Natural Gas for CHP: Efficiency for Stressful Times

CHP in New York State -
Two Years Later
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Overview

- What's up with gas?
- Where is it headed?
- How can CHP help?
- How will it affect CHP?

Key Findings

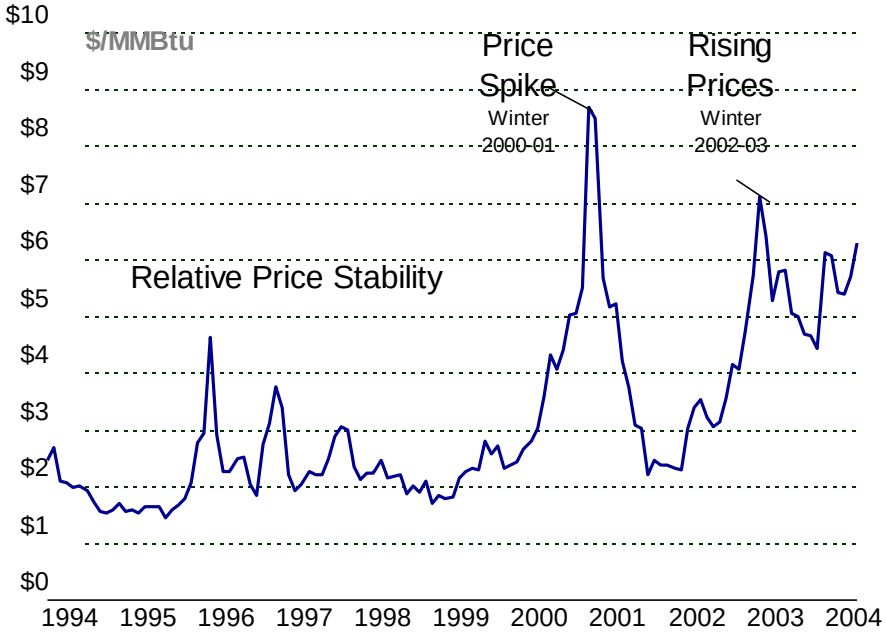
- Gas prices will continue to be higher than historical levels and more volatile.
  - More so in New York than in other regions.
- In the near-term, efficiency measures such as CHP are the most important response.
- CHP also has significant economic and operational value for consumers.

Key Findings - Natural Gas Markets

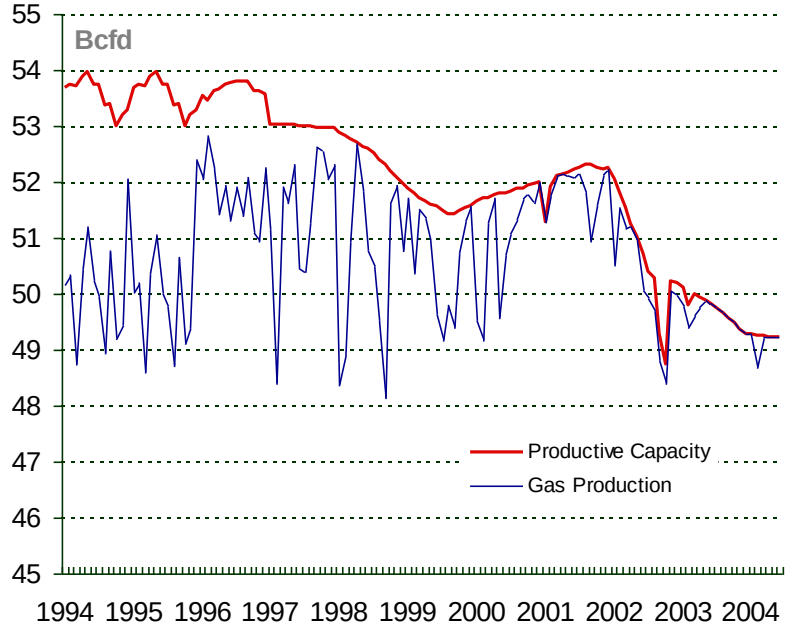
- North American gas supply/demand balance will remain tight.
- Gas consumption will grow.
  - Increased reliance on gas-based power generation.
- "New frontier" gas supplies are necessary.
  - New supplies will be more remote and more costly than supplies developed to date.
- Gas prices will remain relatively high.
  - Henry Hub price will average over $5 through 2010 and then $4 to $5.
- High levels of gas price volatility will continue.
  - Weather and other variables, including pipeline constraints, will yield high levels of price volatility, given the tight balance between supply and demand.

The Changing Gas Balance

Historical Gas Prices At Henry Hub



Lower-48 Dry Gas Production vs. Dry Gas Productive Capacity

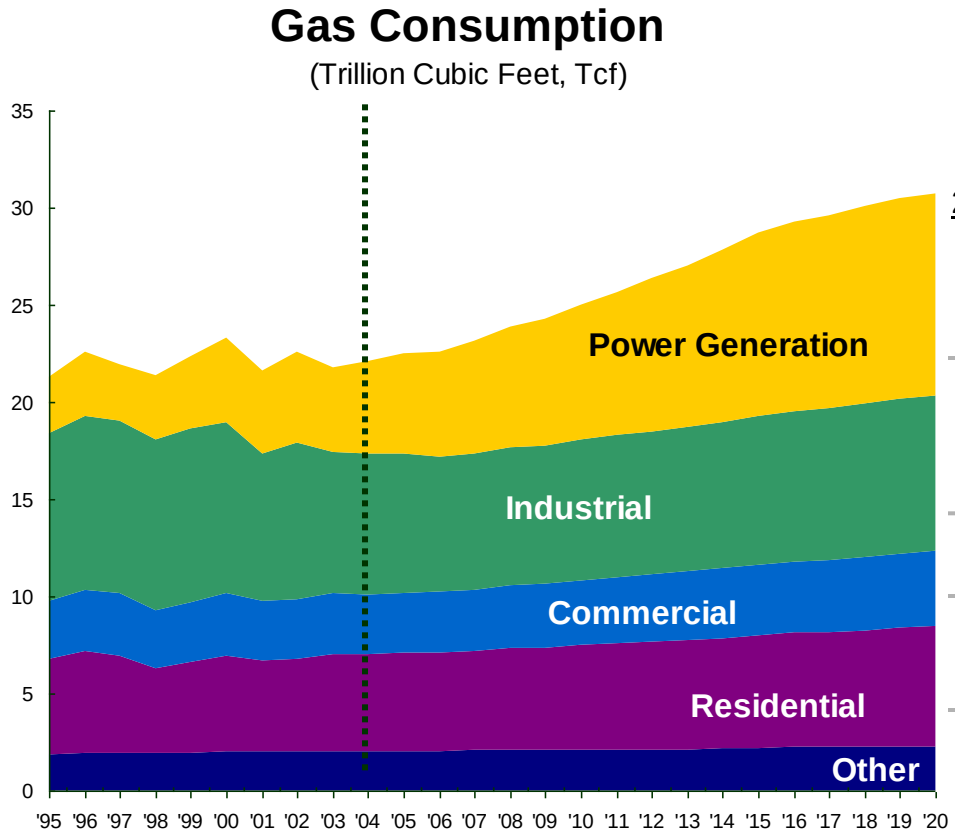


Tightening balance between supply and demand has led to higher gas prices, and increased price volatility.

