

Observations on “Slack” Pipeline Capacity, Basis Differentials, Price Volatility and Price Forecasting

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Andy Van Horn
Van Horn Consulting
61 Moraga Way, Suite 1
Orinda, CA 94563

925 254-3358 phone/fax
vhconsult@earthlink.net



Topics for this Discussion

- “Slack Capacity” Revisited
 - ◆ Is “slack capacity” needed to mitigate price volatility and supply reliability?
If so, how much slack capacity is needed?
- Volatility and Price Forecasting
 - ◆ Do equilibrium price forecasts adequately capture likely future price volatility?
- Infrastructure & Other Issues



What We Know: The Supply/Demand Balance Drives Market Prices

- A well functioning market needs a deliverable supply somewhat in excess of demand.
- Regional and local price volatility occurs as the result of supply/demand shifts caused by
 - ◆ supply shortages,
 - ◆ unanticipated demand, or
 - ◆ delivery constraints.



What Is “Surplus Deliverability?”

- When supplies are adequate, “surplus deliverability” aka “slack capacity” into a gas market can be defined as
 - ◆ Pipeline capacity entering a region
 - ◆ Minus pipeline capacity exiting a region
 - ◆ Plus intraregional natural gas production
 - ◆ Plus net storage withdrawal
 - ◆ Minus regional consumption.

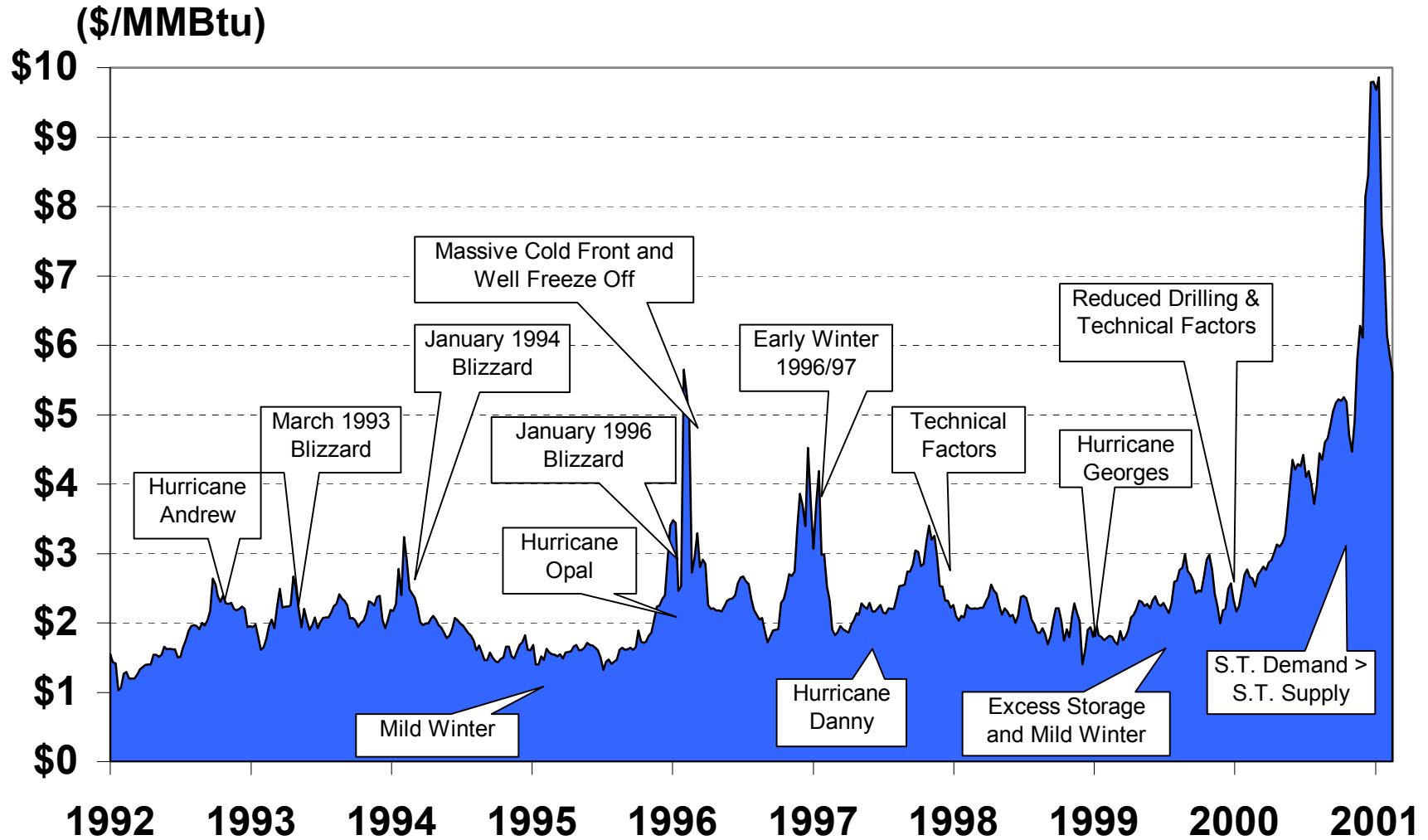


Surplus Deliverability Was Present In Most of the U.S. Spot Market Until 1999

- 1984 – 1995 “The Gas Bubble”
 - ◆ Significant surplus deliverability in most U.S. regions except CA in the late 80s.
 - ◆ Flat or declining prices
- 1995 – 1999 “Relative Supply/Demand Balance”
 - ◆ Moderate surplus deliverability,
 - ◆ Limited price volatility
- 2000 – 200? “Periodic Supply or Infrastructure Inadequacy”
 - ◆ Demand outpaces supply
 - ◆ High price volatility



