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Spud, Pipe and Chill

Mapping a Secular Transition in North American Gas Markets

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In praise of heresy

"The best evidence that an assumption is mistaken is its near-universal acceptance."

Henry Linden, GRI, via Bob Frye, RFF (with liberties)

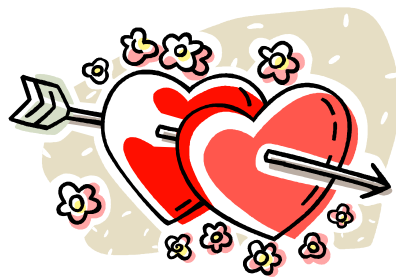
Heresy for this morning:

The pervasive belief among observers and participants in North American gas markets today that we have tripped over a major discontinuity in natural gas resource availability and price is, at best, overstated.

The will to believe is very strong

A broad consensus of political and economic interests stand to benefit from the current crisis mentality

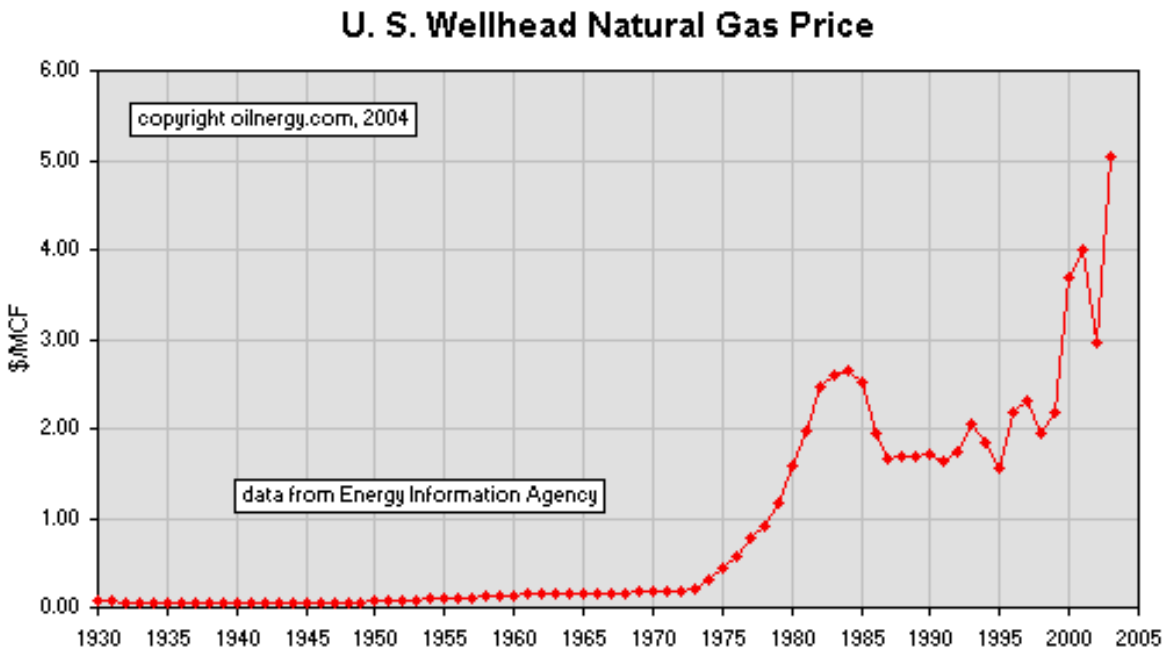
- The Bush Administration, legislators from oil & gas producing states and their industry constituents
  - Objective: conventional gas supply enhancement, industry promotion
- Alaskan politicians and, with varying degrees of enthusiasm, the Prudhoe Bay oil producers
  - Objective: gas royalties and jobs via ANGTS
- Multinational oil and gas majors
  - Objective: Foreign stranded gas liquefaction and export to US
- North American gas producers and their various advocacy groups
  - Objective: “High prices are a ***good*** thing”
- Commodity traders
  - Objective: “Volatility is a ***good*** thing.”