THIS TIGHT BALANCE IS EXPECTED TO CONTINUE

Gas Demand Outlook

- Gas consumption in the power sector will grow substantially.
- Modest growth in R/C gas consumption.
- Industrial gas consumption will fluctuate around current levels - well below pre-2000 levels.
- When necessary, price-induced demand reductions will balance the market.



	Delta 2003-2010	Delta 2003-2020
Power Generation	+2.6 Tcf	+6.1 Tcf
Industrial	+0.1 Tcf	+0.8 Tcf
Commercial	+0.2 Tcf	+0.7 Tcf
Residential	+0.4 Tcf	+1.2 Tcf
Other	+0.1 Tcf	+0.3 Tcf

Demand will continue to lead supply in the North American gas market for the foreseeable future.

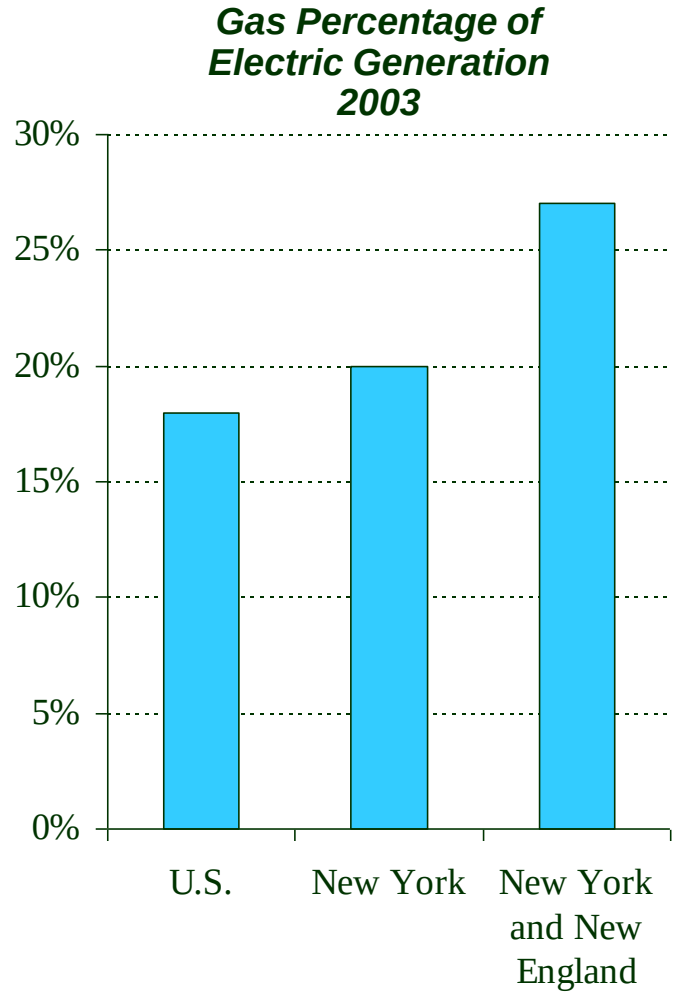
What Drives the Growth in Power Generation Gas Demand?

- Little new generation was built in the 1990's, increasing use of existing gas units.
- After the recent economic slump, electricity demand growth is expected to return to about 1.9% per year.
- Nuclear and Renewables output will grow only slightly, and there is no significant change in hydroelectric capacity.
- Between 1998 and the end of 2003, over 200 GW of new gas-based capacity was constructed.
  - Some of the new gas units will displace older, less efficient gas units, but gas demand will still increase.
  - In contrast to the older steam units, the new combined cycle and combustion turbines were built without any oil backup capability.

Existing gas-based capacity will meet most of the incremental growth in electricity demand through the end of the decade, especially in the Northeast.

Gas-Based Generation in the NE

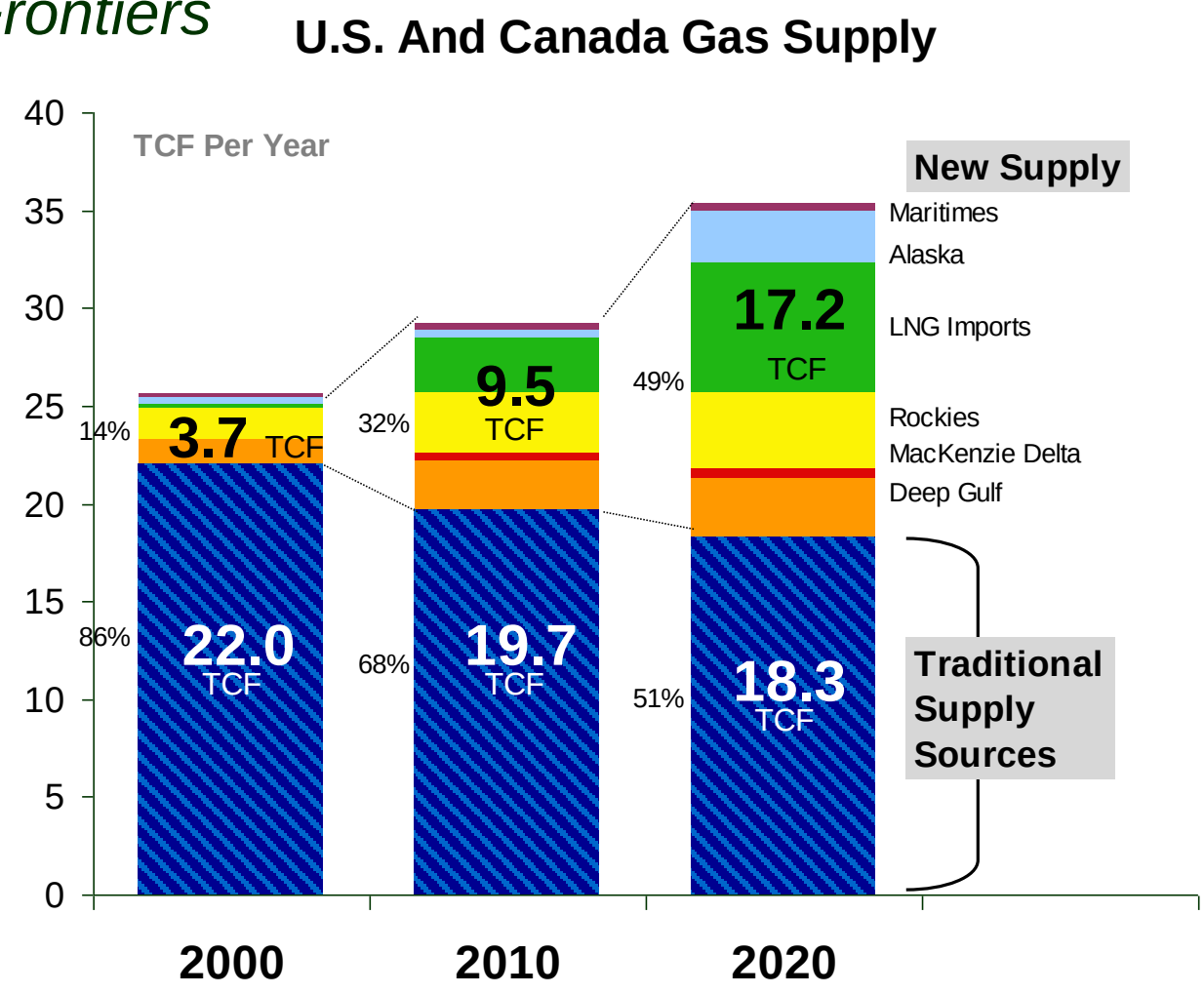
- New York is more gas-intensive than U.S. Average.
- New York/New England even more so.



