



Natural Gas Supply and the Transportation Market

gtiSM

Creating
technology solutions
with **impact**

across the
energy spectrum



GAS TECHNOLOGY INSTITUTE

- > Independent Not-for-Profit R&D Organization
- > Energy & Environmental Topics
- > Natural Gas and Hydrogen Focus



Exploration & Production



Pipeline Materials



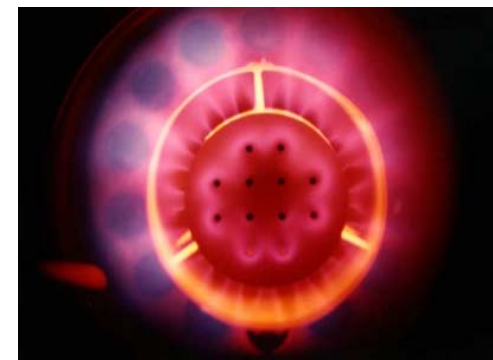
Hydrogen & Fuel Cells



Distributed Generation



Gasification



Combustion

Natural Gas Industry

Yesterday

- > Regulated
- > Monopolistic
- > One size fits all
- > Abundant North American supplies
- > Winter peaks

Today

- > Increasingly deregulated
- > Competitive
- > Unbundled choices
- > Tight supply/demand with growing imports
- > Winter & Summer Peaks



Natural Gas Industry Value Chain

- > **Natural Gas Producers**
 - A few majors, many independents
- > **Interstate Pipeline Companies**
 - FERC jurisdiction
- > **Gas Storage & Import Terminals**
 - FERC jurisdiction
- > **Local Gas Distribution Companies**
 - Publicly traded companies & municipals
 - State public utility commission jurisdiction
- > **Natural Gas/Energy Marketers**



U.S. Natural Gas Supply & Delivery Infrastructure



Natural Gas Production

- Operating wells (~370,000)
- Drilling rigs, gas plants



Natural Gas Storage and Peakshaving

- Underground storage (423)
- Peakshaving Plants
 - LNG, propane/air
- LNG Import Terminals (4)



Natural Gas Delivery

Pipeline Network

- 290,000 miles (transmission)
- 1,100,000 miles (distribution)
- Pipeline interconnects with Canada and Mexico

Gross Revenues

~\$70 Billion

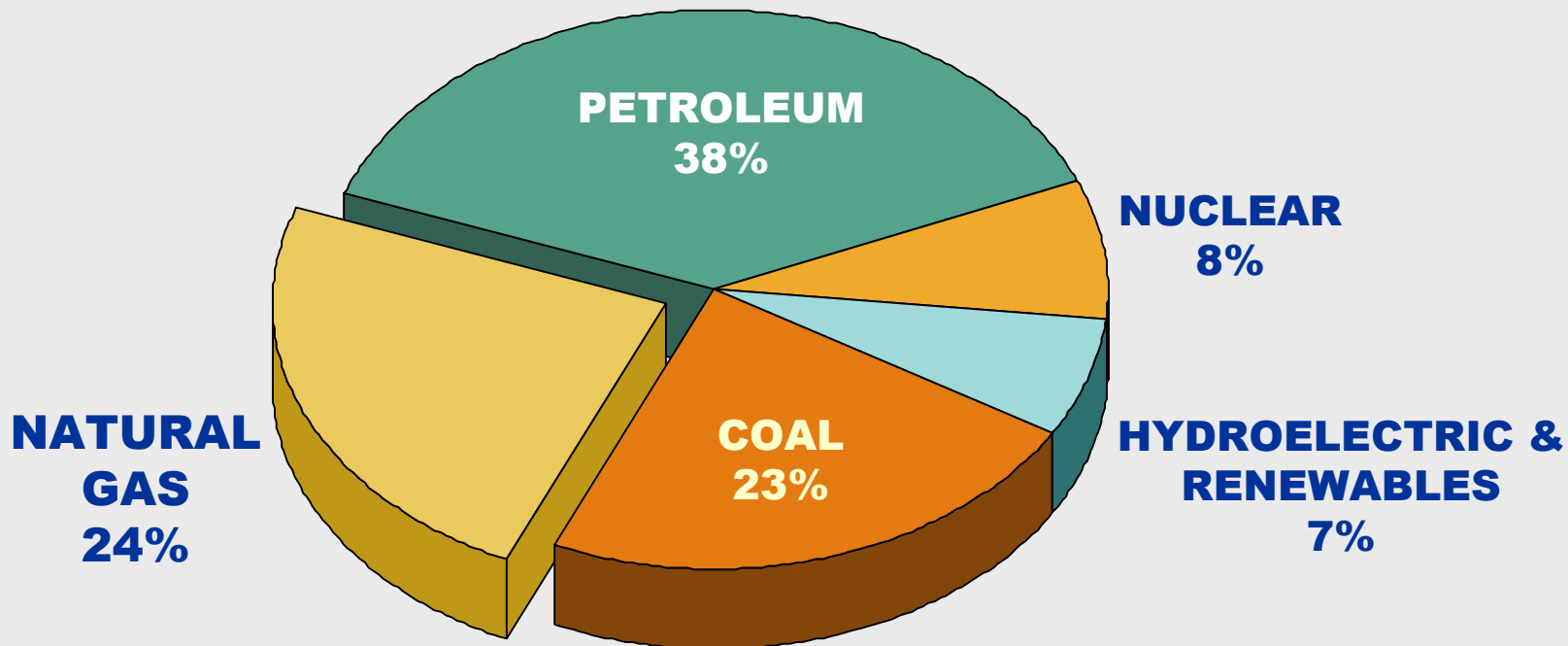
Annual Construction Expenditures

Transmission
~\$3 billion

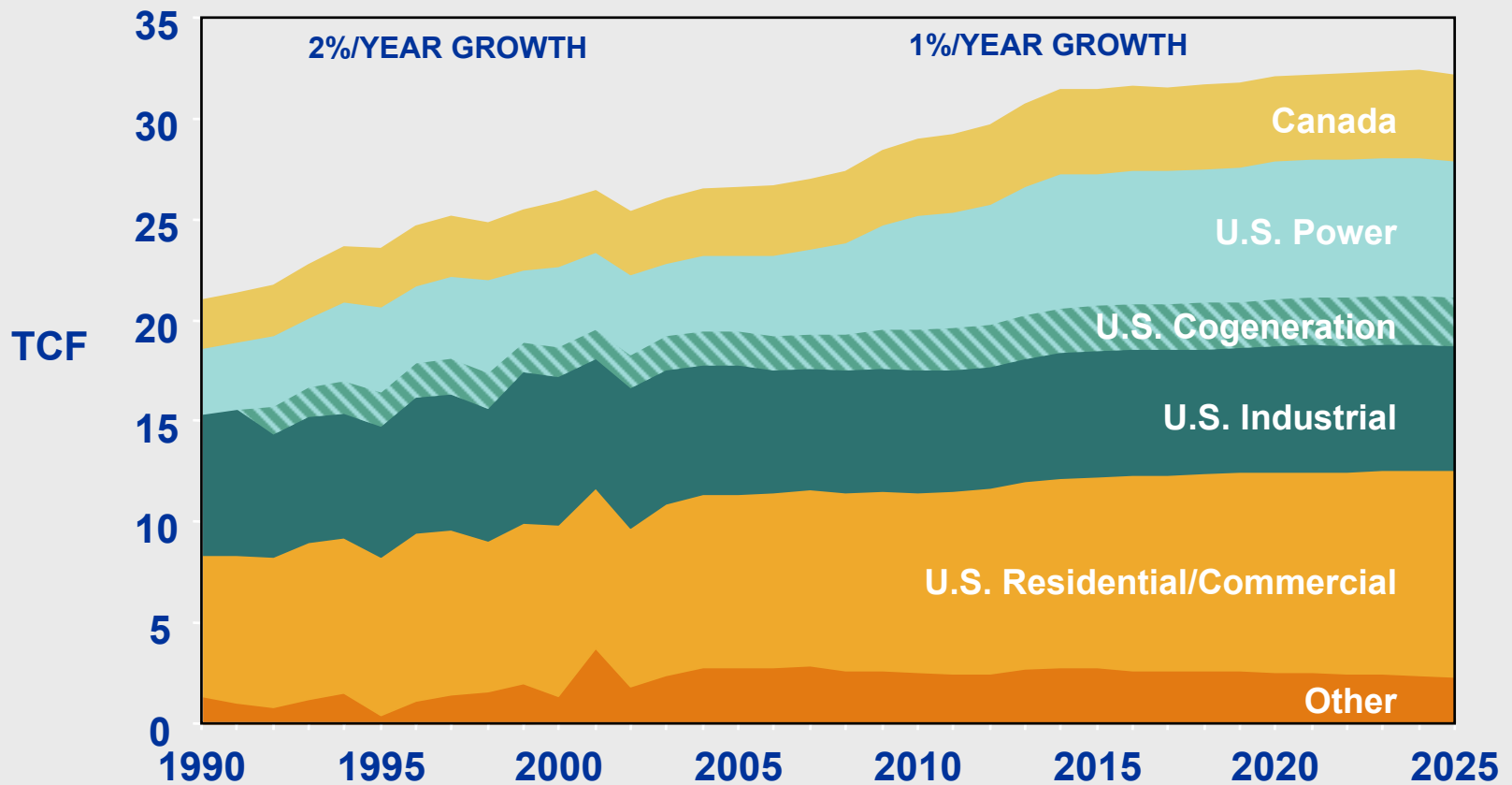
Distribution
~\$4 billion

Natural Gas is Important to Our Economy

Average Annual U.S. Energy Use
97 TCF (equivalent)



Future Projections Power Gen-Driven Growth



Question: Will growth occur with higher prices?

Natural Gas Supply/Demand/Prices

- > Natural gas price factors
 - Supply
 - > Production capacity plus storage and delivery
 - Demand
 - > Basic demand drivers
 - Economy (GDP) & growth
 - Weather (winter and summer)
 - > Elasticity considerations
 - Consumer sensitivity to price
 - Consumer natural gas choices (intrafuel)
 - Consumer switchable fuel choice (interfuel...do users have other options?)

Natural Gas Prices

> Short term

- Recent volatility due to close supply-demand balance
- Decrease in long-term contracts
- Many buyers purchasing on spot market

> Long term

- U.S. conventional natural gas wells continue to mature
- Production investment in more difficult environments
 - > Technically and politically challenging
- Regional production shifts require new pipelines
- Imports, including LNG, become more prominent
- Expanded use of financial tools to mitigate volatility

Short-Term Gas Price Factors

> Supply

- Driven by number of operating wells, production rates, number of rigs, storage, deliverability, costs

> Demand

- Driven by weather, underlying economy, prices

> Elasticity

- Prices, degree of fuel switching

“The key drivers that will determine natural gas prices...are oil prices, weather, the weather adjusted supply-demand balance, and the working gas storage level at the end of the non-heating season.”