Why is the gas supply crisis so obvious?

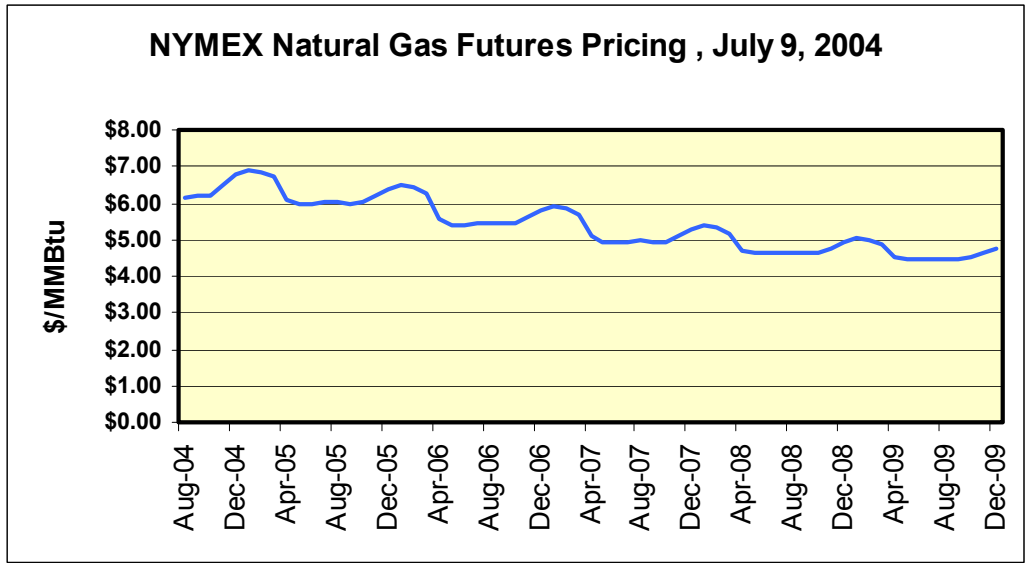
Evidence generally cited:

- The forward price curve, reflecting market sentiment
- Rapid demand growth from power generation
- The storage inventory depletion during the winter of 2002-03
- The current drilling rig count, comparable to the 2001 mini-boom that apparently did not deliver adequate new supplies