Henry Hub Weekly Natural Gas Prices



Data Source: NGW

Graphic prepared by Energy Ventures Analysis, Arlington, VA



The Value of Surplus Deliverability

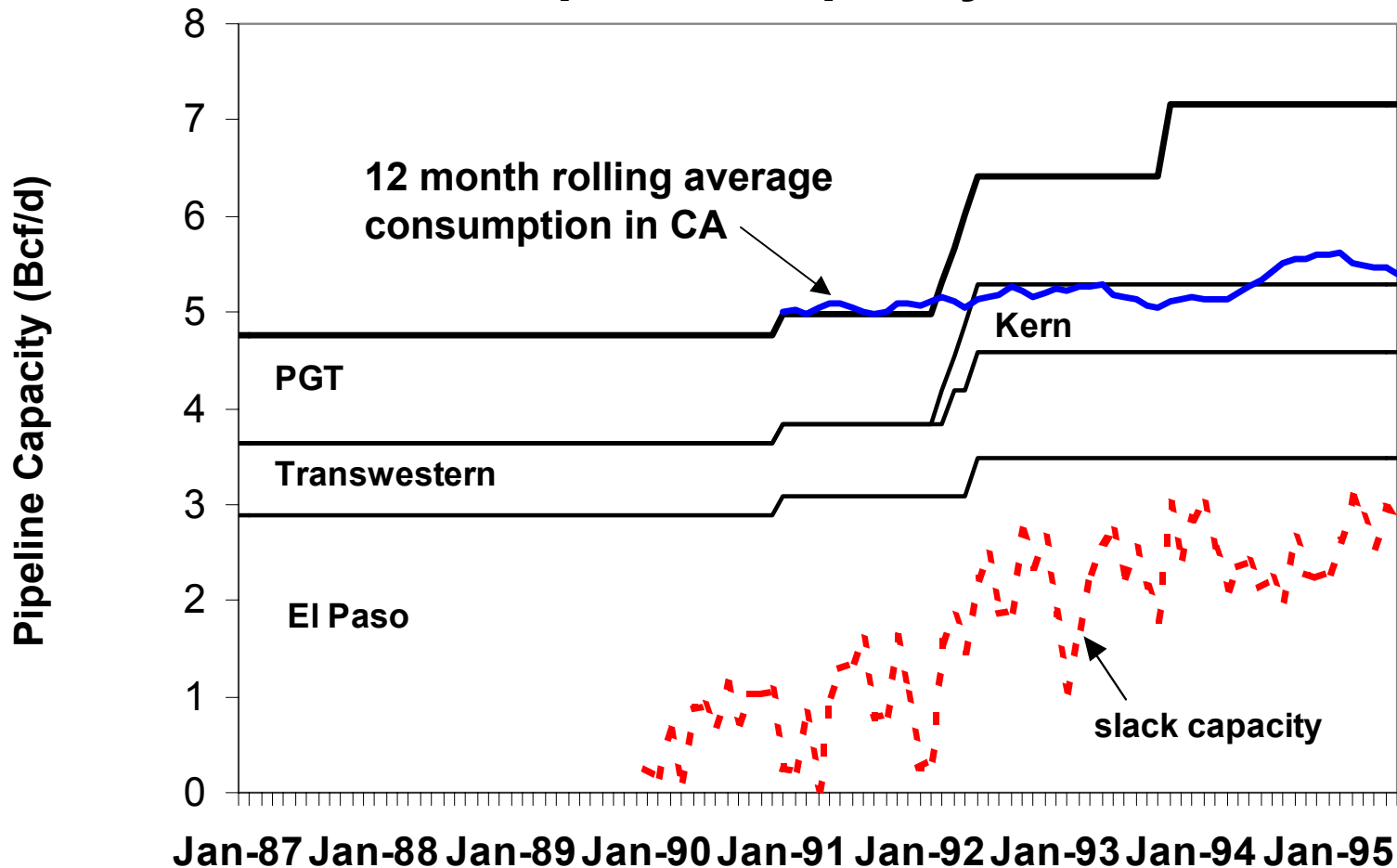
- VHC has measured regional price responsiveness to changes in surplus deliverability in CA, NY, New England and several supply basins
- Recognizing the value of surplus pipeline & storage capacity may help us avoid a future period of “Infrastructure Inadequacy.”