Where Will the Gas Come From?

Relying On New Frontiers

- Production from mature producing areas will decline by 0.9 percent per year.
- New frontier supplies will account for 32 percent and 49 percent of total U.S. and Canada gas supply in 2010 and 2020, respectively.

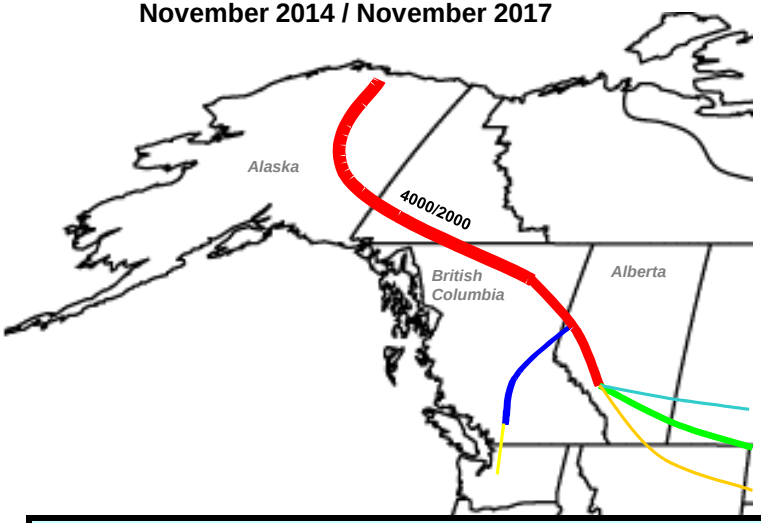


Alaska Gas and LNG Imports

Playing a Major Role

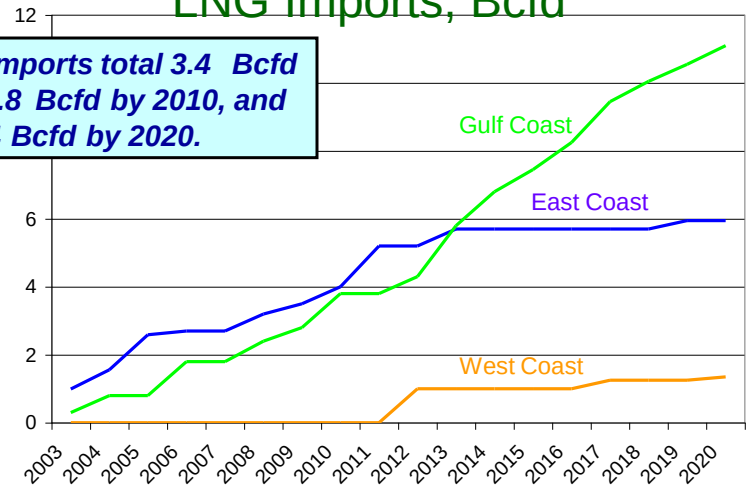
Alaska Capacity Expansions

MMcfd Added
November 2014 / November 2017

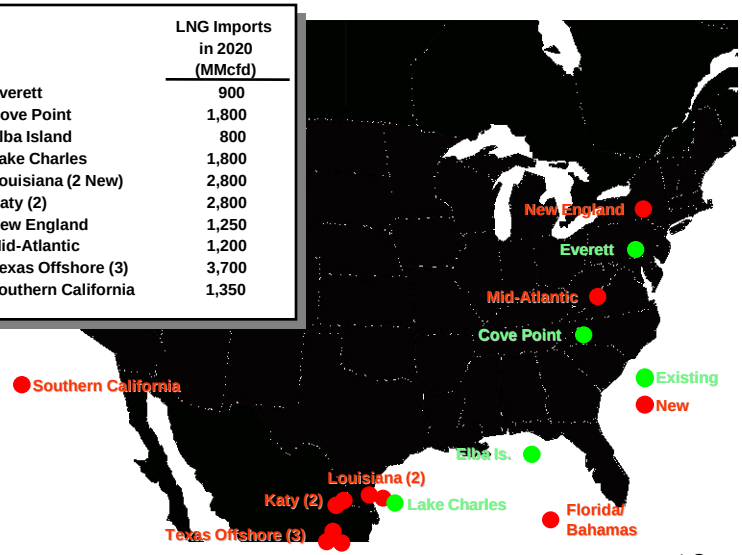


LNG Imports, Bcfd

U.S. LNG imports total 3.4 Bcfd by 2005, 7.8 Bcfd by 2010, and 18.4 Bcfd by 2020.



	LNG Imports in 2020 (MMcfd)
Everett	900
Cove Point	1,800
Elba Island	800
Lake Charles	1,800
Louisiana (2 New)	2,800
Katy (2)	2,800
New England	1,250
Mid-Atlantic	1,200
Texas Offshore (3)	3,700
Southern California	1,350



LNG Imports and Alaska gas will provide over one-quarter of North American gas supply by 2020. There would be little growth in supply without these new sources of supply.

New Frontier Gas Supplies

"Available… But Costly and Slow to Develop"

- Cost of new frontier supplies will set the natural gas price at the margin.
- Prices will be higher than minimum delivered to market costs due to development delays and risk premiums.

Cost Of New Frontier Gas Supplies

New Frontier Source	Total Amount Delivered To U.S. And Canadian Markets In 2020 (TCF)	Estimate Delivery Cost Per Unit Of Gas[1] ($/MMBtu)	Capital Expended Through 2020 To Develop Supply[2] (Billion$ U.S.)
Deepwater Gulf Of Mexico[3]	**3.0**	**2.50**	**260**
Rocky Mountain Gas	**3.9**	**2.80**	**133**
LNG Imports	**6.7**	**3.50**	**107**
Alaska	**2.7**	**3.80**	**50**
Eastern Canada Offshore	**0.4**	**3.50**	**16**
MacKenzie Delta	**0.5**	**3.60**	**14**
Total Of New Frontiers…	**17.2**		**580**