Ron Denhardt

Vice President, Natural Gas Services

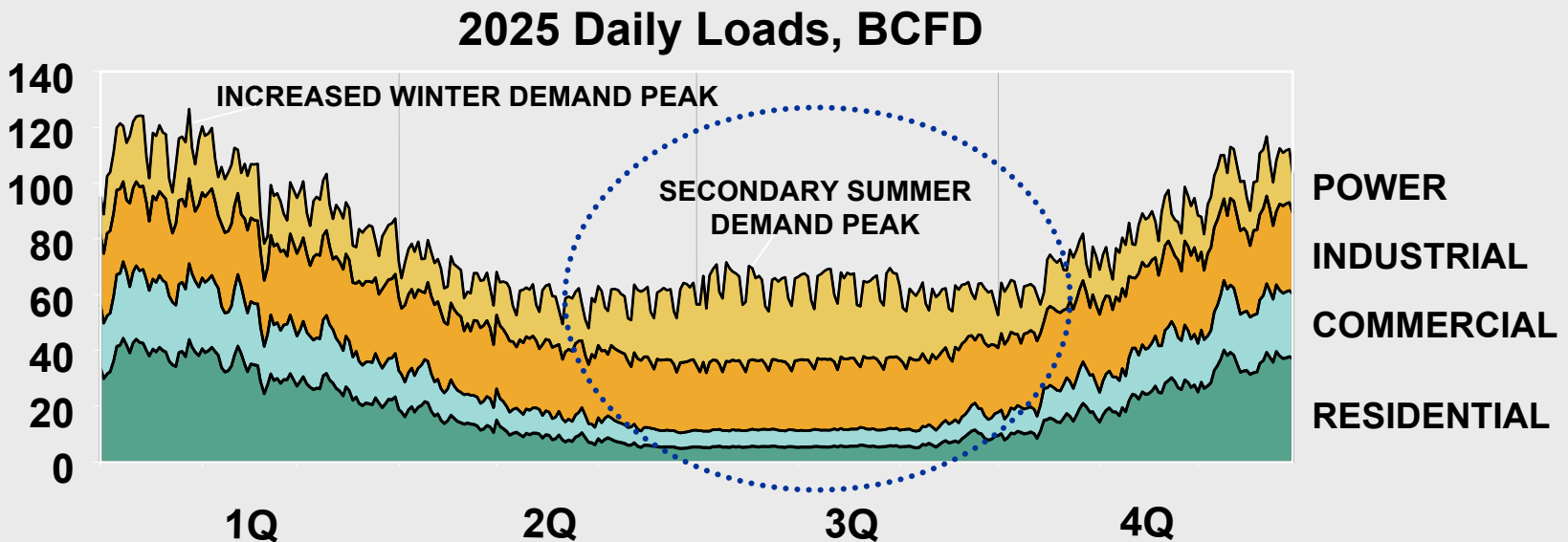
October, 2003

Short-Term Gas Price Factors

Its Not Just Winter Cold Snaps Anymore

- > Historically, natural gas has high winter demand
- > Summer is also growing in importance
 - Very hot summer temperatures drive natural gas demand (and prices) for power generation
- > Problem: Historically, summer is when gas is put into storage
 - Higher summer prices inhibit some storage operators
 - > Some delay buying gas for storage in hope of lower prices
 - This can aggravate winter price volatility on cold days if storage levels are below normal

Future Monthly Natural Gas Demand...higher summer use



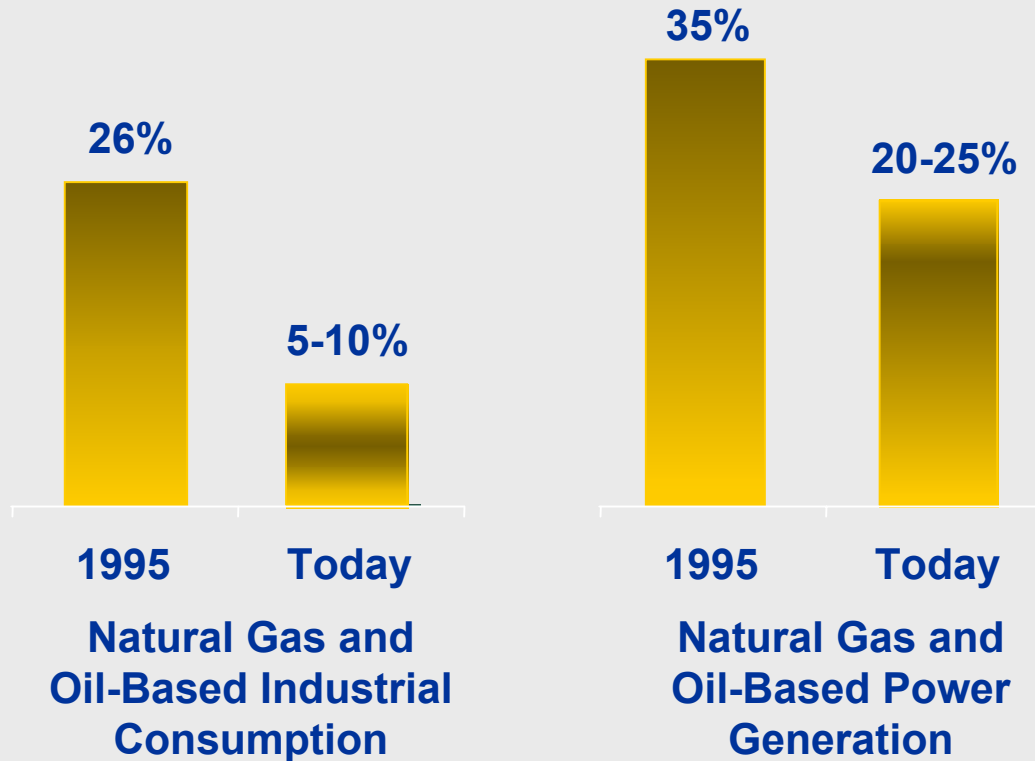
Positive: Improved pipeline asset utilization

Negative: Less gas for storage
Higher off-peak prices

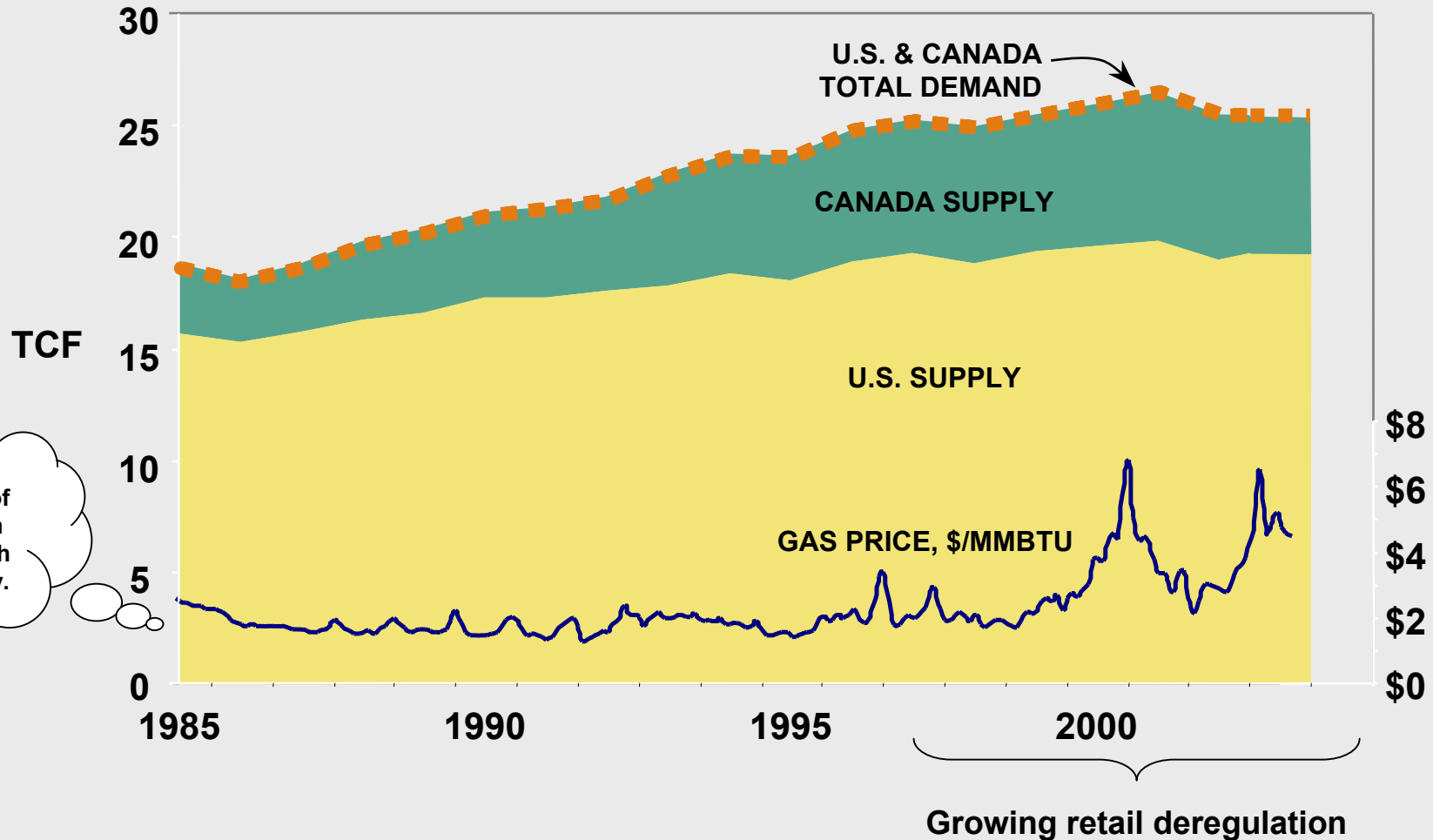


Consumer Fuel Flexibility Reducing

Fuel Substitution Capability

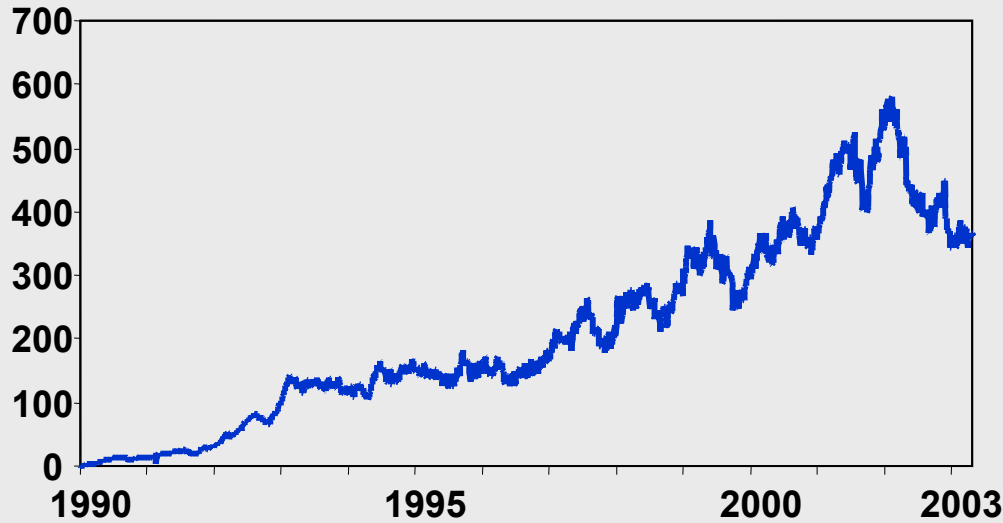


Increased Natural Gas Price Volatility



Source: National Petroleum Council (2003)