California Is A Textbook Example

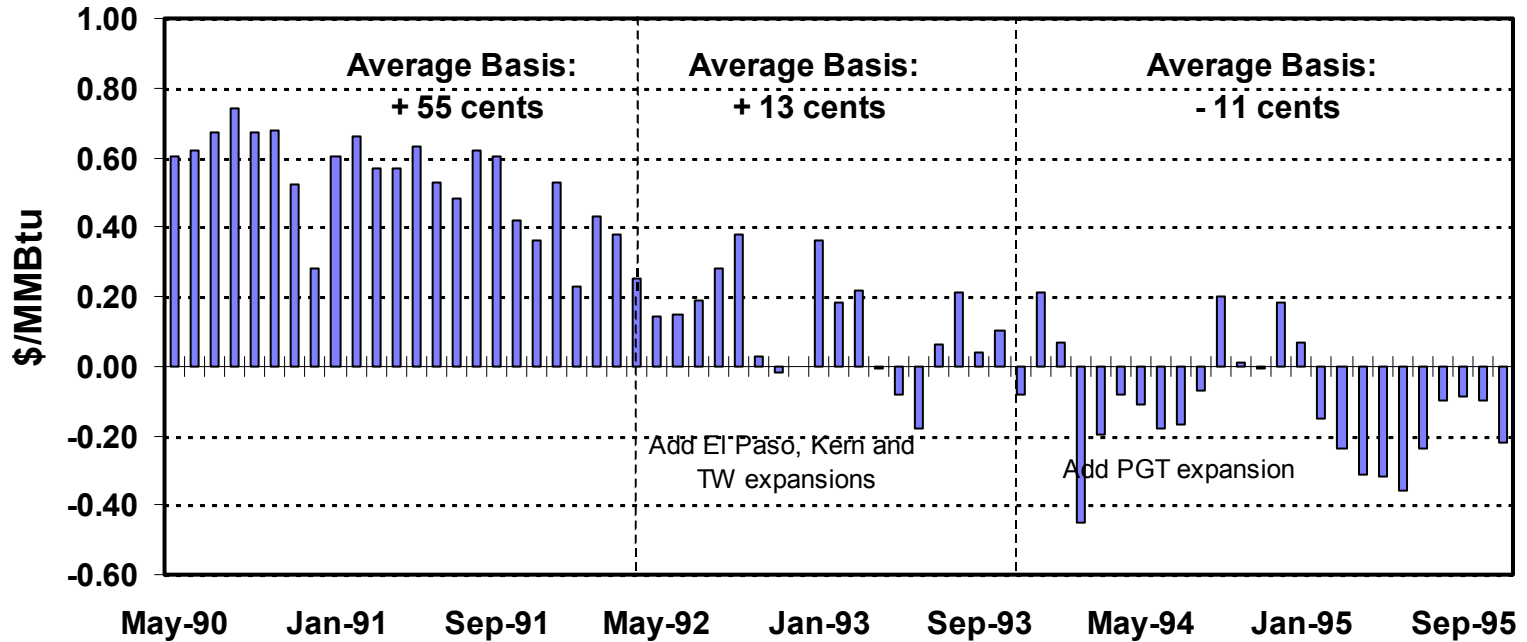
Slack Capacity → Surplus Deliverability

Interstate Pipeline Capacity into California

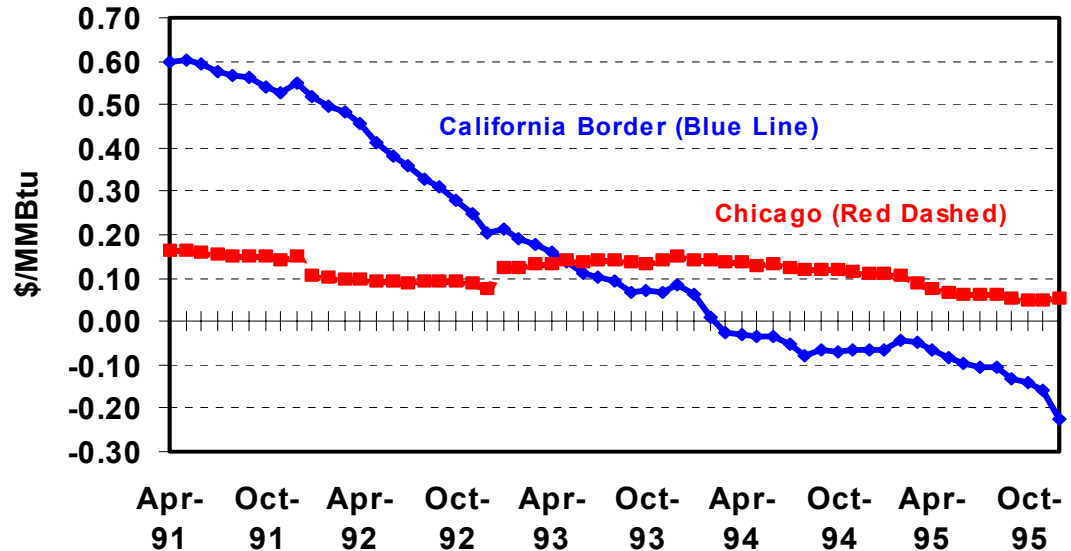




Why Did The CA-Henry Hub Basis Decline?