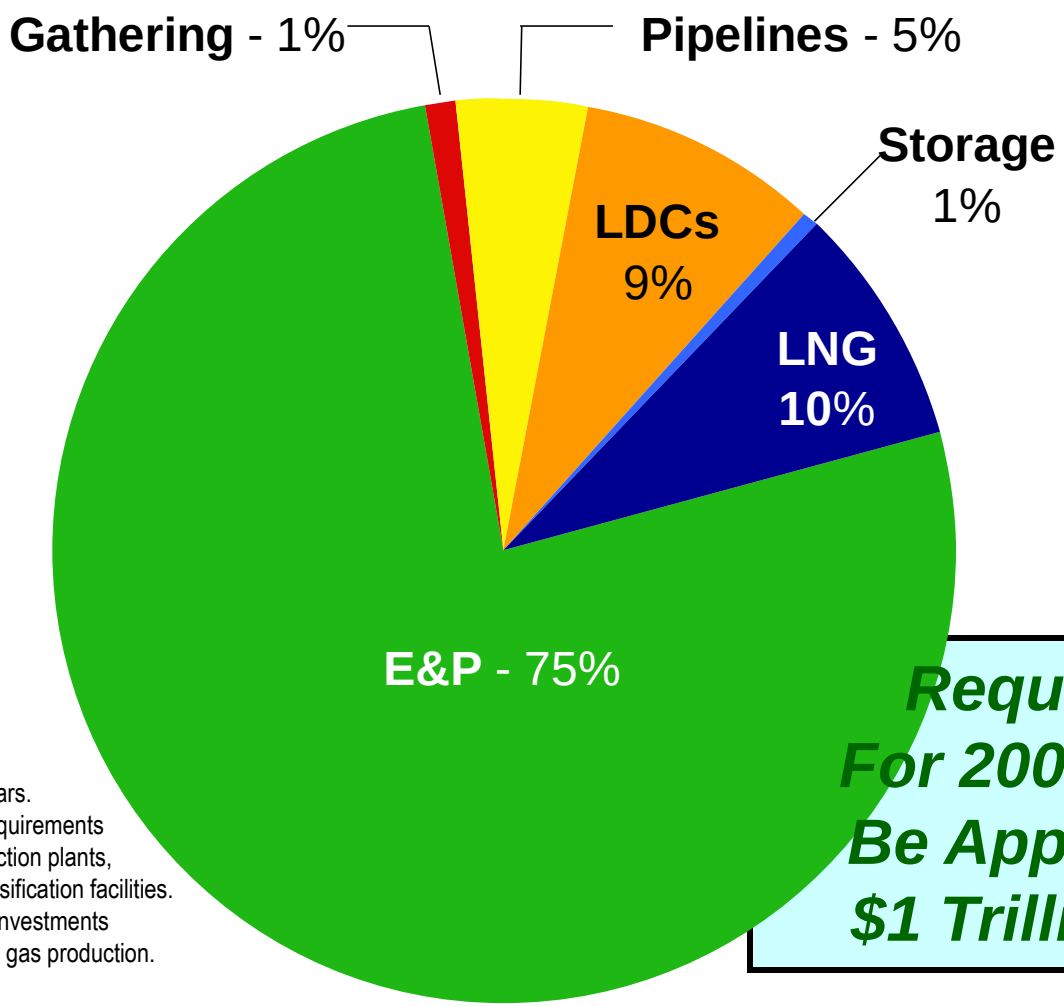
1) Cost of deliveries into closest major market area in constant 2003 dollars. 2) Total cost of development, including all E&P expenditures and all development expenditures to bring the gas supply to market. 3) Almost two-thirds of the capital expenditure applies to oil well development.

Obstacles For Supply Growth

- Large Capital Requirements
- Liquidity Crunch
- Investor Recognition of Opportunities
- Price Volatility Creates Uncertainty
- Uncertainty About Future Gas Demand
- Access Restrictions
- Cumbersome Approvals Process
- Environmental and Siting Issues

There is much uncertainty about future gas supply development.

U.S. Natural Gas Investment

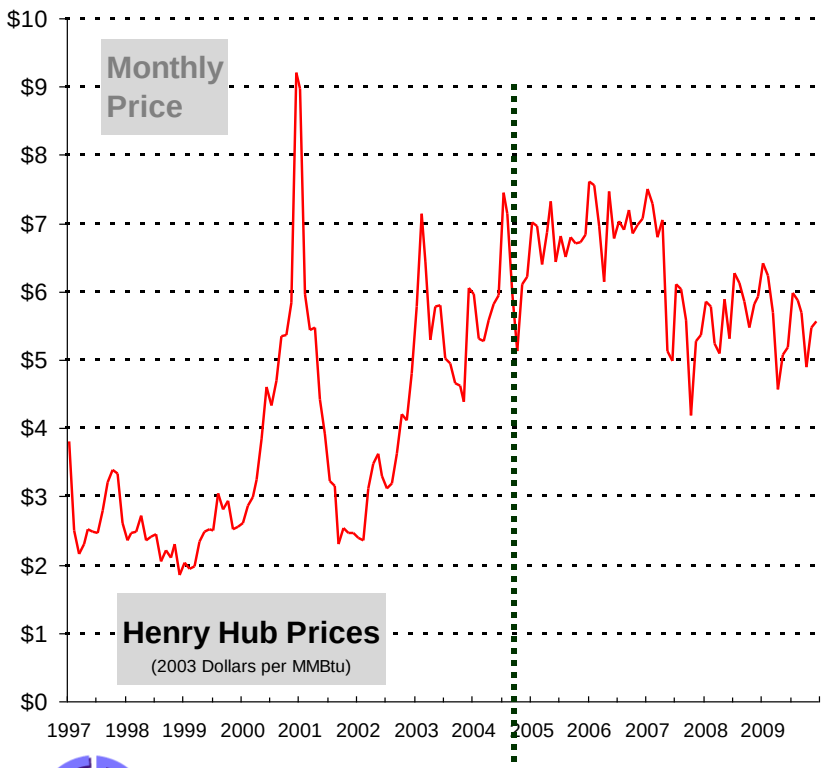


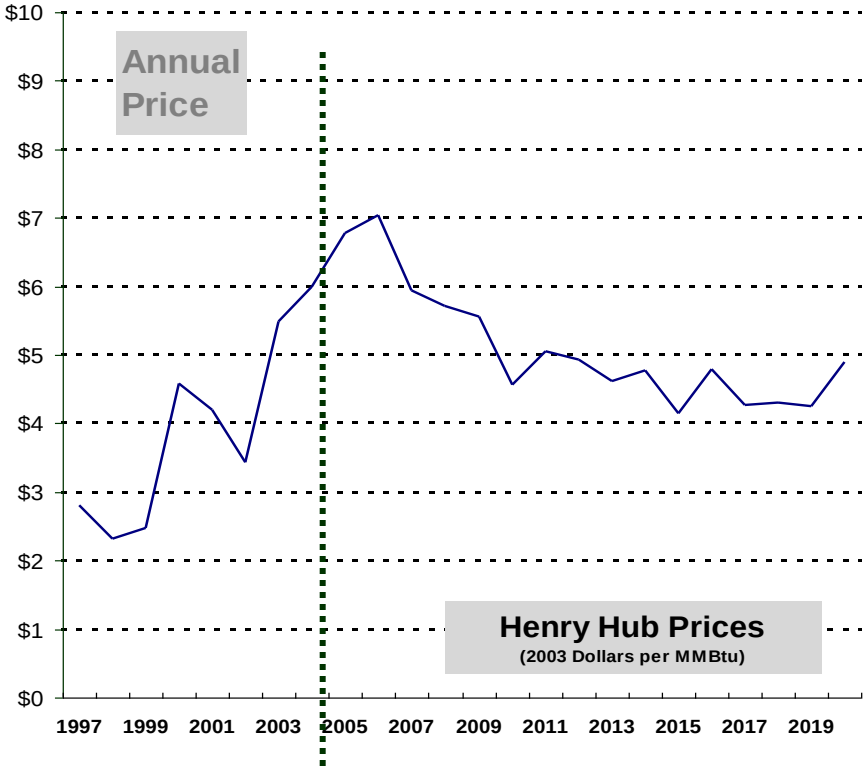
Real 2003 dollars.
LNG capital requirements include liquefaction plants, ships and regasification facilities.
E&P includes investments for both oil and gas production.