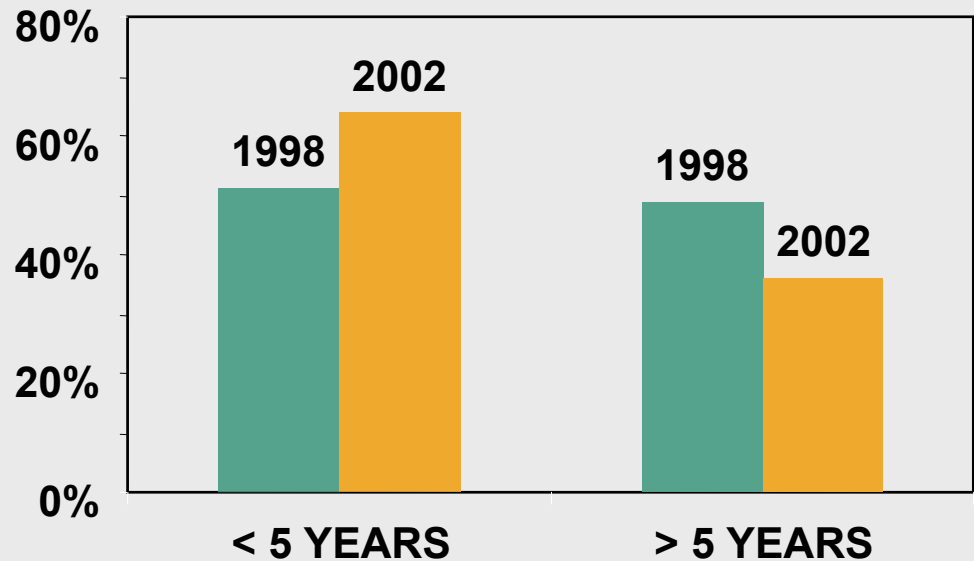
Nymex Open Interest - Natural Gas Contracts



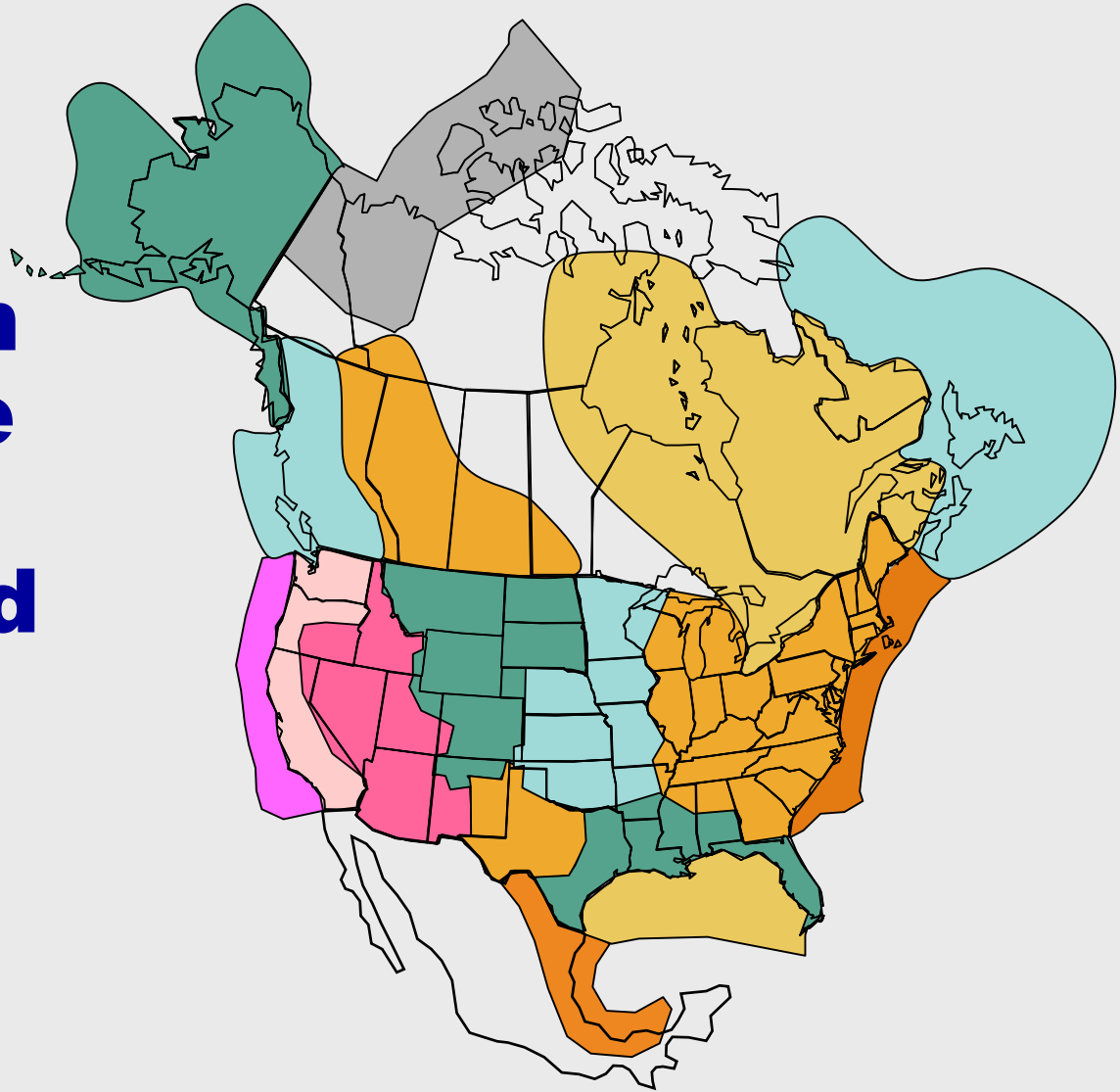
Deregulation has changed players and tools used in natural gas contracts