Twelve Month Rolling Average Monthly Basis Differential Relative to Henry Hub

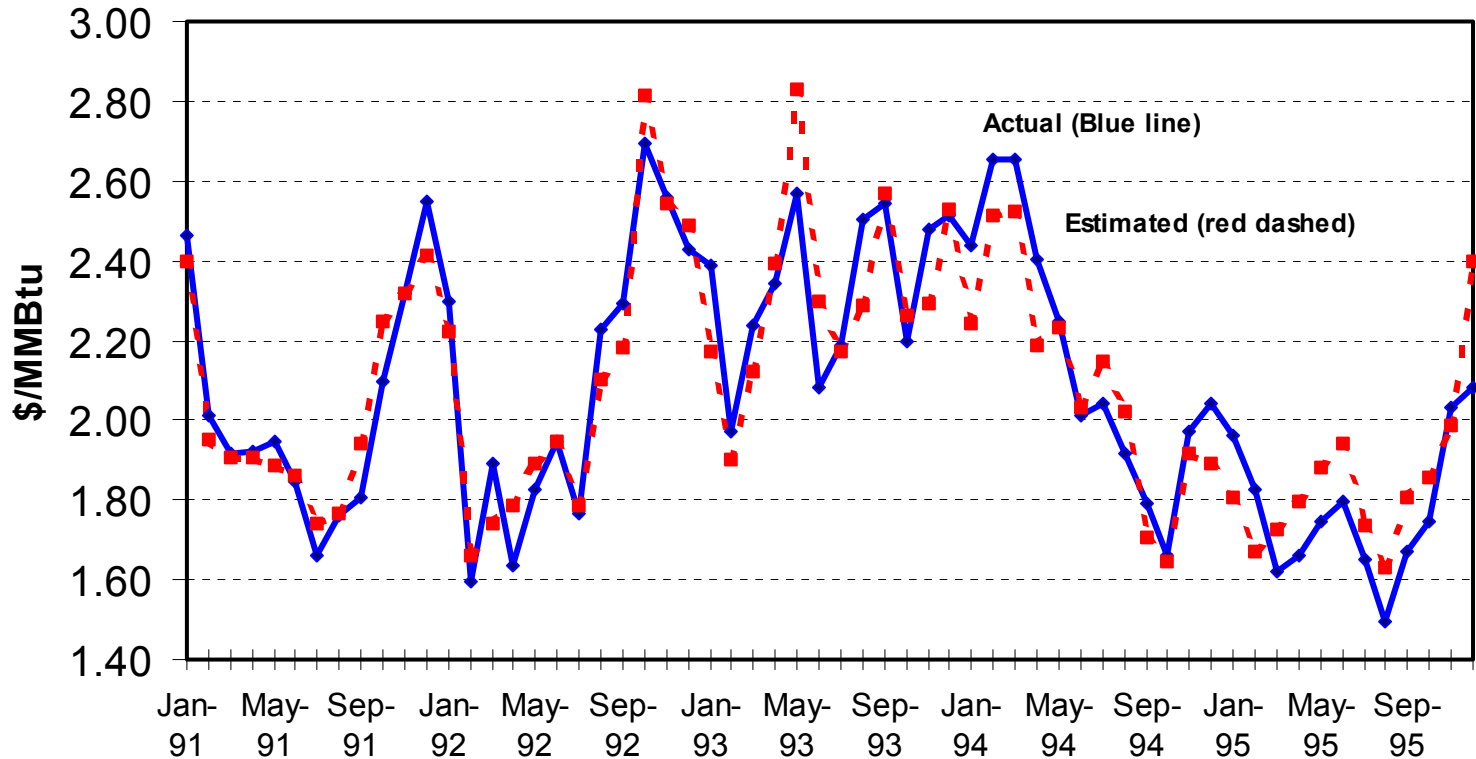




Henry Hub Prices & Shifts in CA Deliverability Explain CA Gas Prices

Actual and Estimated SCE WACOG Price of Gas

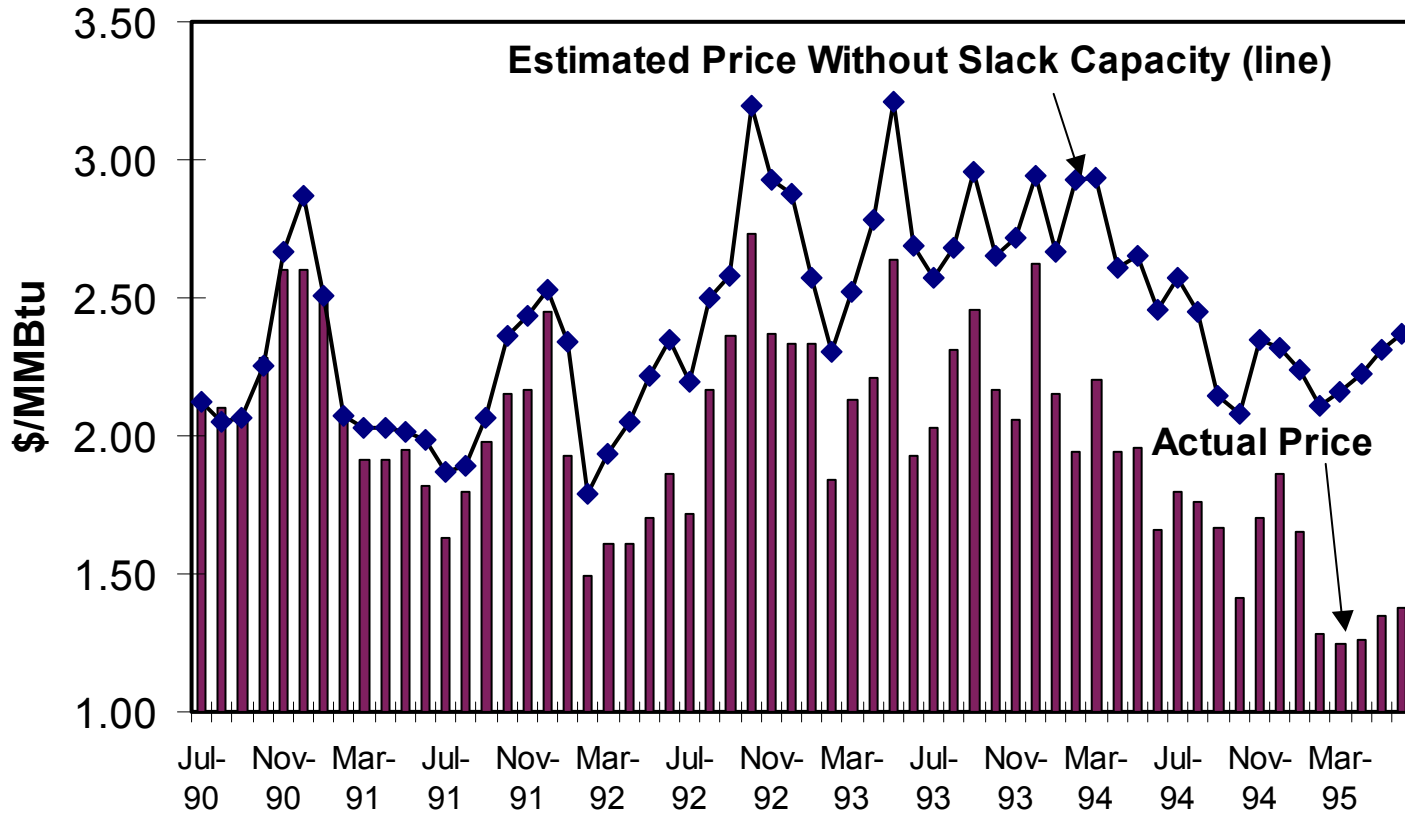
Estimated Using 5 Years of Monthly Data 1991 -1995





Each Bcf/d Increase in Deliverability Dropped CA Prices by >16¢/MMBtu

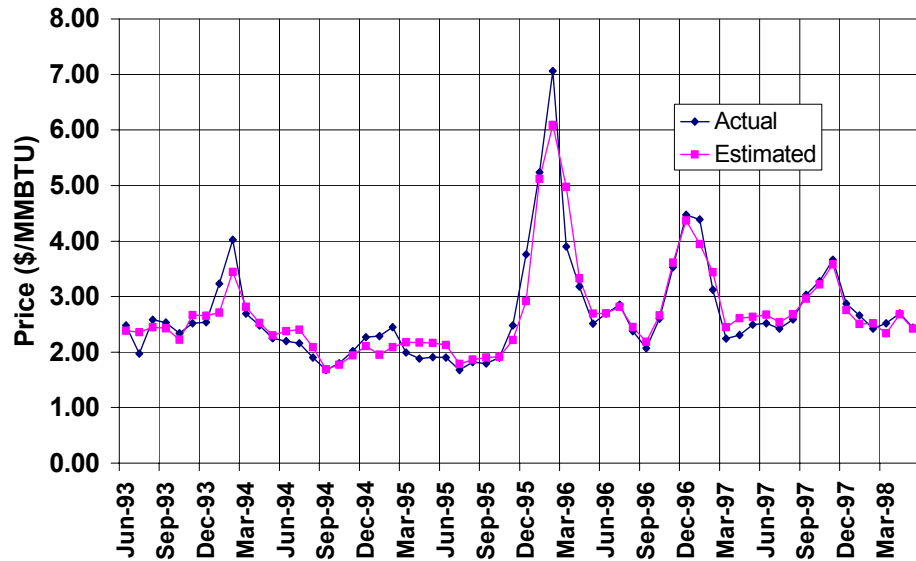
California Border Price With and Without Slack Capacity