Requirements For 2003-2020 Will Be Approximately $1 Trillion Dollars

Natural Gas Price Projection

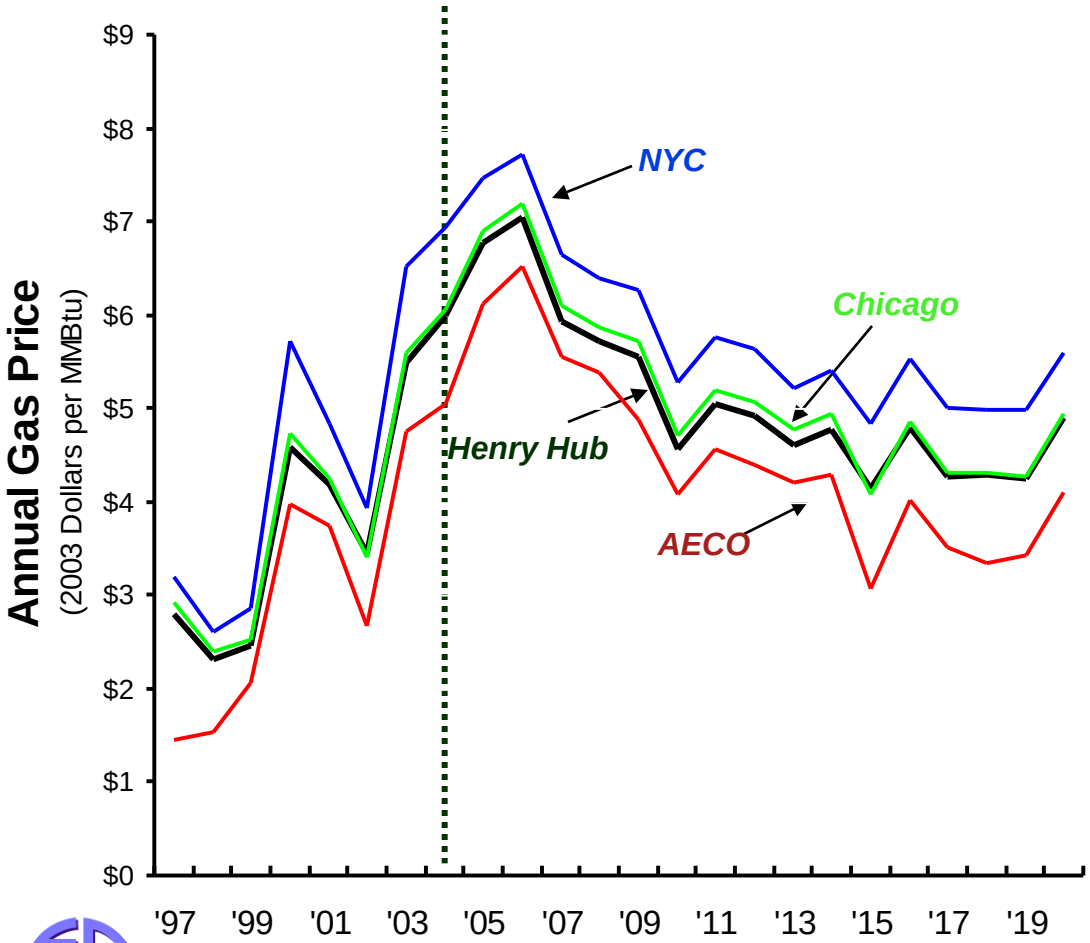
- Gas prices will climb to $7 in the short term and decline to the $4 to $5 range by 2010.
  - Growing gas demand will encourage development of new frontier gas supplies.
- However, price volatility will remain high and upside potential is high.