Public financial markets growing, but fewer long-term agreements than historical

Firm Contract Expirations

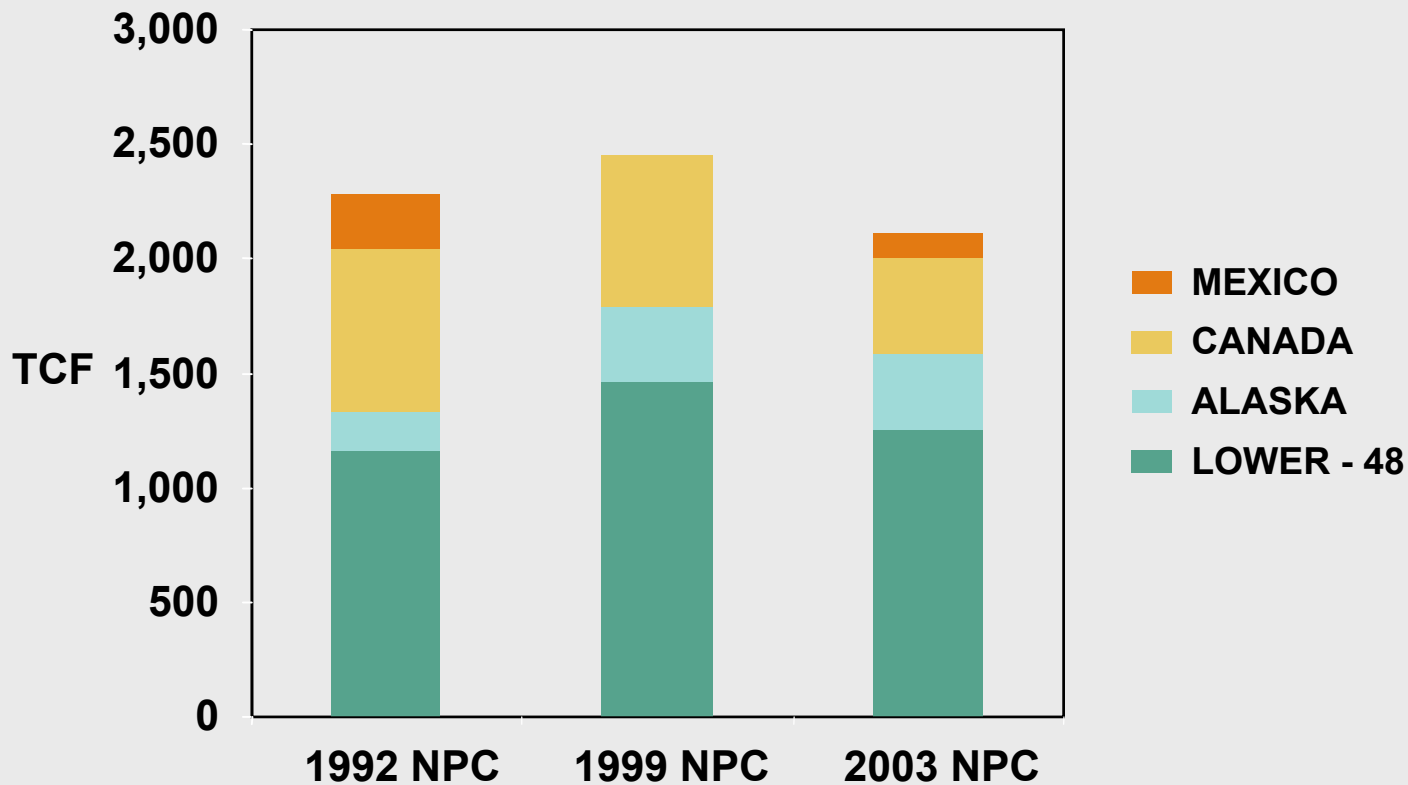


North American Resource Base: Large and Diverse



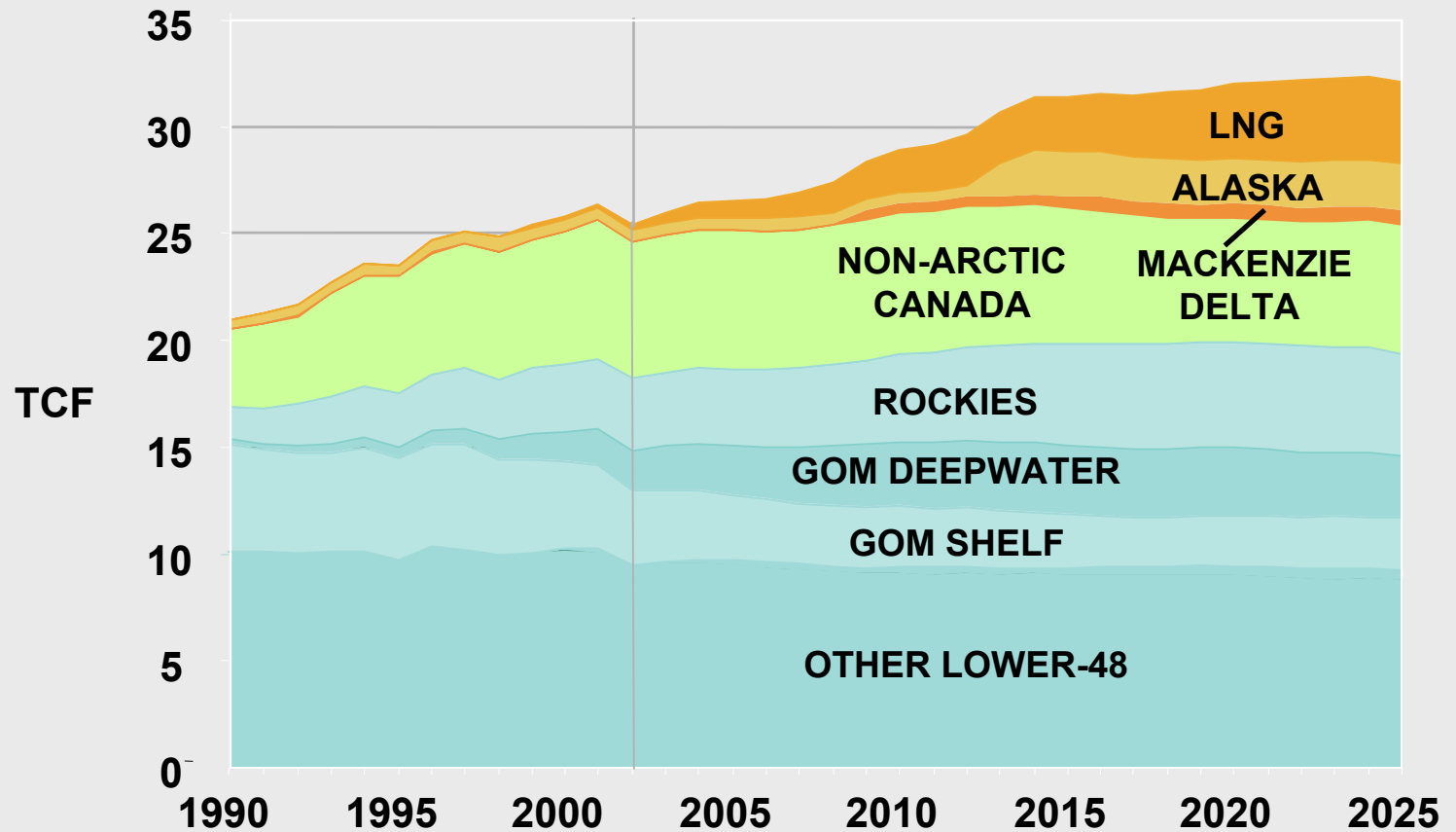
North American Resource Base

Technical Resource



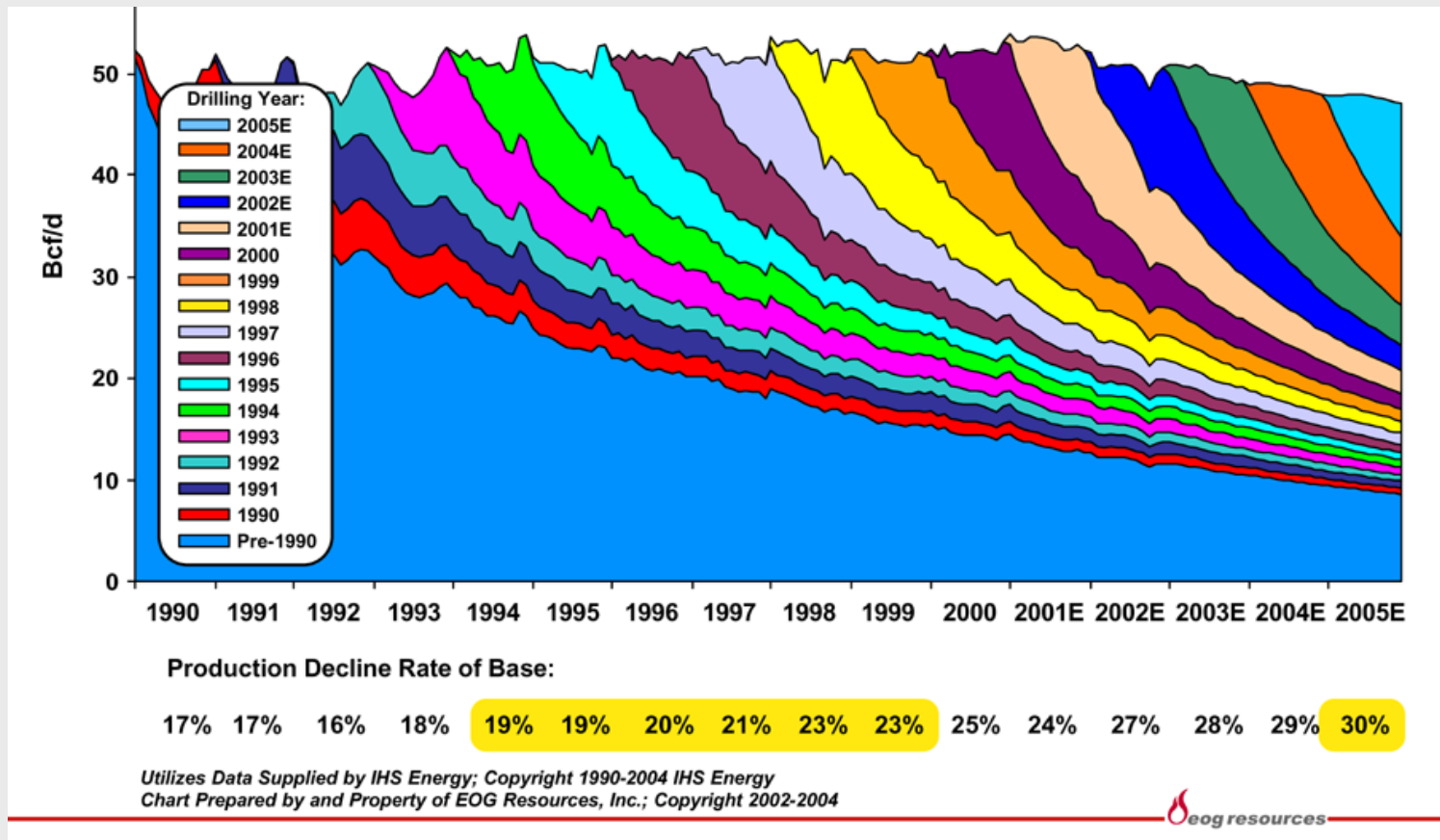
Multiples of current demand (years)	85	93	81
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Future Supplies From Traditional & New Sources

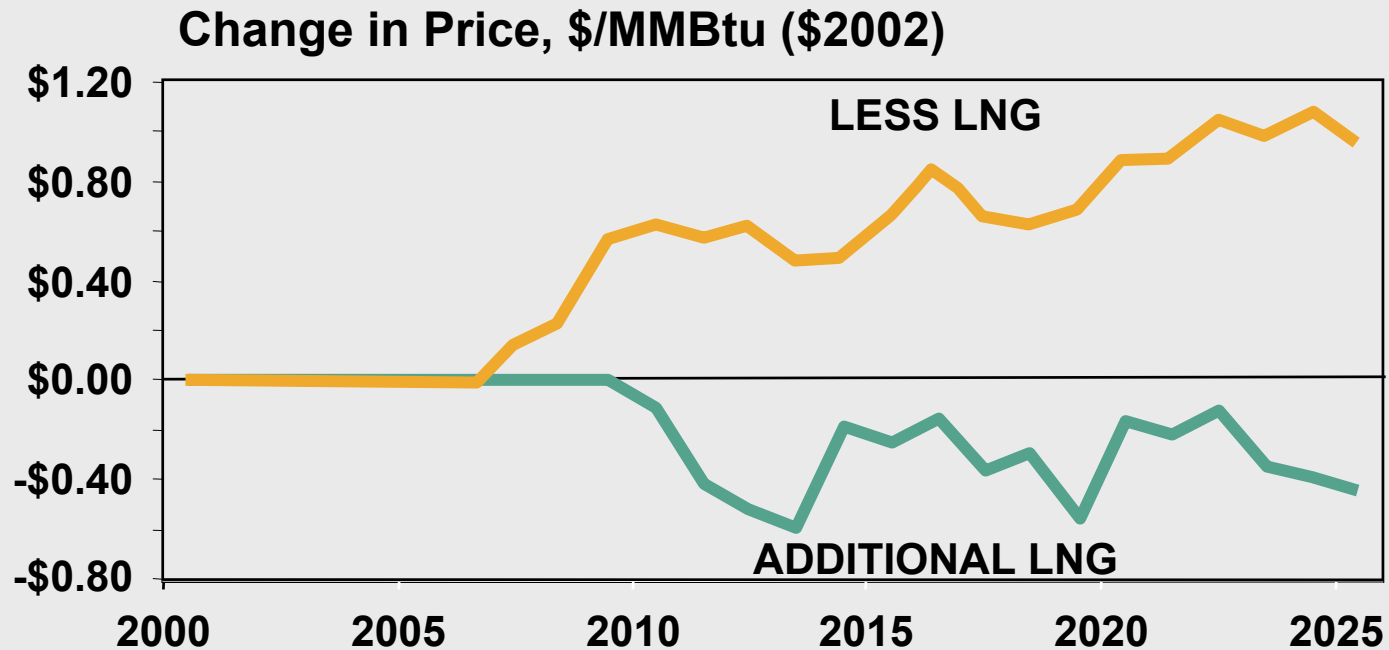


Source: National Petroleum Council (2003)

- US Natural Gas Production Base: Smaller Wells, More Rapid Decline Rates
- Bottom Line: Higher Drilling Activity & Costs To Maintain Output



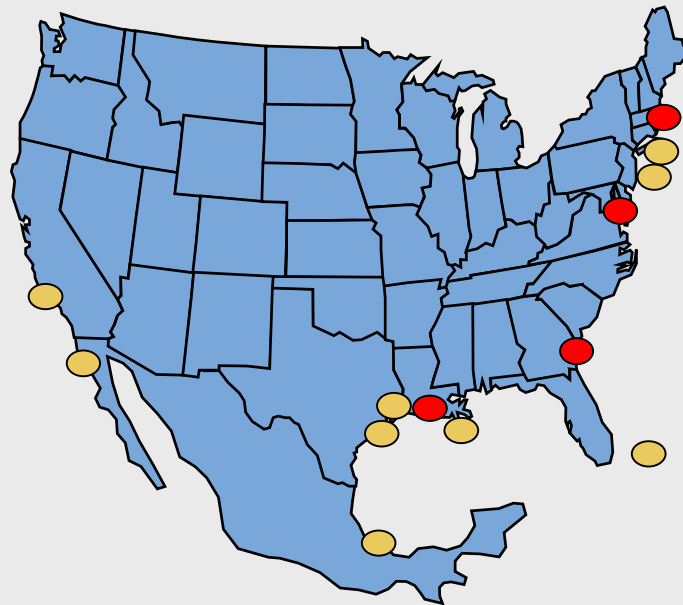
LNG Imports Can Help Address Volatility & Lower Costs to Consumers