Surplus Deliverability Plays A Similar Role In Other Regional Markets

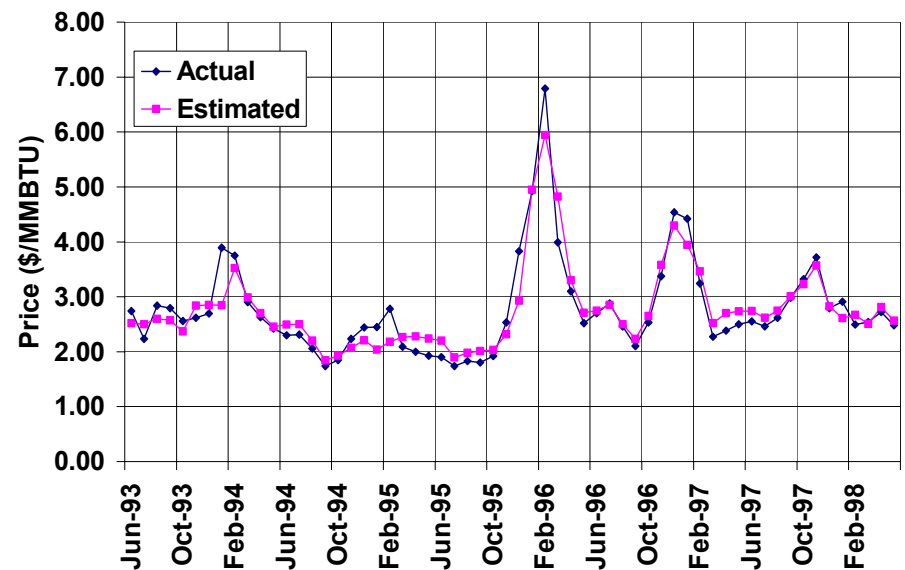
New York City Gate Natural Gas Price



1993 - 1998

**>-11¢/MMBtu per Bcf/d
Increase in Deliverability**

Boston City Gate Natural Gas Price



1993 - 1998

**>-12¢/MMBtu per Bcf/d
Increase in Deliverability**

The Value Would Be Greater If Added Capacity Were Needed But Is Not There



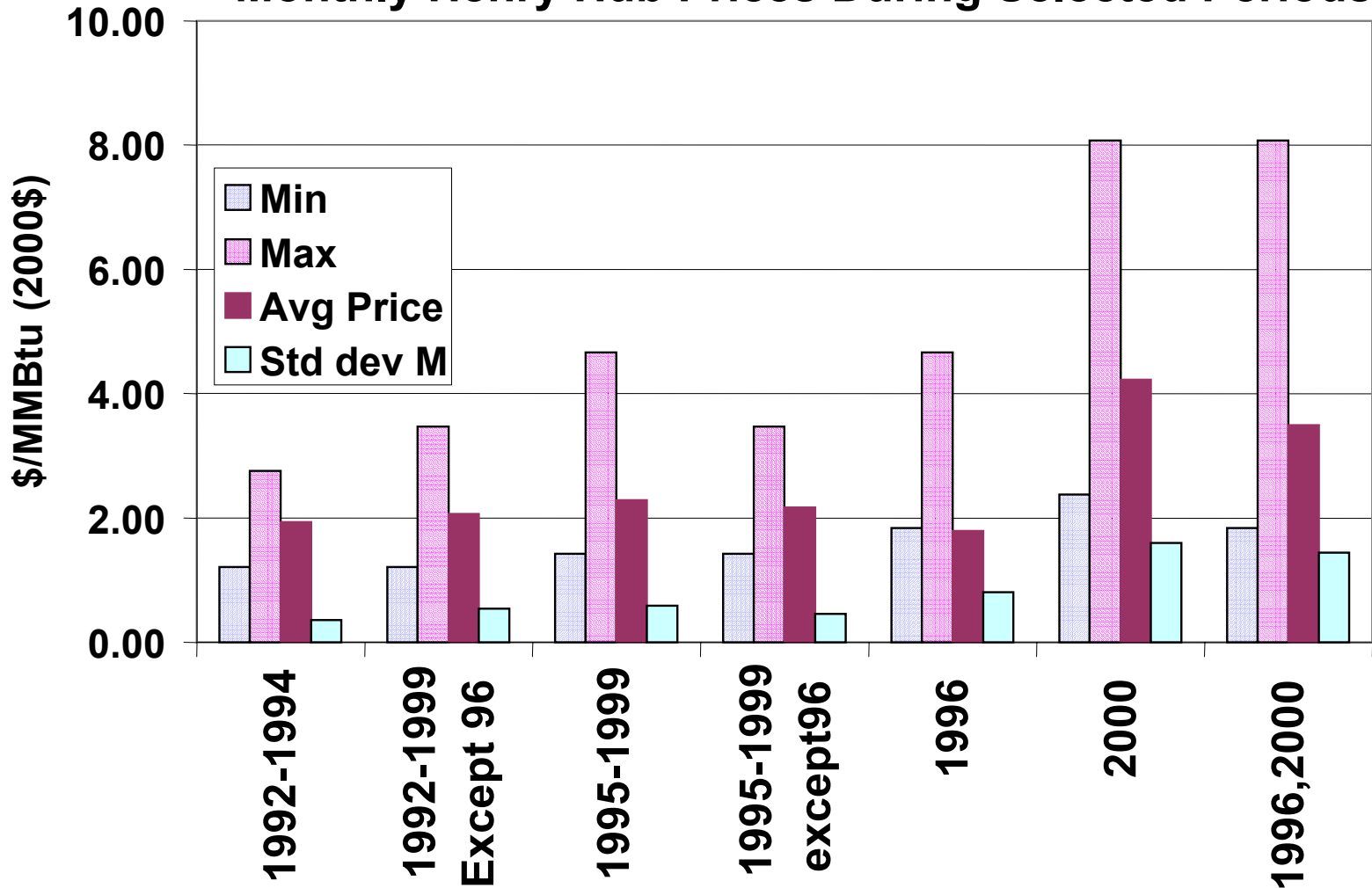
Surplus Deliverability Is Needed For A Workable Supply/Demand Balance

- Added pipeline & storage capacity lowers market prices – particularly, if it can prevent periods of insufficient deliverability.
- Demand growth and short supply caused the high price volatility in 2000 and 2001, and then was exacerbated by deliverability constraints.
 - ◆ But what would year 2000-2001 prices have been in California without the 1993 PGT expansion?