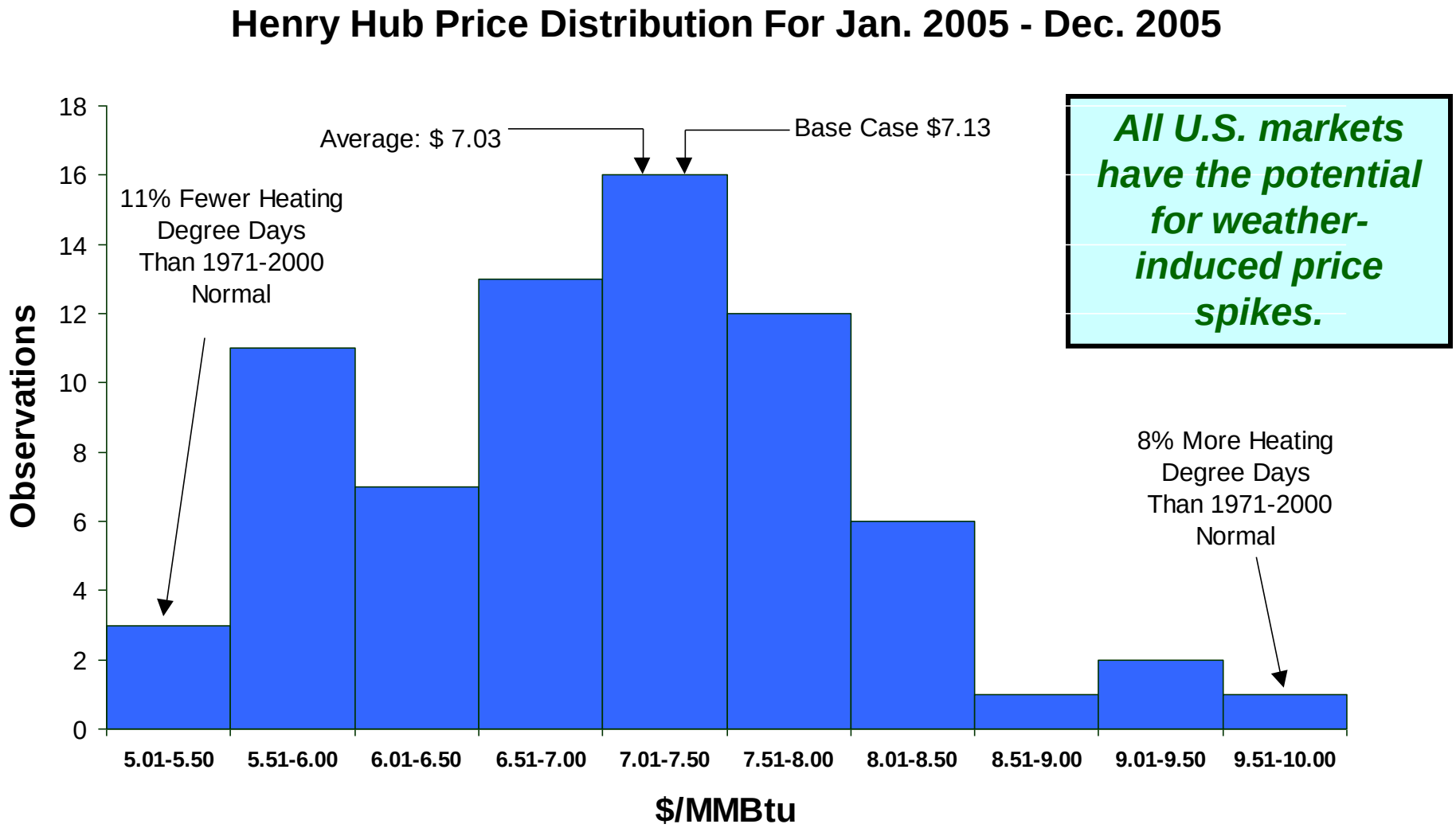
Regional Natural Gas Prices

For A Few Select Locations

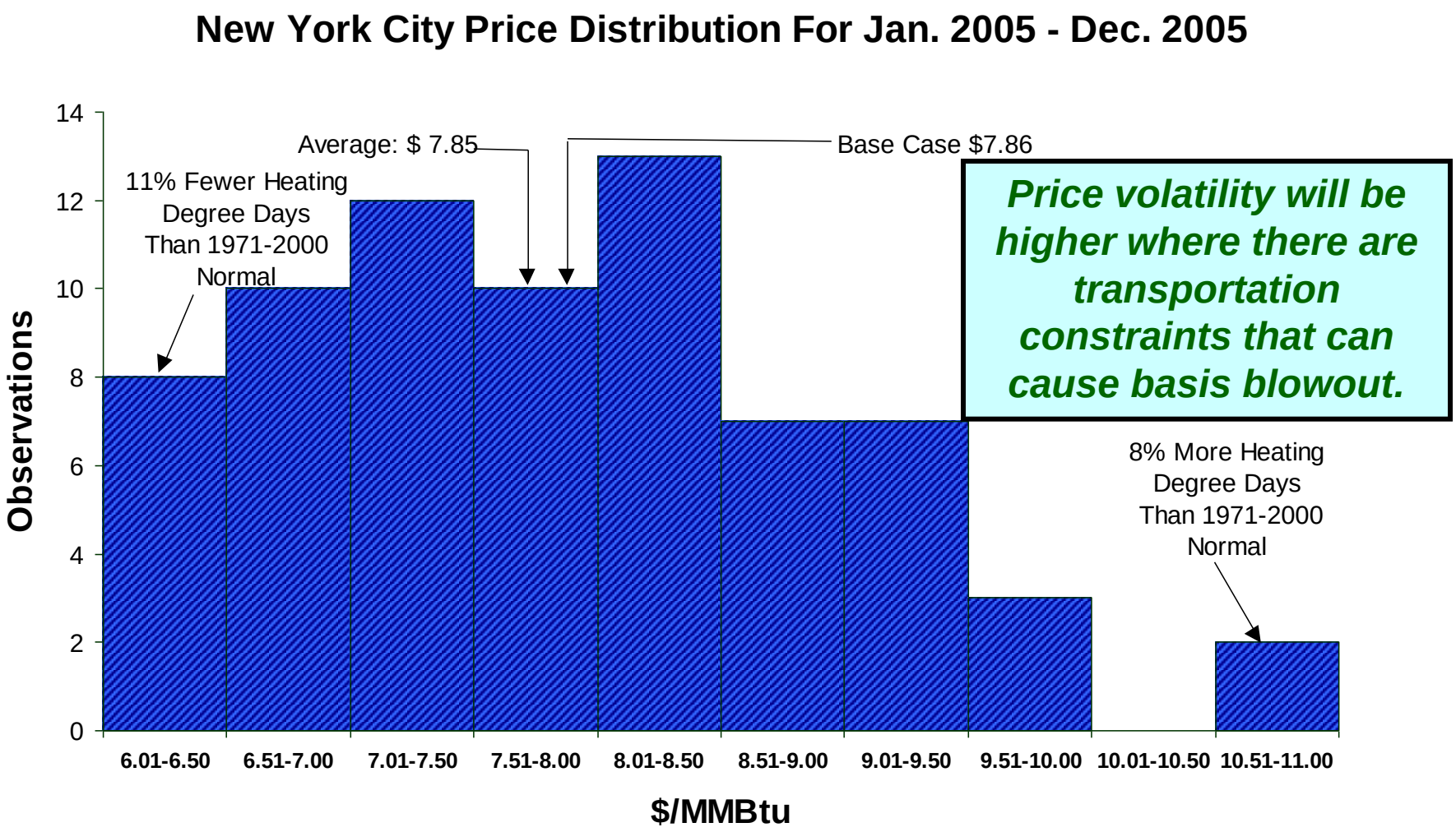


Regional gas prices will change along with Henry Hub gas price. Prices are subject to greater volatility in areas where there are transportation constraints, such as NYC.

Impact Of Weather - Henry Hub



Impact Of Weather - NYC



Price volatility will be higher where there are transportation constraints that can cause basis blowout.

Restatement Of Key Findings

- Gas supply/demand balance will remain tight.
- Gas consumption will grow, largely as a result of growth in gas-based power generation.
- "New frontier" gas supplies are necessary.
- Supply development will face many obstacles.
- Gas prices likely to average above $5 per MMBtu through 2010.
- High levels of gas price volatility will continue.
- Weather alone can swing gas prices by a couple dollars.
- Regional gas prices will move with Henry Hub price, but are subject to greater volatility depending on transportation constraints.

THE GAS MARKET IS IN A NEW ERA

CHP Impact on Gas Markets

- In the best case, there will be a delay before any new sources of gas supply can come on line.
- Efficiency responses will be a critical component of short and long-term solutions.
- CHP is an immediately available, widely applicable efficiency measure.