More LNG use can address peaks, supplement conventional gas storage & reduce price volatility

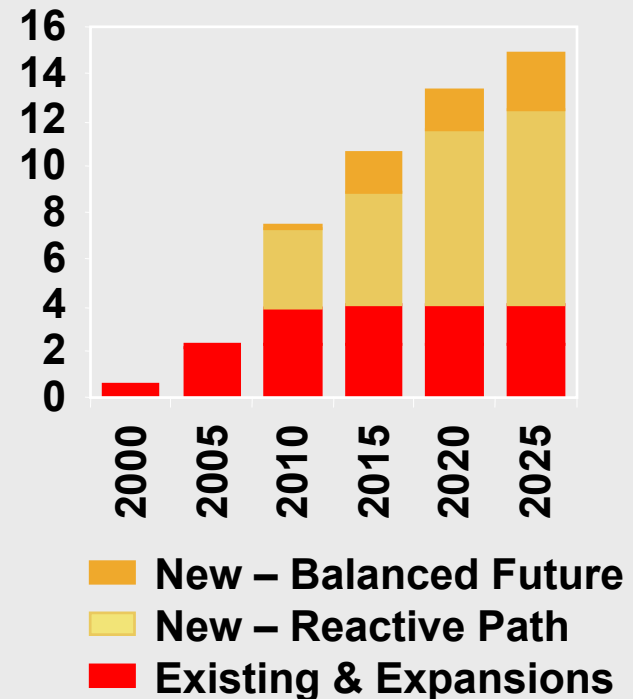
LNG Imports Need to Expand, But Political Obstacles Exist

Import Terminals



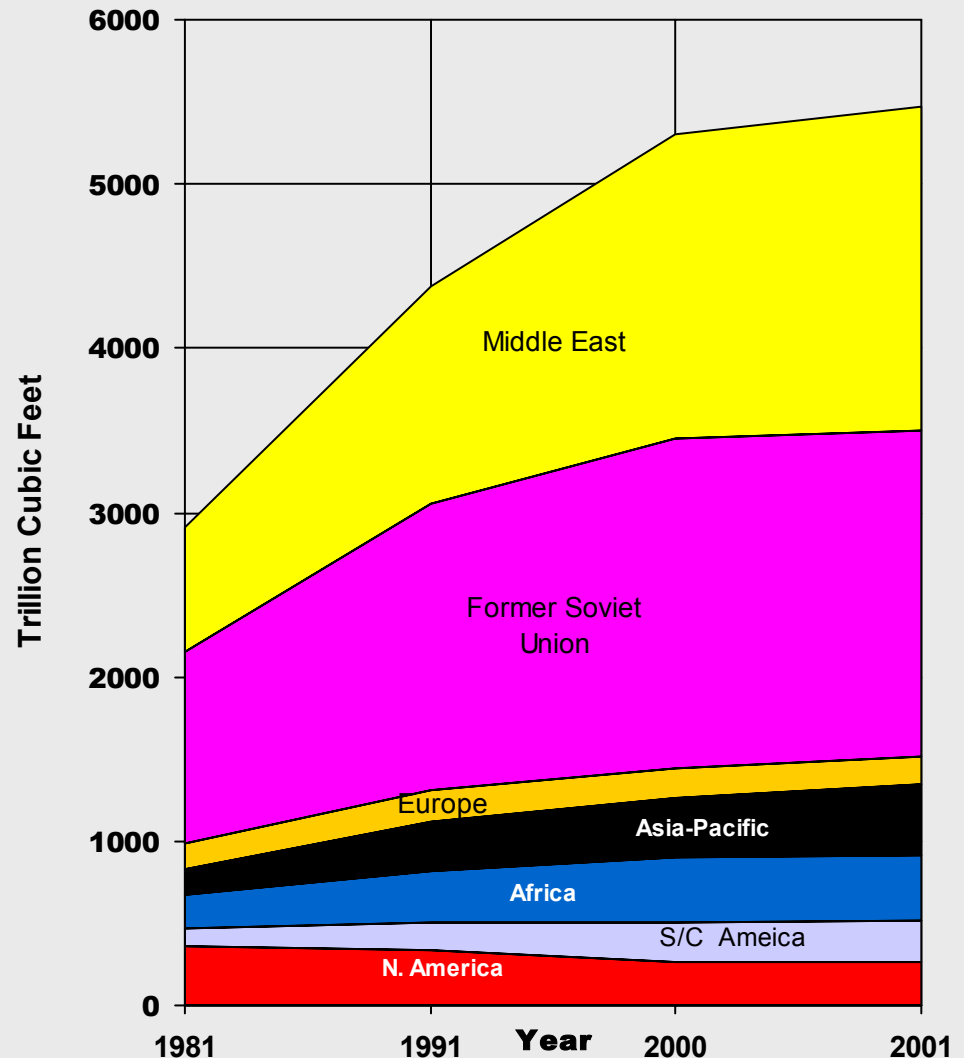
- Existing
- Potential

Projected Imports BCFD



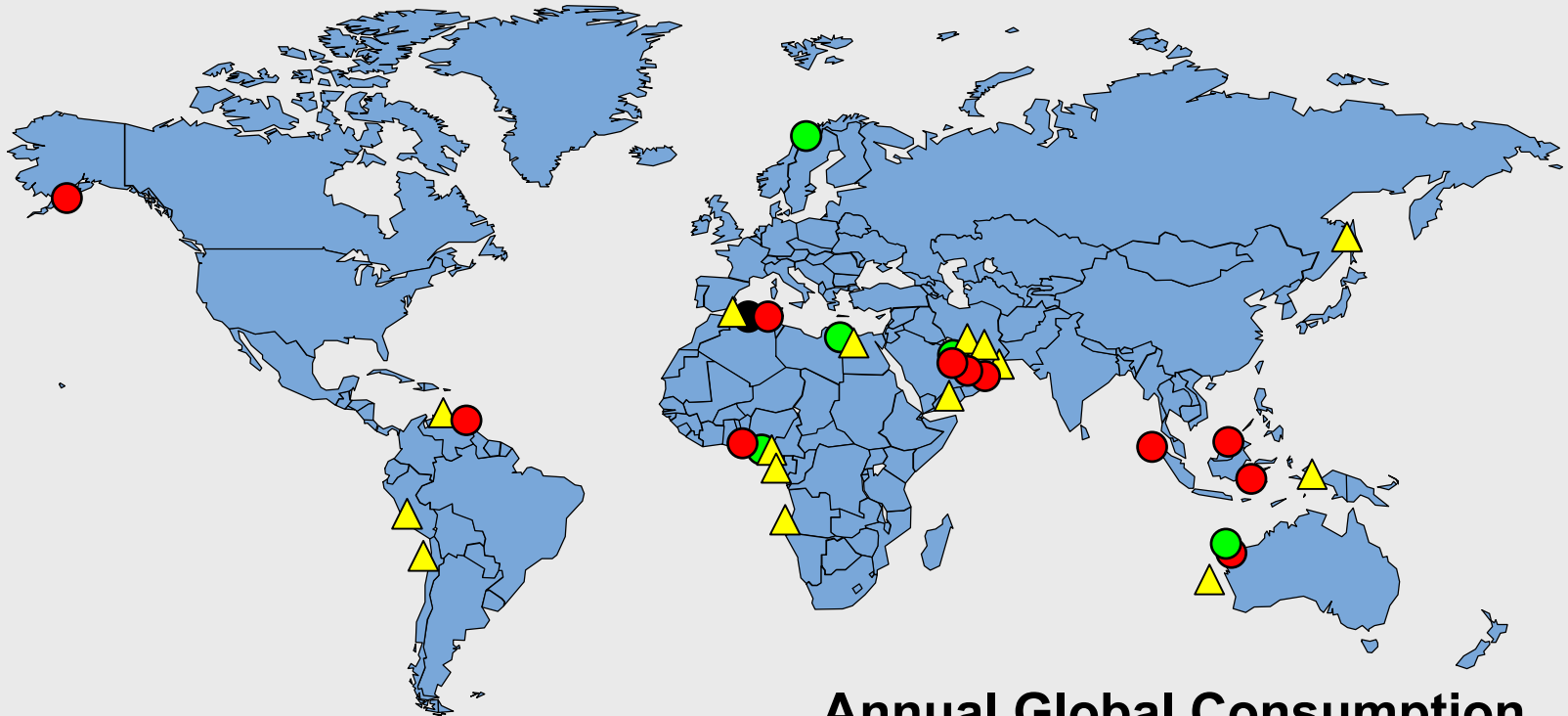
Substantial World Natural Gas Reserves

- > Large world natural gas reserves
- > U.S. natural gas imports will increase
- > International LNG shipments growing



Vast World Gas Resources Growing LNG Capacity

Global LNG Supply

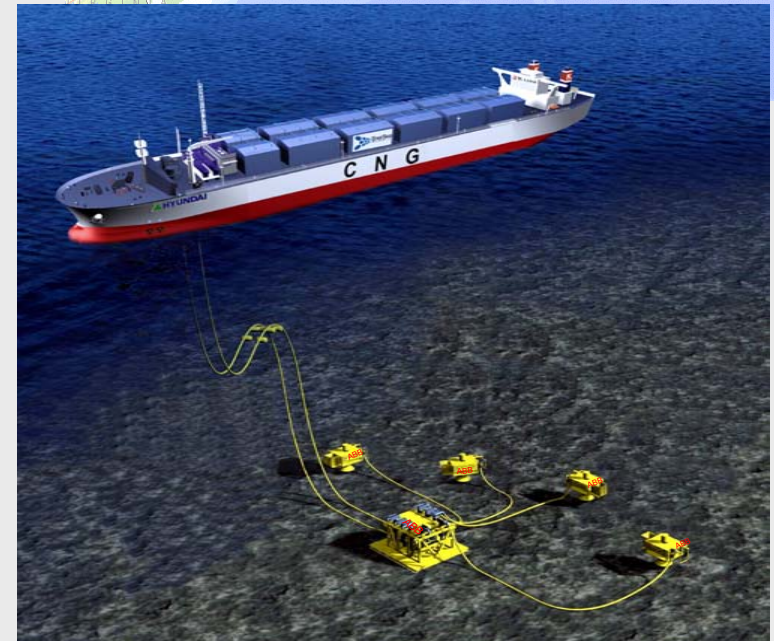
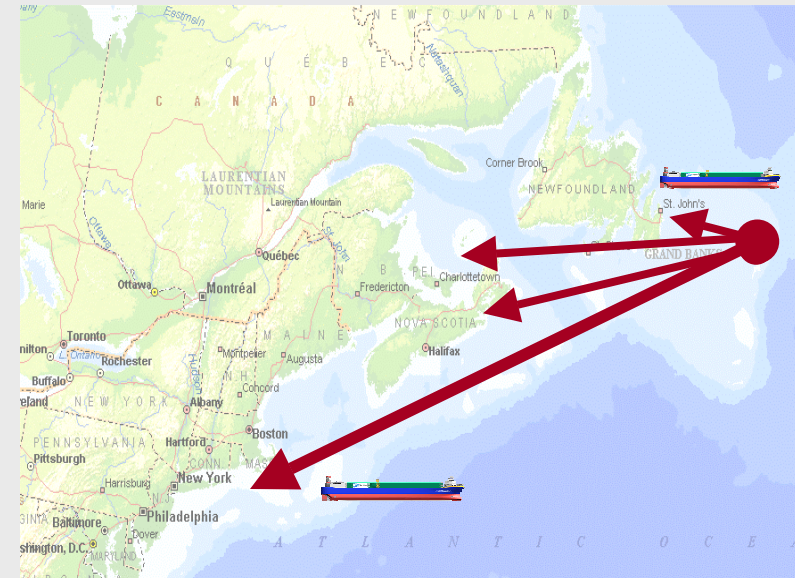