After 1999 Price Volatility Increased Dramatically

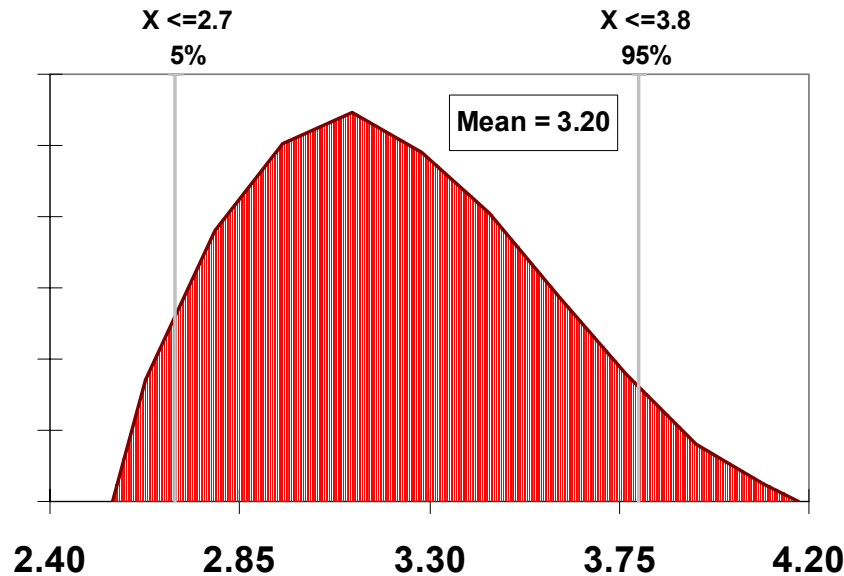
Monthly Henry Hub Prices During Selected Periods



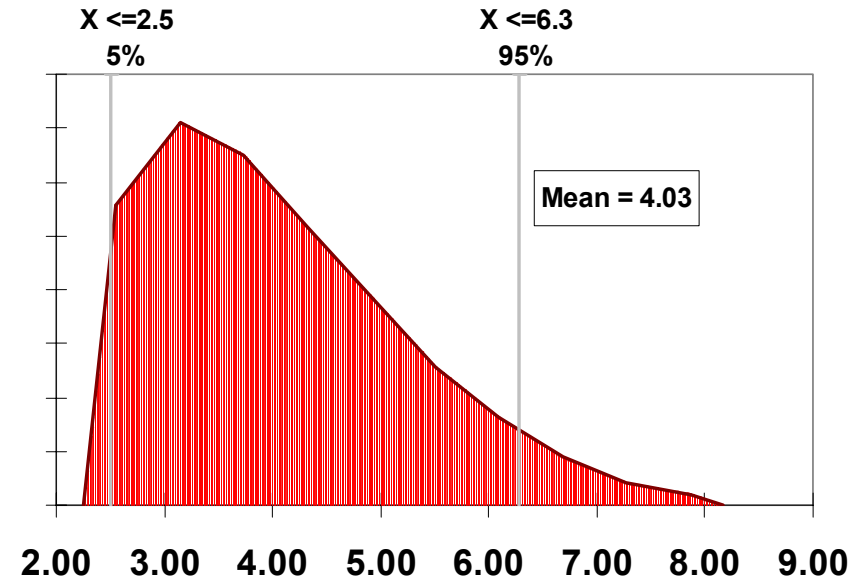


Price Volatility In Future Years Will Raise Average Costs

Hypothetical Annual Price Distributions in Year 2020



$\sigma = \$0.35/\text{MMBtu}$ (1995-1999)
Mode = \$3.12
Average = \$3.20

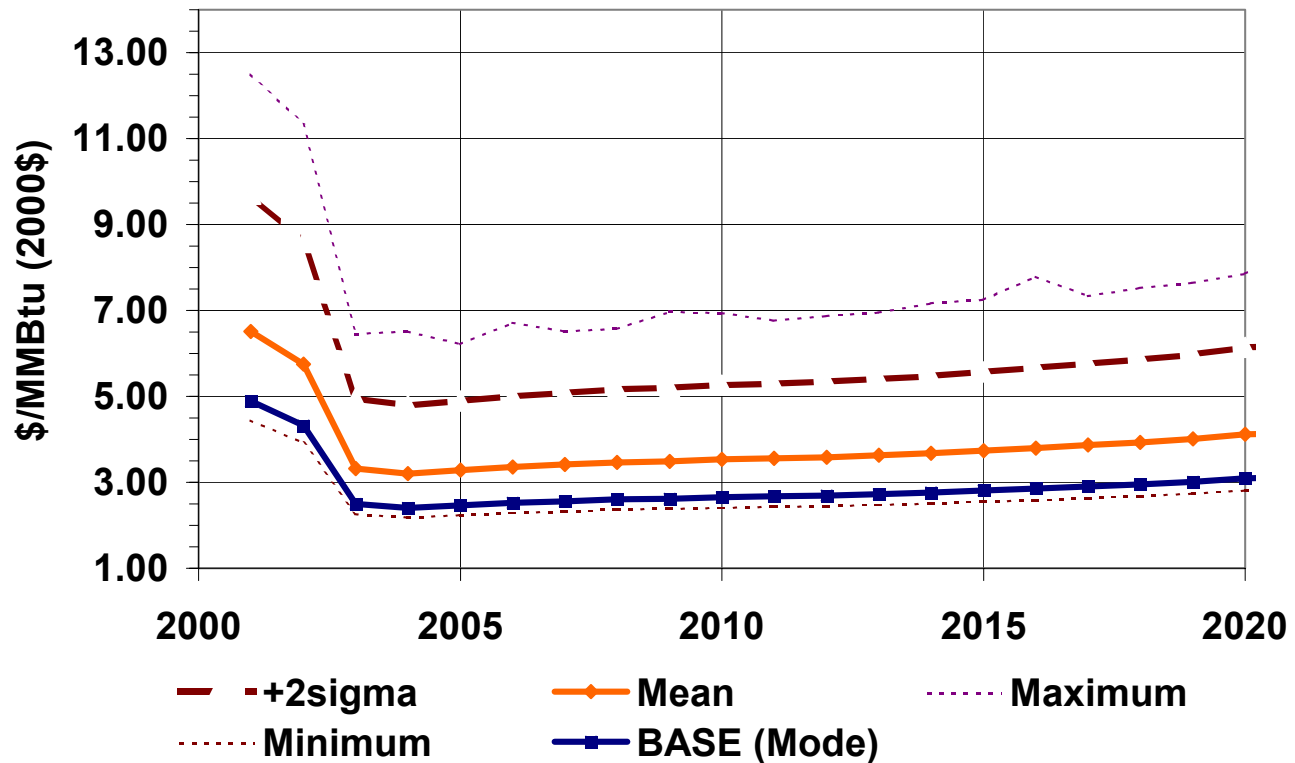


$\sigma = \$1.11/\text{MMBtu}$ (1996, 2000)
Mode = \$3.14
Shut-in Price = \$2.25/MMBtu
Average = \$4.03



