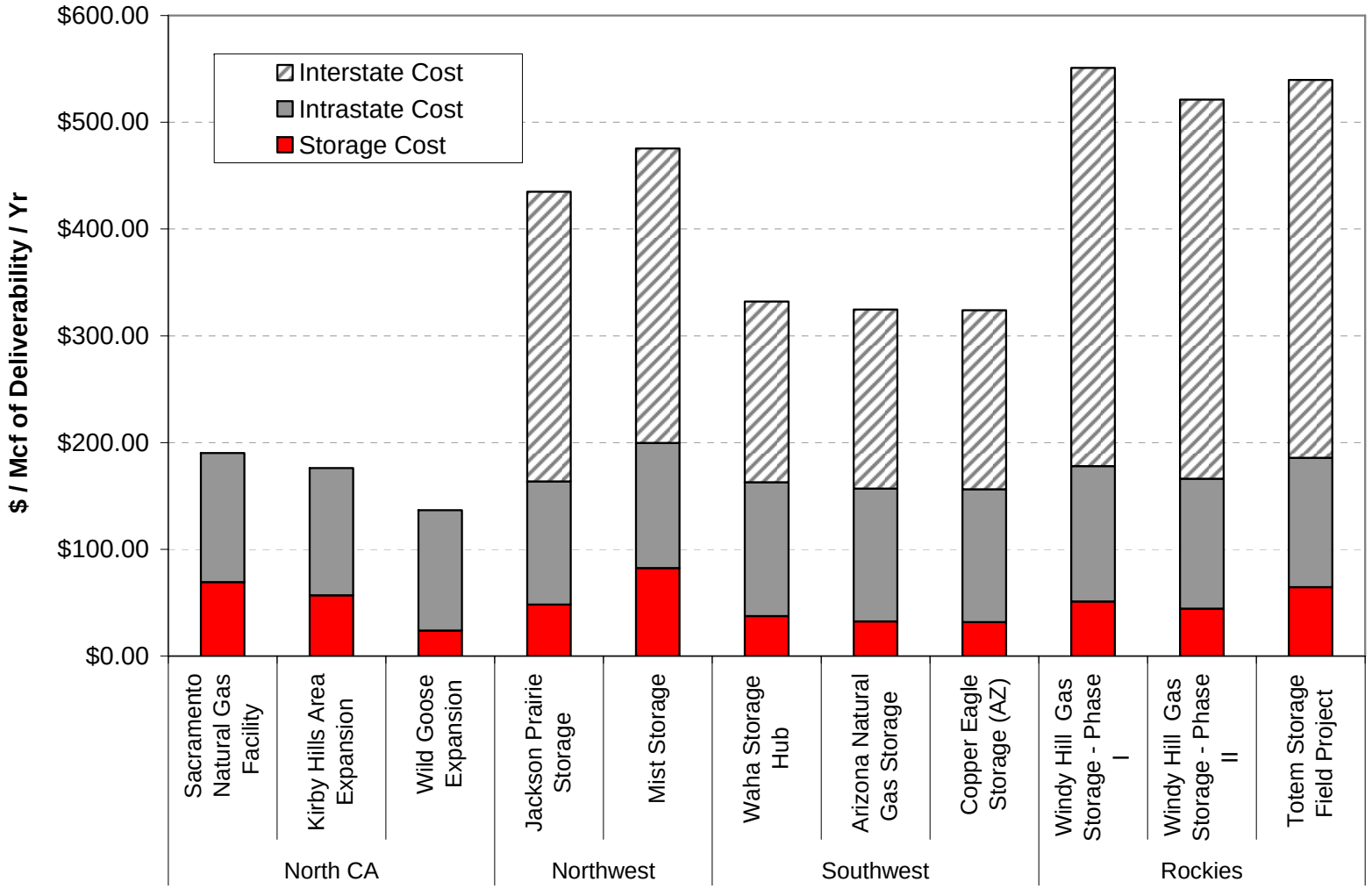
Cost components for out-of-state storage