- Existing Liquefaction Plants
- Under Construction Liquefaction Plants
- ▲ Proposed Liquefaction Plants

**Annual Global Consumption
< 2% of World Proved
Reserves**

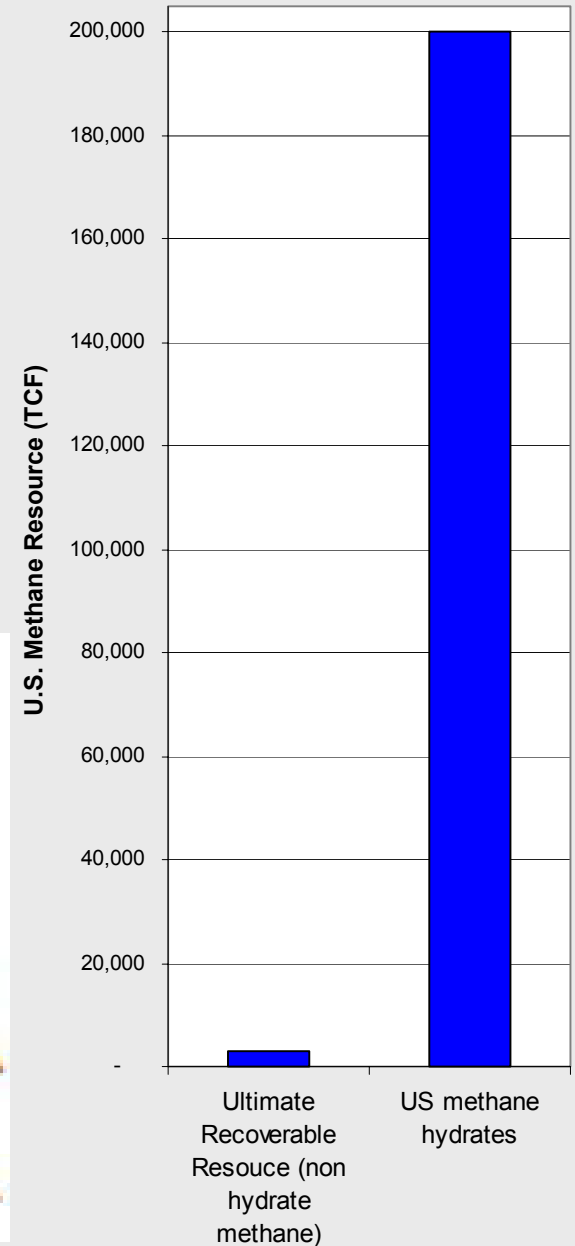
CNG Transport

- > Ocean transport of compressed natural gas being investigated
 - About 0.5 bcf per ship
 - EnerSea, others
- > Shorter regional routes
 - Caribbean/South America to U.S.
 - Canadian Atlantic Coast to U.S.



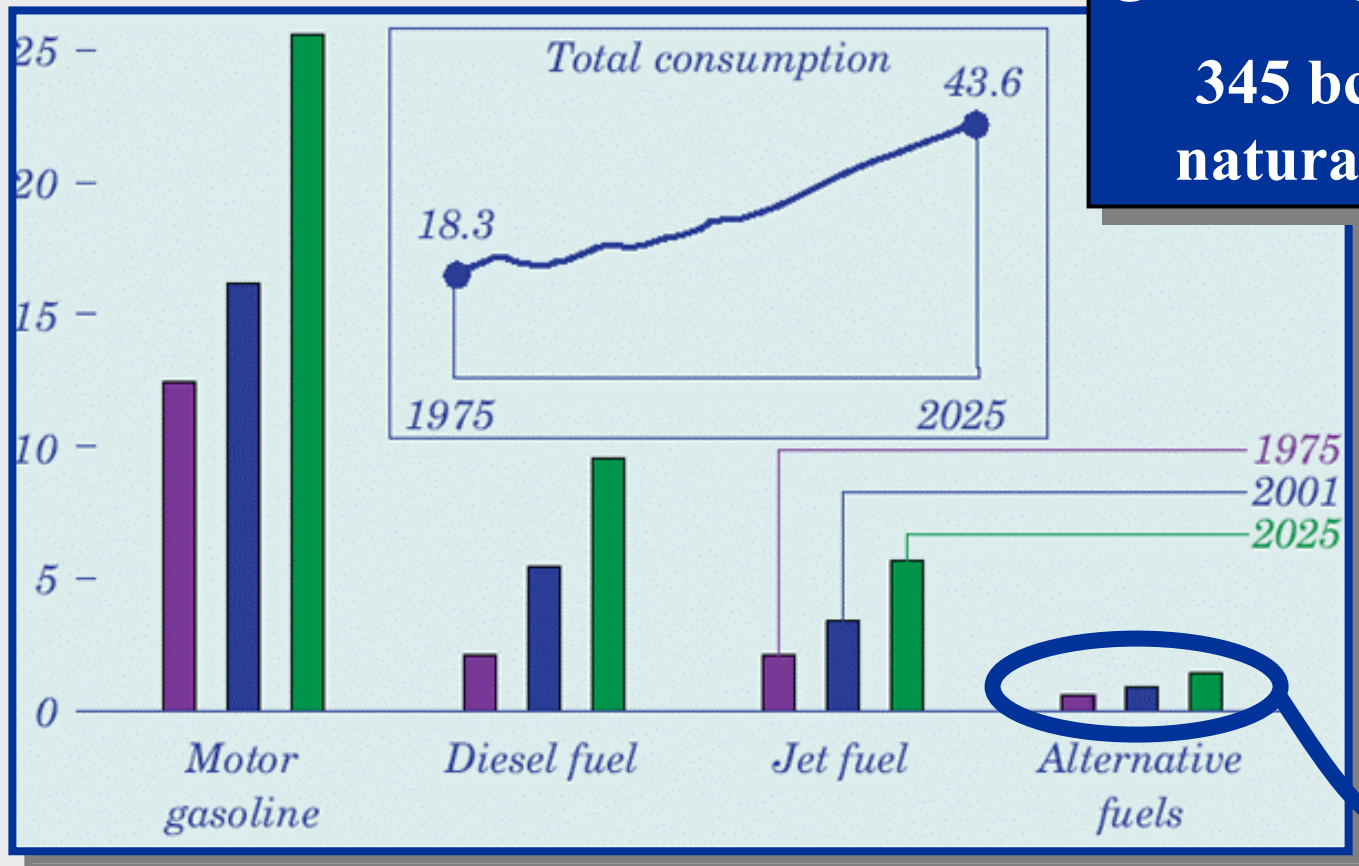
Methane Hydrates

- > Methane hydrates are major potential energy resource
 - Many times proven or ultimate resource estimates
 - U.S. has substantial methane hydrates

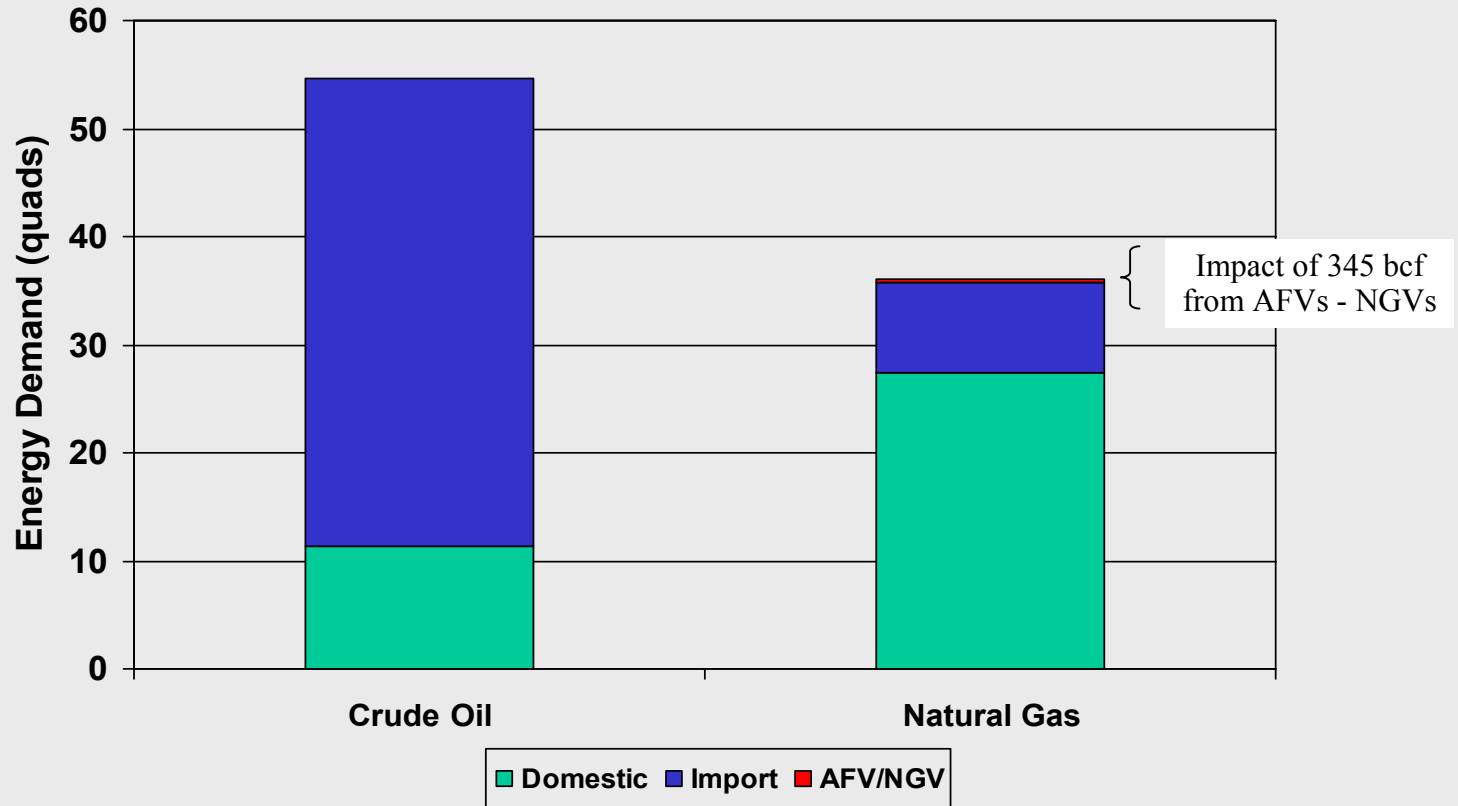


DOE Projection AFV Use in 2025

In 2025
2.8 billion
gasoline gallons
345 bcf of
natural gas



Projected Year 2025 Oil and Natural Gas Demand



Oil Import Reliance Continues To Grow



Assumes all DOE AFV projections come from natural gas.
Adapted by GTI from DOE/EIA energy projections.