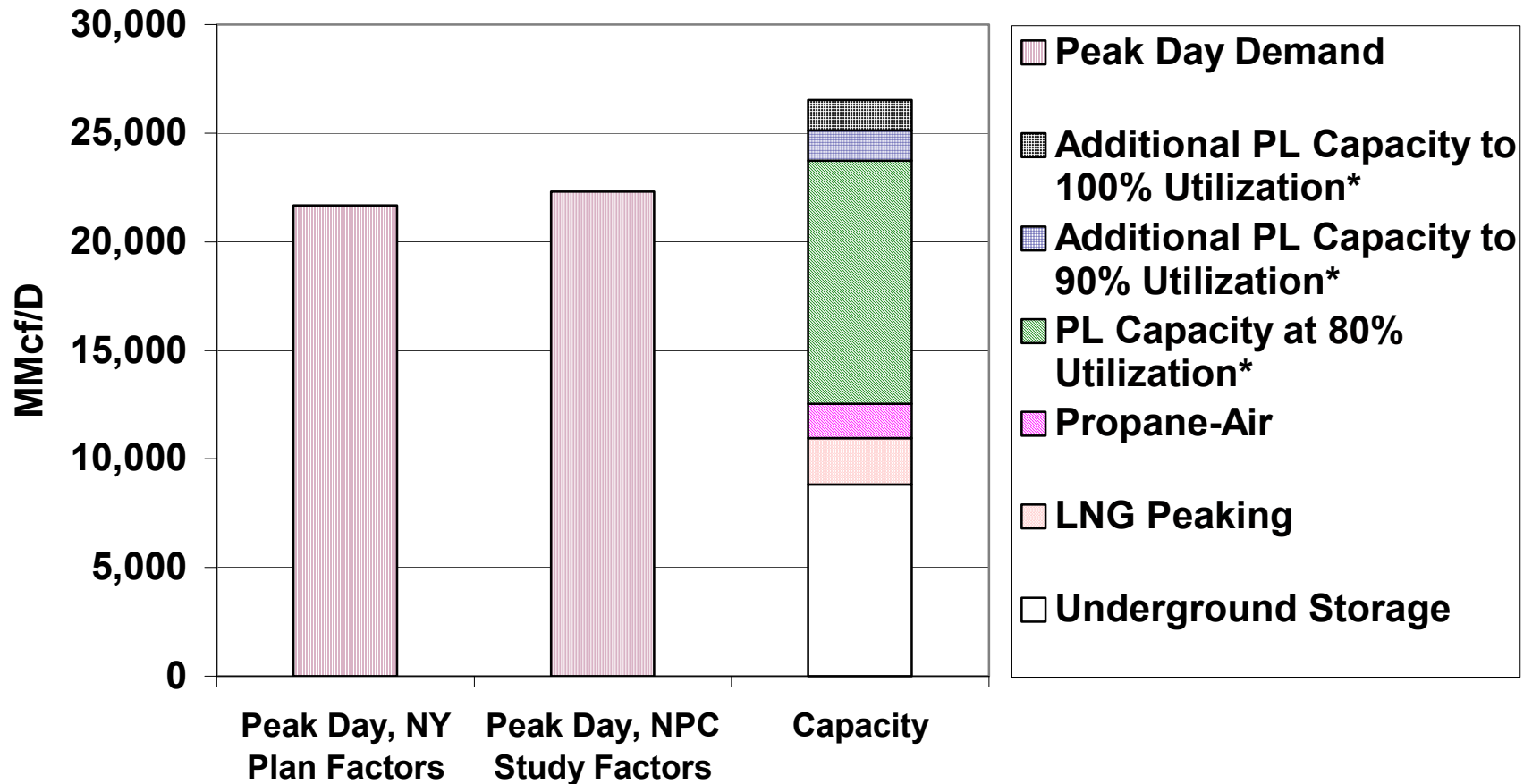
What Happens to Long Run Equilibrium Price Forecasts When Annual Price Volatility Varies?

U.S. Average Wellhead Natural Gas Prices
2001-2020 (High Volatility)





Diverse Options Must Be Evaluated Under A Range of Scenarios



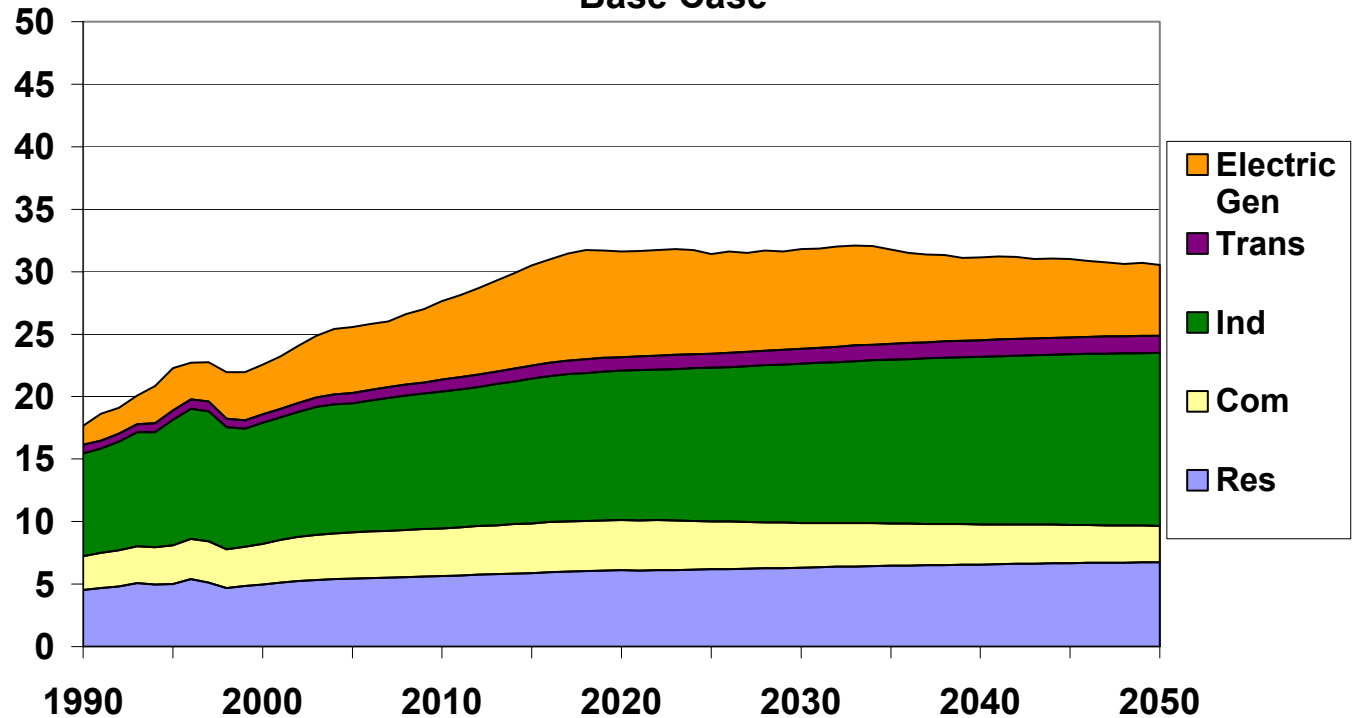
Projected Northeast Peak Day Demand in 2005 and Available Capacity to Meet Northeast Demand Under A High Growth Scenario