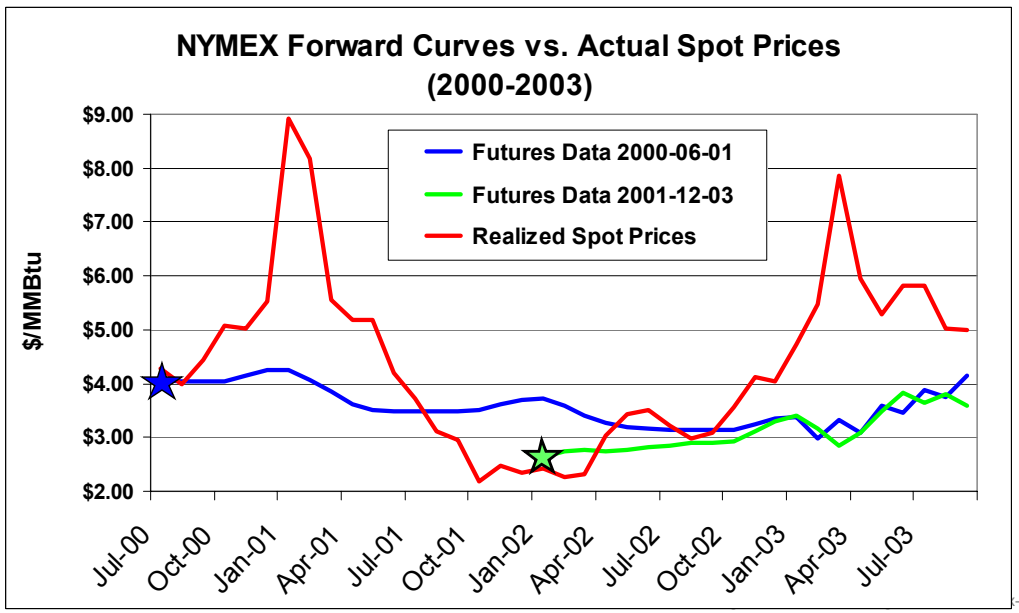


Market expectations

The forward markets reflect this belief that no near-term solution (other than minor price-based demand destruction) is available.

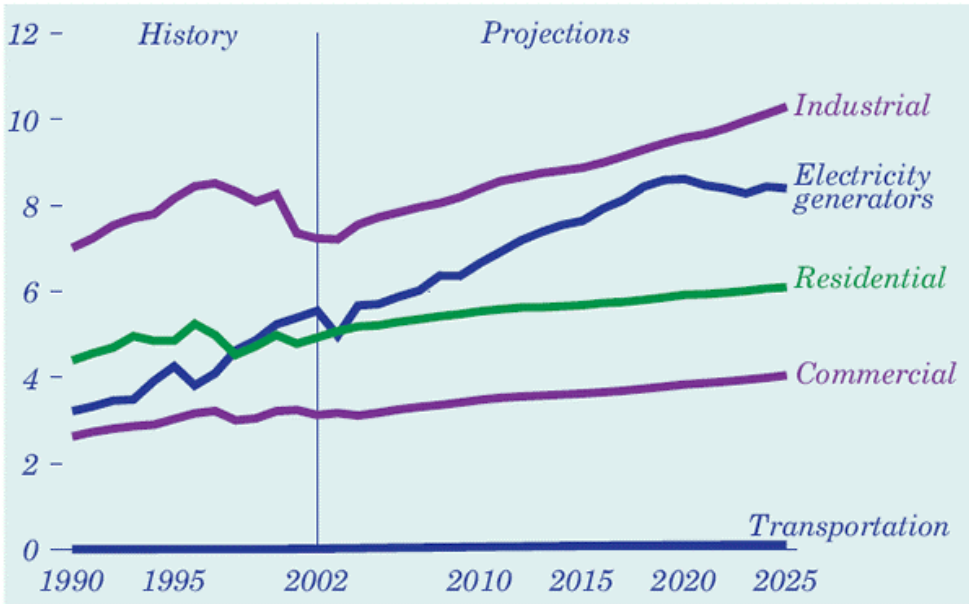


The forward markets, however, have been poor predictors of future gas price behavior

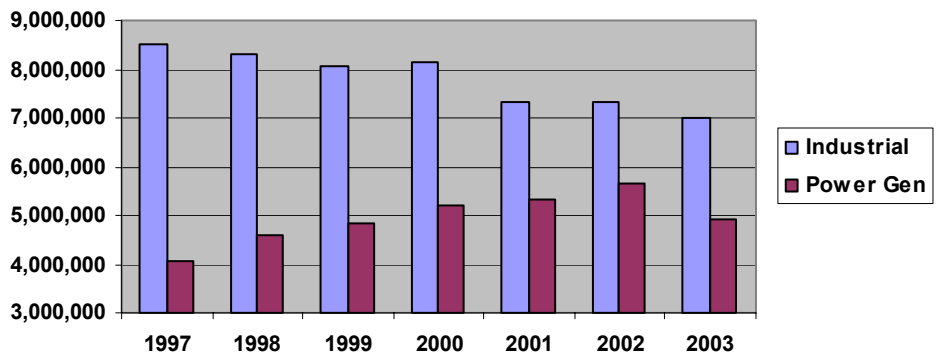


Natural gas demand growth

Historic and Projected Natural Gas Consumption by Sector, Tcf



Annual US Industrial and Power Generation Gas Demand, 1997-2003 (MMcf)



The EIA's most recent demand forecast documents the recent decline in industrial and power generation demand, but assumes an immediate resumption of previously-anticipated growth trends.