Natural Gas Purchasing & Price Management

- > With growing deregulation, natural gas consumers need to become more involved
 - Take on responsibilities previously done by gas utilities
 - Be aware of choices on how to buy natural gas
 - Understand how to manage risk
- > You can do this yourself or outsource by working with an energy marketer or energy supplier

MARKET PRICING

- > The Commodity Price
 - INDEX
 - NYMEX
 - Often tied to specific location...for example, one is called “The Henry Hub” in Louisiana
 - Real time “spot market prices”
 - Futures market prices
- > Plus Delivery/Distribution Costs
 - Includes delivery, storage, etc...
 - Bundled
 - Unbundled



Natural Gas Intelligence
 NGI's Weekly Gas Price Index
 NGI's Daily Gas Price Index

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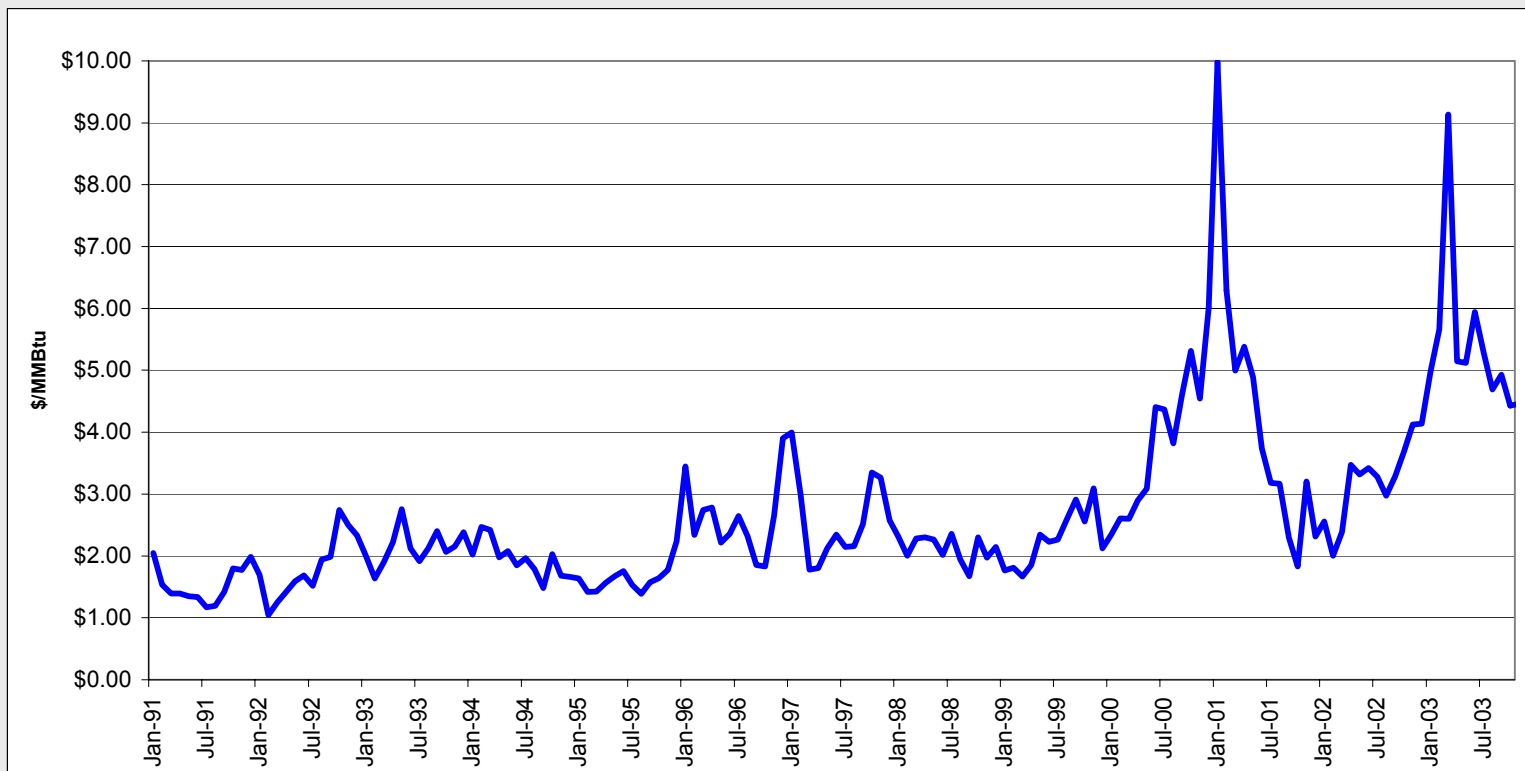
Spot Gas Prices Delivered to Pipelines

Region	October 2003 Incremental [1]		Change from		Oct [3]
	10/20 - 10/24 Range	10/24 Avg.	Prev. Week	Bidweek	Bidweek Avg.
South Texas					
Agua Dulce	- - - -	- -		4.29	- -
El Paso GTT (Valero)	- - - -	- -		4.25	- -
Florida Gas Zone 1	4.20-4.92	4.69		.30	4.39
Houston Pipe Line	- - - -	- -			- -
NGPL S. TX	4.21-4.86	4.60	-.13	.24	4.36
Tennessee	4.12-4.88	4.59	-.12	.32	4.27
Texas Eastern S. TX	4.12-4.90	4.60	-.08	.36	4.24
Transco St. 30	4.27-4.93	4.64	-.03	.36	4.28
Trunkline	- - - -	- -			4.26
Regional Avg.	4.12-4.93	4.62	-.07	.33	4.29
East Texas					
Carthage	4.24-4.89	4.64	-.13	.37	4.27
Houston Ship Channel	4.20-4.90	4.65	-.11	.40	4.25
Katy	4.18-4.91	4.64	-.14	.33	4.31
NGPL TexOk	4.20-4.90	4.63	-.15	.10	4.53
Texas Eastern E. TX	4.05-4.85	4.57	-.06		- -
Texas Gas Zone 1	4.20-4.95	4.73	-.08		- -
Transco St. 45	4.22-5.05	4.74	-.05	.34	4.40
Trunkline	- - - -	- -			- -
Regional Avg.	4.05-5.05	4.66	-.10	.32	4.34
West Texas					
El Paso Permian	4.09-4.75	4.39	-.13	.25	4.14
Northern Natural Mid 1-6	- - - -	- -			- -
Northwestern	4.04-4.51	4.30	-.25	.20	4.10
Waha	4.10-4.83	4.47	-.10	.29	4.18



NATURAL GAS MONTHLY NYMEX SETTLEMENT - \$/MMBtu

Month	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Average	5 Yr Avg
Jan		\$ 2.046	\$ 1.695	\$ 2.003	\$ 2.022	\$ 1.639	\$ 3.448	\$ 3.998	\$ 2.309	\$ 1.765	\$ 2.349	\$ 9.980	\$ 2.555	\$ 4.988	\$ 3.138	\$ 4.327
Feb		\$ 1.538	\$ 1.046	\$ 1.634	\$ 2.470	\$ 1.416	\$ 2.340	\$ 2.986	\$ 2.001	\$ 1.810	\$ 2.610	\$ 6.293	\$ 2.006	\$ 5.660	\$ 2.601	\$ 3.676
Mar		\$ 1.395	\$ 1.249	\$ 1.906	\$ 2.418	\$ 1.428	\$ 2.746	\$ 1.780	\$ 2.286	\$ 1.666	\$ 2.603	\$ 4.998	\$ 2.388	\$ 9.133	\$ 2.769	\$ 4.158
Apr		\$ 1.391	\$ 1.418	\$ 2.224	\$ 1.981	\$ 1.566	\$ 2.779	\$ 1.807	\$ 2.300	\$ 1.852	\$ 2.900	\$ 5.384	\$ 3.472	\$ 5.146	\$ 2.632	\$ 3.751
May		\$ 1.350	\$ 1.596	\$ 2.758	\$ 2.076	\$ 1.672	\$ 2.214	\$ 2.122	\$ 2.262	\$ 2.348	\$ 3.089	\$ 4.891	\$ 3.319	\$ 5.123	\$ 2.678	\$ 3.754
Jun	\$ 1.557	\$ 1.336	\$ 1.685	\$ 2.119	\$ 1.851	\$ 1.757	\$ 2.361	\$ 2.346	\$ 2.017	\$ 2.226	\$ 4.406	\$ 3.738	\$ 3.420	\$ 5.945	\$ 2.626	\$ 3.947
Jul	\$ 1.510	\$ 1.167	\$ 1.517	\$ 1.918	\$ 1.966	\$ 1.532	\$ 2.646	\$ 2.145	\$ 2.358	\$ 2.262	\$ 4.369	\$ 3.182	\$ 3.278	\$ 5.291	\$ 2.510	\$ 3.676
Aug	\$ 1.426	\$ 1.195	\$ 1.939	\$ 2.121	\$ 1.789	\$ 1.385	\$ 2.322	\$ 2.161	\$ 1.942	\$ 2.601	\$ 3.820	\$ 3.167	\$ 2.976	\$ 4.693	\$ 2.396	\$ 3.451
Sep	\$ 1.428	\$ 1.420	\$ 1.987	\$ 2.401	\$ 1.484	\$ 1.575	\$ 1.853	\$ 2.515	\$ 1.672	\$ 2.912	\$ 4.618	\$ 2.295	\$ 3.288	\$ 4.927	\$ 2.455	\$ 3.608
Oct	\$ 1.555	\$ 1.800	\$ 2.743	\$ 2.066	\$ 2.031	\$ 1.644	\$ 1.828	\$ 3.346	\$ 2.301	\$ 2.560	\$ 5.312	\$ 1.830	\$ 3.686	\$ 4.430	\$ 2.652	\$ 3.564
Nov	\$ 1.970	\$ 1.772	\$ 2.499	\$ 2.155	\$ 1.683	\$ 1.772	\$ 2.652	\$ 3.266	\$ 1.972	\$ 3.092	\$ 4.541	\$ 3.202	\$ 4.126	\$ 4.459	\$ 2.861	\$ 3.884
Dec	\$ 2.380	\$ 1.987	\$ 2.332	\$ 2.385	\$ 1.661	\$ 2.241	\$ 3.901	\$ 2.577	\$ 2.149	\$ 2.120	\$ 6.016	\$ 2.316	\$ 4.140		\$ 2.785	\$ 3.348
Average	\$ 1.689	\$ 1.533	\$ 1.809	\$ 2.141	\$ 1.953	\$ 1.636	\$ 2.591	\$ 2.587	\$ 2.131	\$ 2.268	\$ 3.886	\$ 4.273	\$ 3.221		\$ 2.440	\$ 3.156