Analysis of CHP Gas Impacts

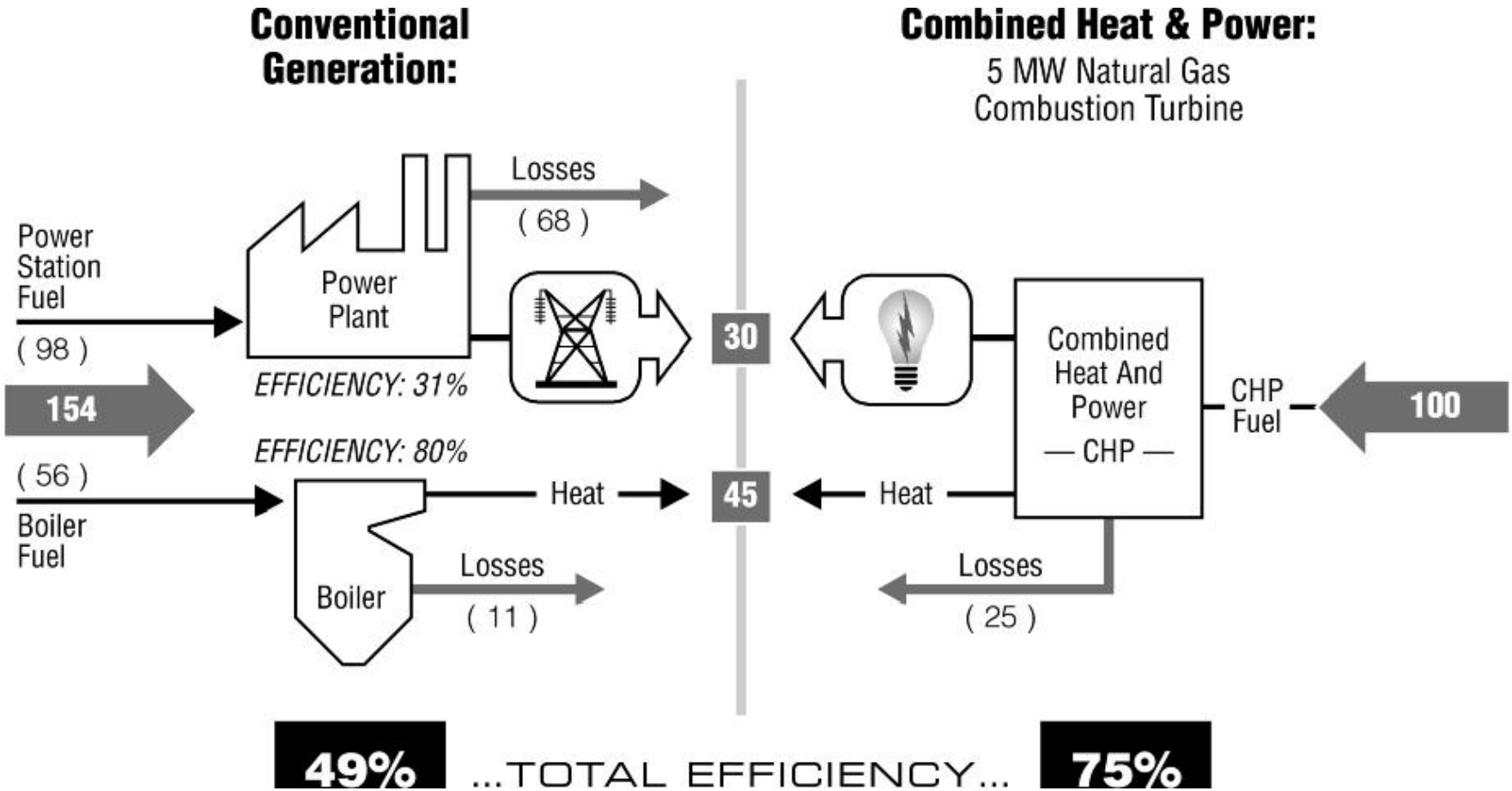
- USCHPA asked EEA to evaluate the relationship between CHP and natural gas demand and infrastructure.
- The first cut looks at California, Texas, and Northeast (New York and New England).
  - Historically strong markets for CHP with price-sensitive industrial consumers.
- It finds that expanded use of CHP can achieve a significant reduction in gas demand in these regions.

Reducing Demand for Gas

Will gas-based CHP reduce gas demand?

- CHP uses less energy than conventional systems
- Specific fuel impacts depend on what fuel the CHP system uses and replaces. Fuel replaced for grid electric generation is highly variable.
- This analysis is a first order cut of a complicated analysis.

Efficiency Benefits of CHP



Impacts of CHP on Gas Markets

- High efficiency CHP reduces demand for natural gas.
- Reduces fast-growing gas demand for power generation.
- Regional reductions in gas demand reduce national gas price.
- Moves gas consumption to consistent, base-load application - reduces price volatility.

Estimate of CHP Market Penetration

- Assumed a mix of technologies, sizes and applications:
  - 500 kW to >20 MW
  - Reciprocating engines and turbines
  - Industrial and commercial application
  - All gas-fired
  - Assumed market penetration ranging from 5 to 50 percent of technical potential - not a detailed economic analysis.

Assumed CHP Market Penetration

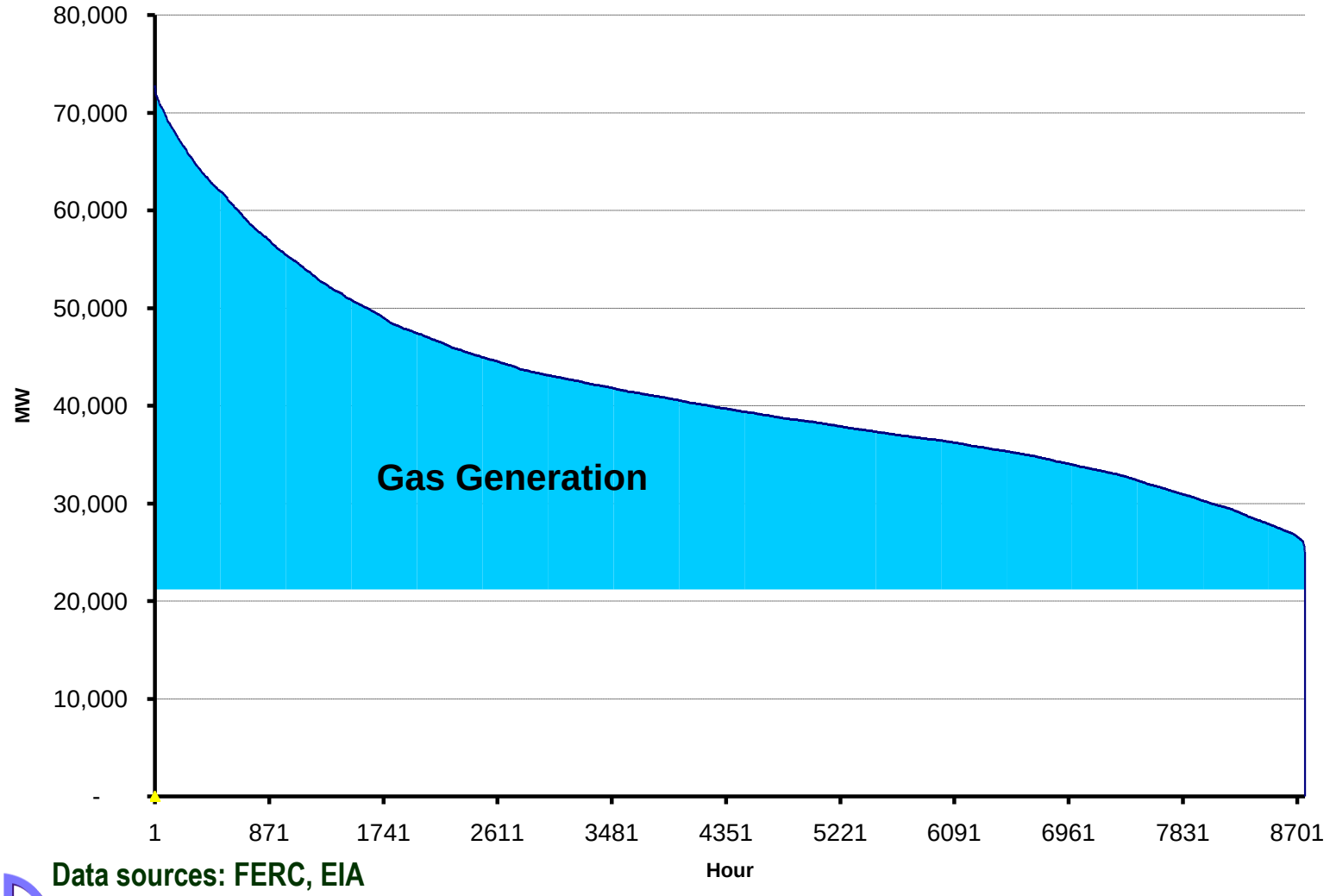
	Northeast		Texas		California	
	Units	MW	Units	MW	Units	MW
Existing Grid	2,032	68,354	504	39,508	1,442	54,574
Existing CHP	414	8,708	135	15,639	795	9,438
Assumed CHP Additions	3,503	4,238	2,284	5,297	3,190	5,071

Calculating Gas Demand Impacts

- On-site thermal system is assumed to be gas replacing gas.
- Displacement from grid depends on marginal fuel over operating period.
- Utility data used to estimate when gas is on margin in each region.
- Gas on margin all the time in Texas and California, 85% of the time in Northeast.