There is some recent evidence of demand-price elasticity, however.

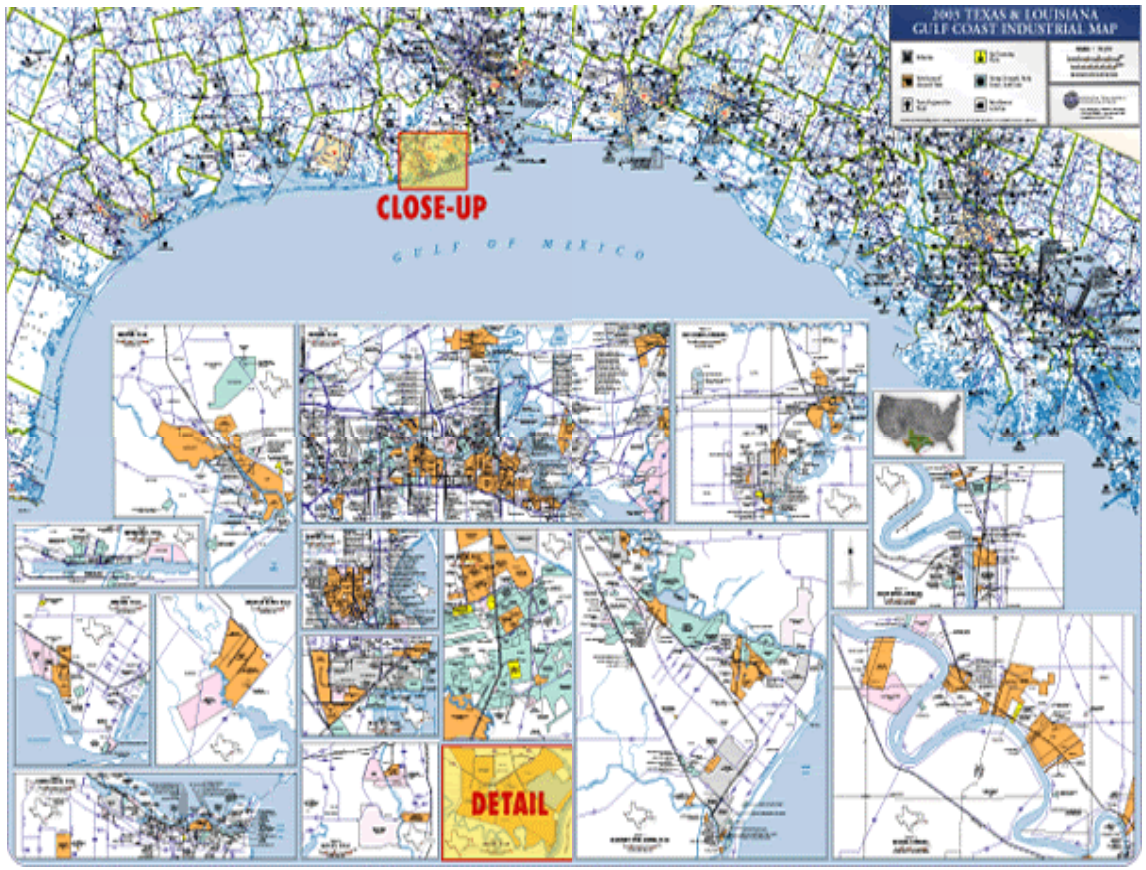
Source: USDOE Energy Information Administration

Anticipated industrial demand growth bears scrutiny

If the price outlook is correct, US industries premised on abundant, cheap gas have entered period of secular decline. In particular, the huge US Gulf Coast petrochemical industry, premised on freely available $2.00/MMBtu natural gas, has seen its peak.