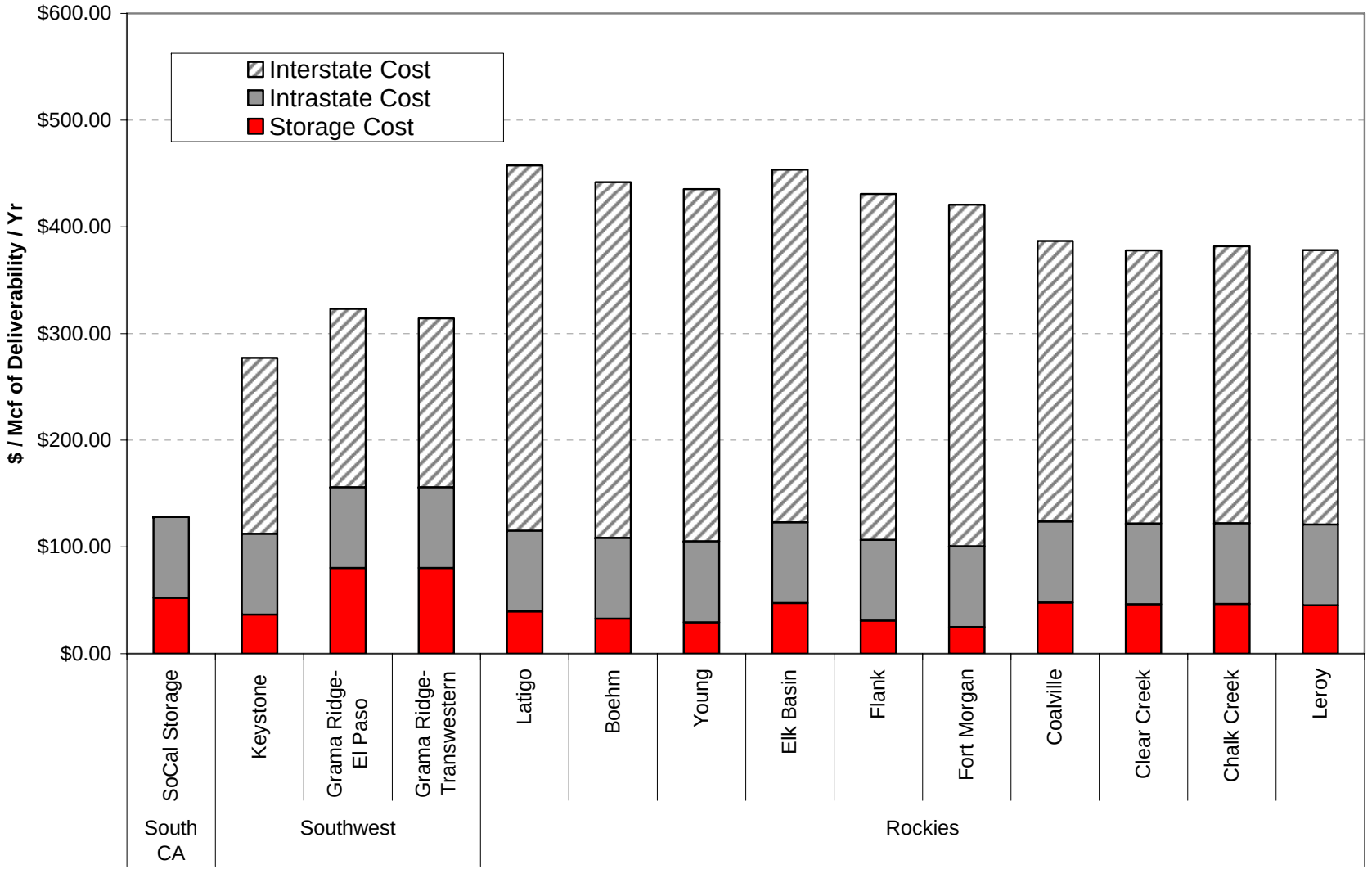
Existing facilities in its service area offer the most economically viable storage alternative for PG&E