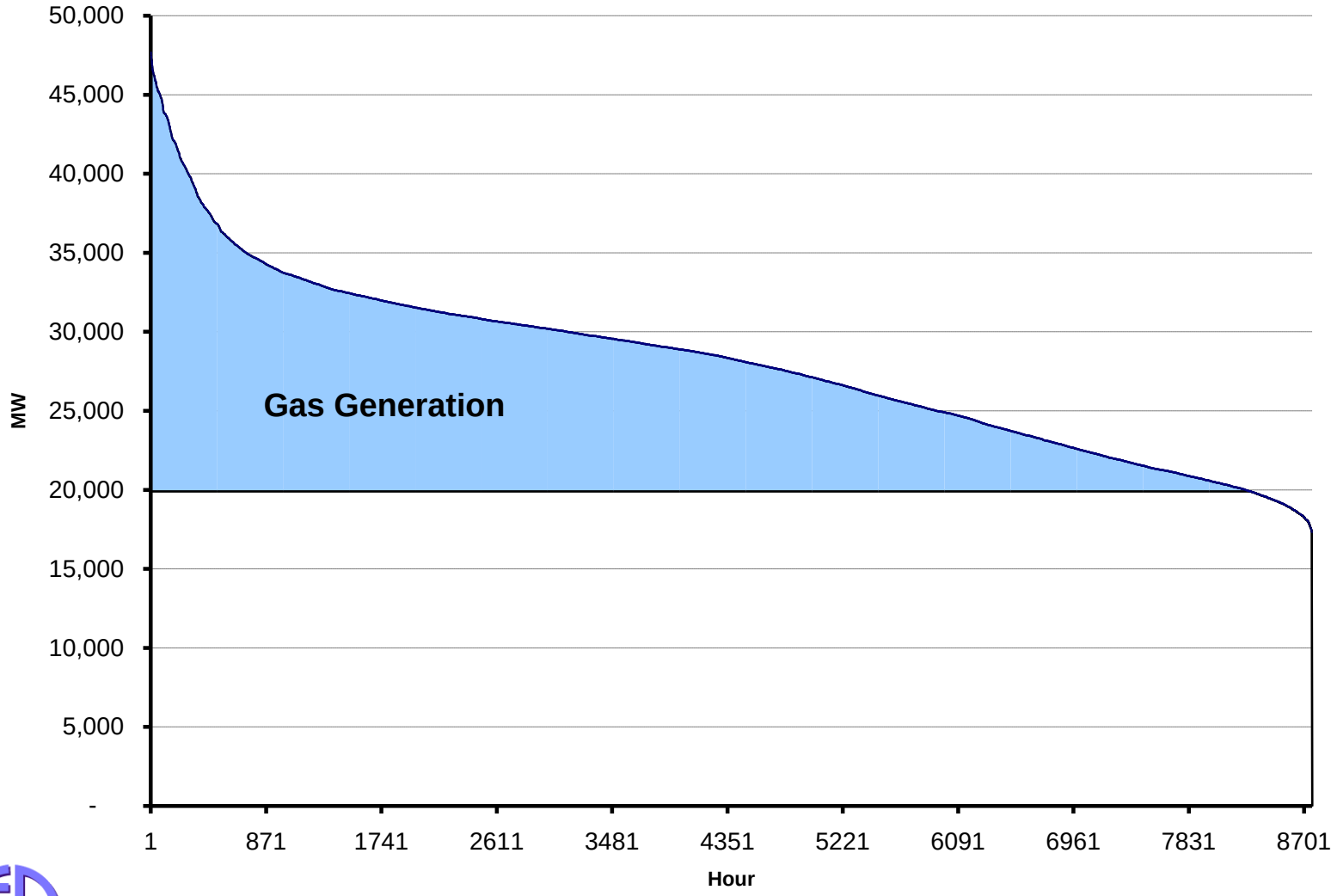
Gas Role In Generation

Texas 2001



Data sources: FERC, EIA

Gas Role In Generation
Northeast 2001



Calculation of Gas Demand Reduction
(MMcf)

	Northeast	Texas	California
On-Site Gas Consumption Displaced by New CHP	161,274	206,631	196,147
Gas Consumption for Grid Electricity Displaced by New CHP	285,517	448,521	412,450
Total Displaced Gas Consumption	446,791	658,152	608,597
Gas Consumption for New CHP	322,942	422,626	393,350
Net Gas Reduction	123,849	235,526	215,247

Gas Impacts of Increased CHP (MMcf)

	Northeast	Texas	California
Current Gas Consumption ('01)	1,892,059	3,915,959	2,404,176
Gas Displacement from CHP	123,849	235,526	215,247
Percent Reduction	-6.5%	-6.0%	-9.0%

Gas Impact Conclusions

- CHP is a readily available efficiency option that could achieve significant reductions in gas use in the near-term.
  - Small gas use reductions in this range can have large national gas price effects.
  - Modest CHP implementation can produce these effects.
- A variety of policy measures can be used/will be needed to encourage this development of CHP.

CHP and Gas Prices

If gas prices are high, can CHP compete with the grid?

CHP Remains Competitive

- Efficiency has a higher value when energy costs are high.
- Higher gas prices will drive electricity prices higher in competitive electric markets, such as the Northeast.
- CHP provides option value, hedging value and security value.

CHP vs. the Grid

CHP will compete best when:

- Marginal grid units are gas-fired.
- Competitive markets transmit this price directly to consumers.
- New York, Northeast, Texas, California

Gas Links CHP and Grid Prices

Cost of Generation
$/kWh

CHP					Grid	
Fuel*	$0.042	←	$7 Gas	→	Supply**	$0.06
O&M	$0.015					
Capital	$0.020				T&D	$0.065
Total	$0.077				Total	$0.125

*Fuel cost for CHP based on incremental electric efficiency.

**Electric supply price from grid, based on marginal gas unit.

CHP and Security

- 2003 blackout shows vulnerability of the central grid.
- Most CHP facilities designed to stay on-line, operated during the black-out.
- Provided significant value to owners and sometimes to surrounding community.

Conclusions

- Gas prices will be higher than historical.
- CHP is still a competitive option.
- Increased CHP could help the tight gas market and infrastructure.
- CHP is also a valuable hedge against prices and grid instability.