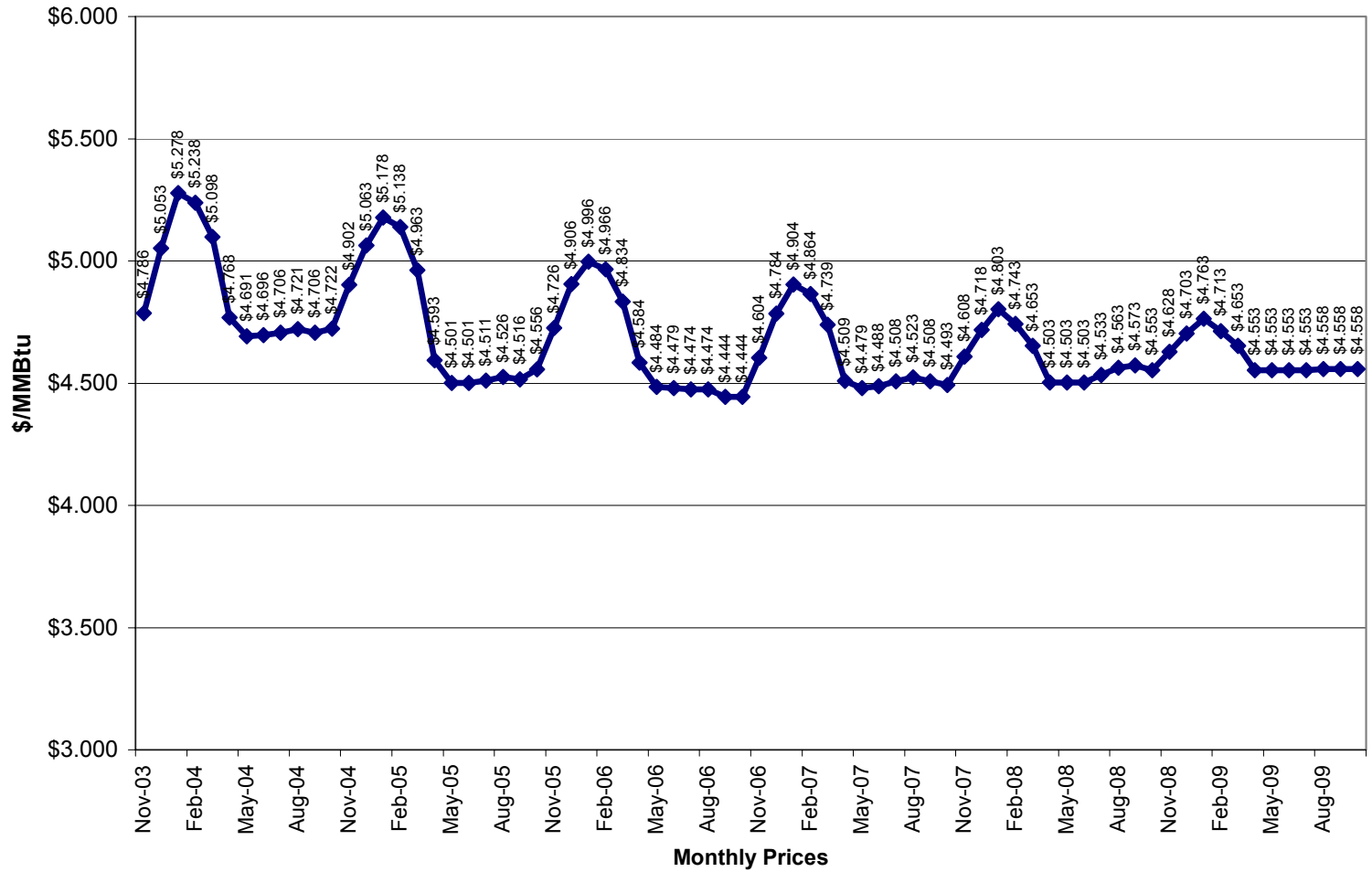
“Derivatives” and Hedging

- > Hedging is purchase or sale of a Futures or Options contract as a temporary substitute for an actual cash transaction to be made at a later date
- > A hedger offsets an anticipated future transaction in the actual market by taking a position in the Futures Market
 - This avoids the risk of price changes at a future time of anticipated need
- > The goal is to transfer the risk of price change to another market participant

Some Definitions

- > **Forward contract**: The original and most basic form of a derivative contract, a forward transaction is an agreement to buy or sell a certain quantity of an asset or commodity in the future at a specified price, time and place.
- > **Futures**. A standardized agreement to buy or sell a certain quantity of an asset or commodity in the future at a specified price, time and place. They are standardized as to the quantity, the specific underlying assets or commodities, and the time. Only the price and the number of contracts are negotiated in the trading process.
- > **Option**. An agreement that grants the options buyer the right, but not the obligation, to buy or sell an asset or commodity at a specified “strike” price on or before a certain date. A call option grants the right to buy at the specified strike price, and so it pays off if the market price for the underlying item rises above that mark. A put option grants the right to sell as the strike price and pays off when the market price falls below the strike price.
- > **Swap**. Simultaneous buying and selling of the same security or obligation. It can be an agreement in which two parties exchange interest payments based on an identical principal amount, called the notional principal amount.

Natural Gas Futures 10/24/03



Hedging By Energy Players

- > You can do this personally or “leave it to the pro’s”
- > Gas utilities and energy marketers
 - Many energy marketers (large and small) in the market
 - Some, but not all utilities, use financial hedging...more likely with larger utilities

Resource

- **National Energy Marketers Assoc.**
(www.energymarketers.com)
- **Or, consult your energy supplier**

Hedging Method (percent)	Large Utilities	Small Utilities
Futures	35	24
Options	36	4
Swaps	28	5

Source: USGAO (GAO-03-46)

Gas Utilities and Energy Marketers

- > Where the use of energy marketers is allowed, gas users have access to spot & futures prices
- > Where the gas is supplied by the utility, traditionally the cost is a moving average of historical prices. Many utilities also offer spot & fixed prices

Why Use Hedging?

- > You can use hedging to set prices and costs in line with your budget
- > Helps minimize risk of future costs being much greater than your budget plans
 - This can make you a hero if prices go up
 - However, it may require you to explain why you hedged if future prices go down
- > Main benefit of hedging is that you know & control your future costs

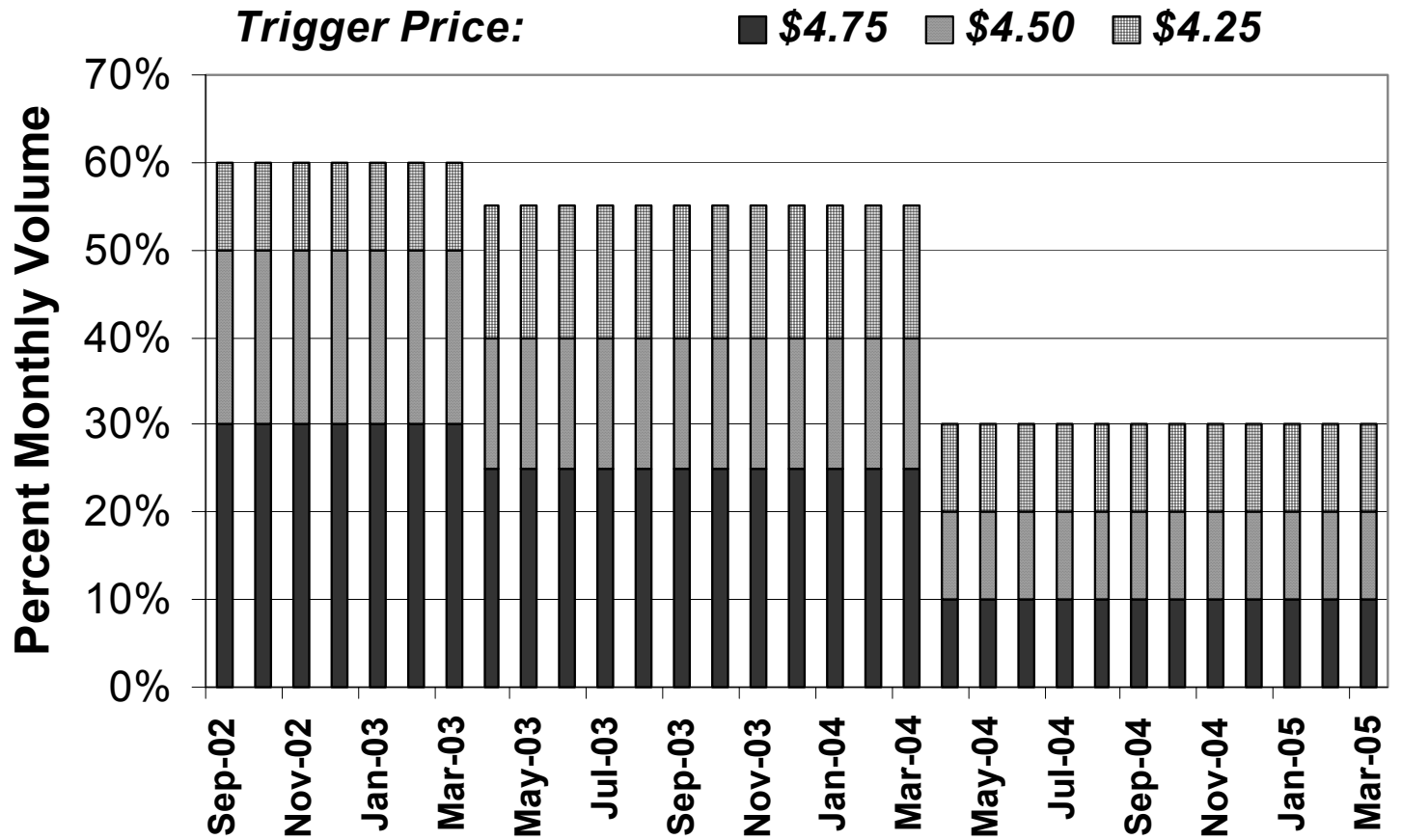
COMMODITY PRICE ANALYSIS

- > Hedging strategies benefit from knowledge of expected future trends
 - Different approaches and methodologies can be used in an attempt to forecast future prices
- > TECHNICALS – Price patterns, graphs of supply & demand functions
- > FUNDAMENTALS – Production levels, drilling rig count, weather, consumer demand

Hedging Example

- > Using a layered hedge coupled with spot market prices
- > In this example, near-term natural gas is hedged to the maximum extent
 - Balance of gas use from spot market
- > Further out hedging can be arranged as more knowledge is gained
- > Average gas cost is a blend of hedge positions and spot market prices

Layered Hedge



Summary

- > High natural gas price volatility in recent years will likely continue a few more years
 - More import LNG supplies will help with peaks
- > Short term price factors driven by supply/demand balance, weather and other considerations
- > Price risk can be addressed through hedging
- > There are adequate natural gas supplies in North America for 50-100 year period
 - Natural gas hydrates could be tremendous future resource...for next millennium?

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