How Will We Get From Here to There?

(Models May Overlook Infrastructure Constraints)

U.S. Natural Gas Consumption 1990-2050
(Quads per year)
Base Case



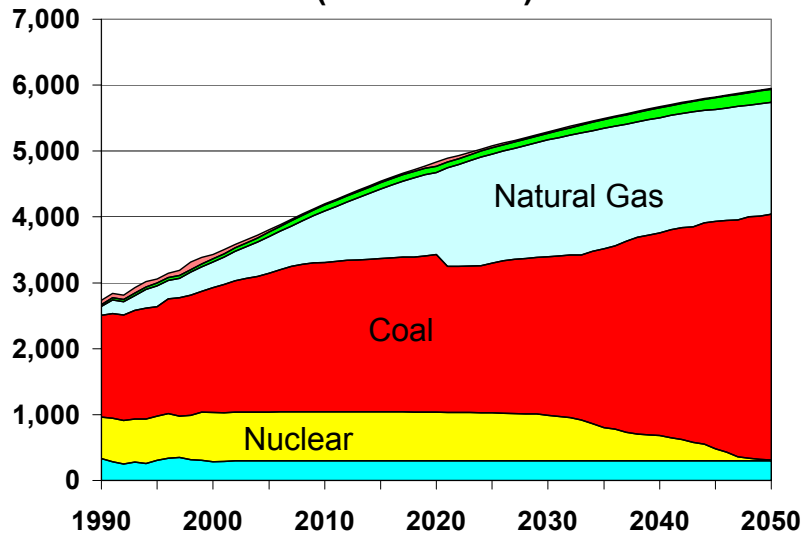
NEMS – VHC/EPRI 2050 Technology & Market Modeling (2001)
& E-EPIC Study (1999-2000)



The Electricity Market Will Have Long Term Impacts On Natural Gas Supply and Infrastructure Needs

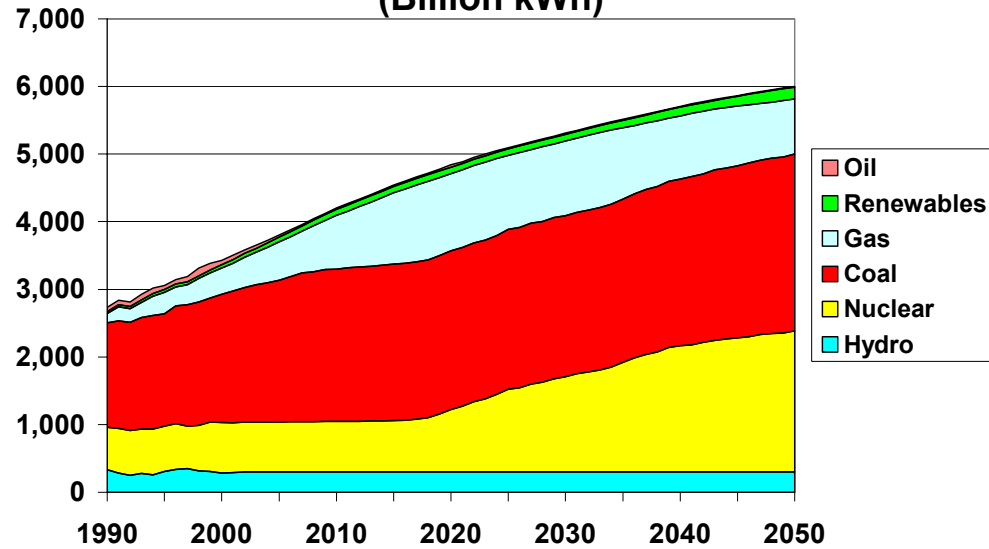
- Gas Consumption by Electric Generators Is Expected To Double by 2015

US Electric Generation by Fuel 1990-2050
(Billion kWh)



No New Nuclear Plants

US Electric Generation by Fuel 1990-2050
(Billion kWh)



New Nuclear Plants



Electricity & Gas Market Issues Are Critically Intertwined

- Financial Issues: Boom or Bust for Gas Combined Cycle Owners & Pipeline Builders
- Regulatory Issues: RTOs, Electric Restructuring, Emissions, On-Demand Gas Tariffs, Imbalance Rules, Storage Service, Residential Priority
- Operational Issues: Where Will Ross Perot's Great Sucking Sound Be Heard?
 - Well Decline Rates
 - Pipe Underpressurization
- Infrastructure Expansion Issues:
 - ◆ Electric Transmission
 - ◆ Gas Transmission & Storage





Better Modeling and Analysis Will

- Improve our understanding of market behavior
- Guide investment and operating decisions
- Inform regulatory policy debates about
 - ◆ Electric restructuring – CA avoided regional market modeling & analysis
 - ◆ Environmental markets
 - ◆ A national energy plan
- Help us develop
 - ◆ Coordinated energy and environmental policies
 - ◆ Profitable business strategies





In Summary

- Surplus Deliverability is needed to provide gas-on-gas competition and maintain reliability
- Infrastructure Expansion faces major hurdles in practice that models may overlook in projecting supply & prices
- Price Volatility reminds us we don't understand everything