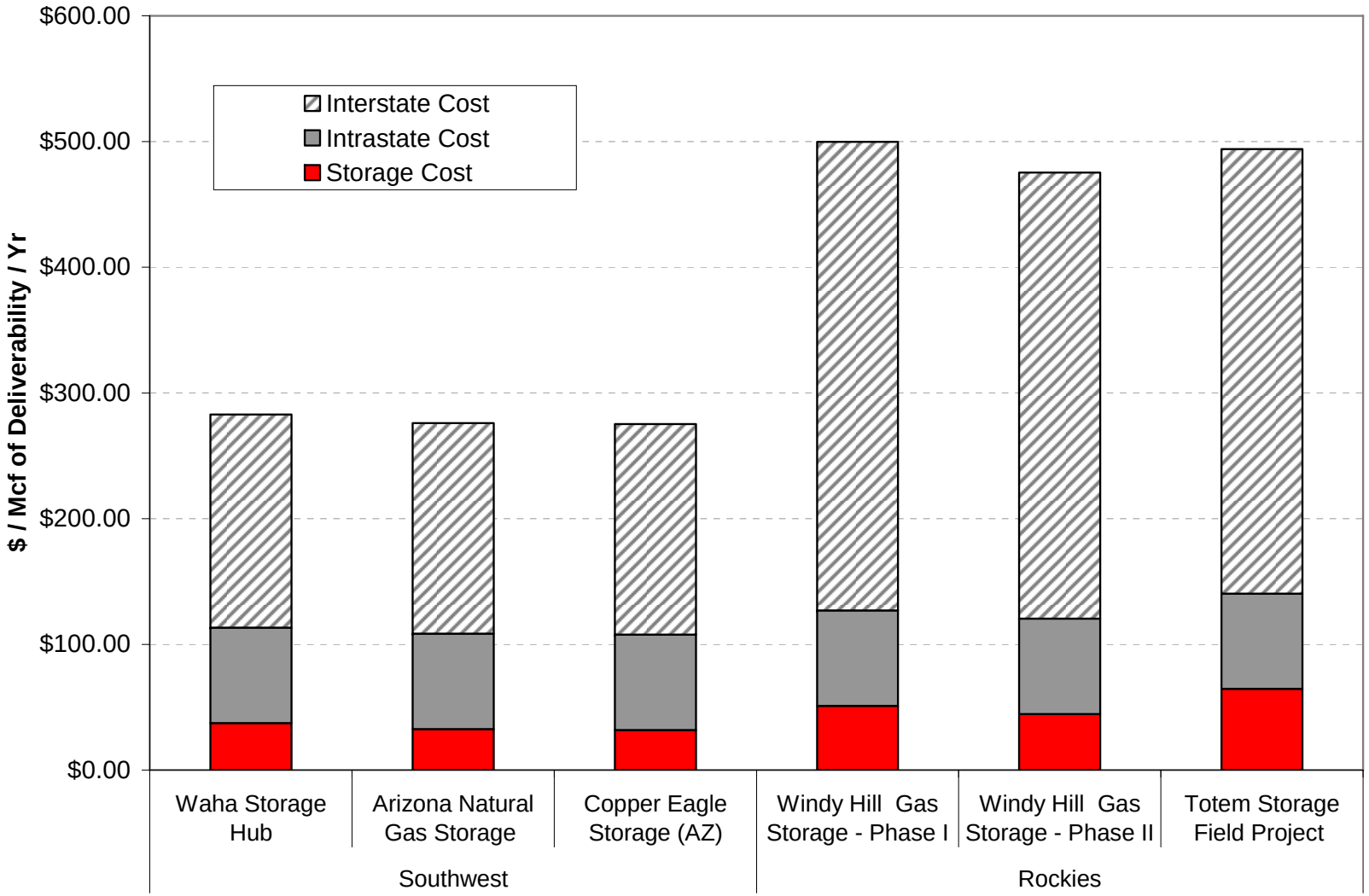
In-state proposed storage facilities are more attractive than out-of-state facilities for PG&E; Southwest facilities may offer viable alternative



Existing facilities in its service area offer the most economically viable storage alternative for SoCal



Proposed Southwest facilities offer the most viable alternative for SoCal's storage needs



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Summary Observations

- The analysis of pipeline send-out data indicates that there was sufficient pipeline and storage capacity to meet California demand in the past three years
- Demand scenarios examining the infrastructure needs forecasted demand sensitivities, additional supply assets will be needed to adequately meet the peak demand load from a planning perspective
- Analysis indicates that California has sufficient infrastructure to meet its supply needs in 2015 under baseline conditions as well as sufficient supply resources when planning to meet high demand scenarios
- By 2020, while California's infrastructure needs are sufficient to meet baseline conditions, additional supply of 50-200 Bcf will be needed in high demand scenarios from a planning perspective
- The type of asset required varies depending on the expected peak load profile
- Fundamentals supporting storage are strong – expectation of increased volatility, sustained seasonal basis

Summary Observations

- In-state storage offers the most economical source of storage service for California. Existing storage in both North and South California are less expensive than new build alternatives in the state or the import of storage services, from facilities located east or north of California
- Out-of-state storage offers a relatively expensive alternative for California but could present an option if development of storage within California becomes unviable
- B&V does not assess onerous regulatory requirements, relative to other locations in the United States, which would prevent additional storage development in California