- **Future capacity expansions will follow cheap gas supplies in the Middle East, West Africa, Australia, etc.**
- **Dow, Dupont and other chemical firms have already announced their intent to shift petrochemical operations to offshore locations offering cheap hydrocarbons**
- **No exodus, just gradual migration through expansion and capital stock turnover**

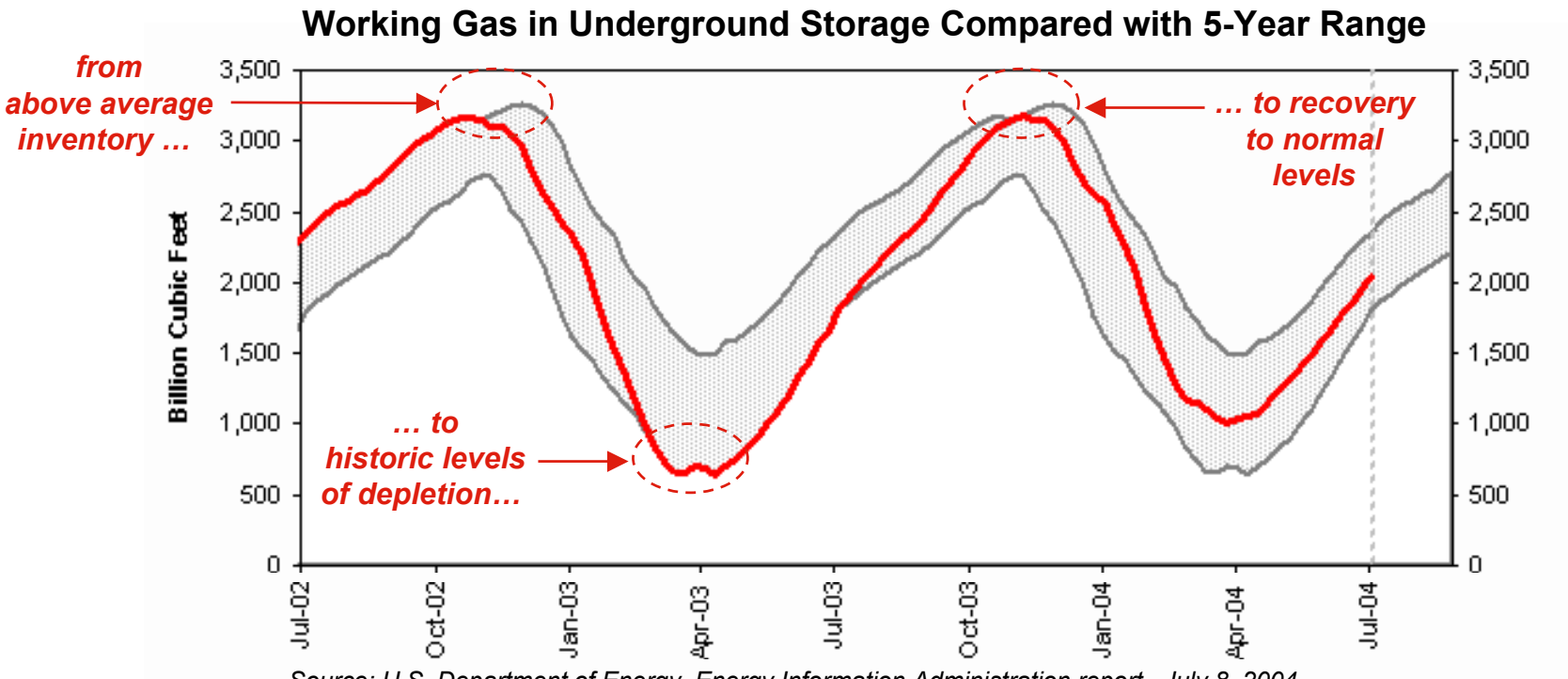
US Gulf Coast Petrochemical Infrastructure



Source: Design Technics Corporation, 2003

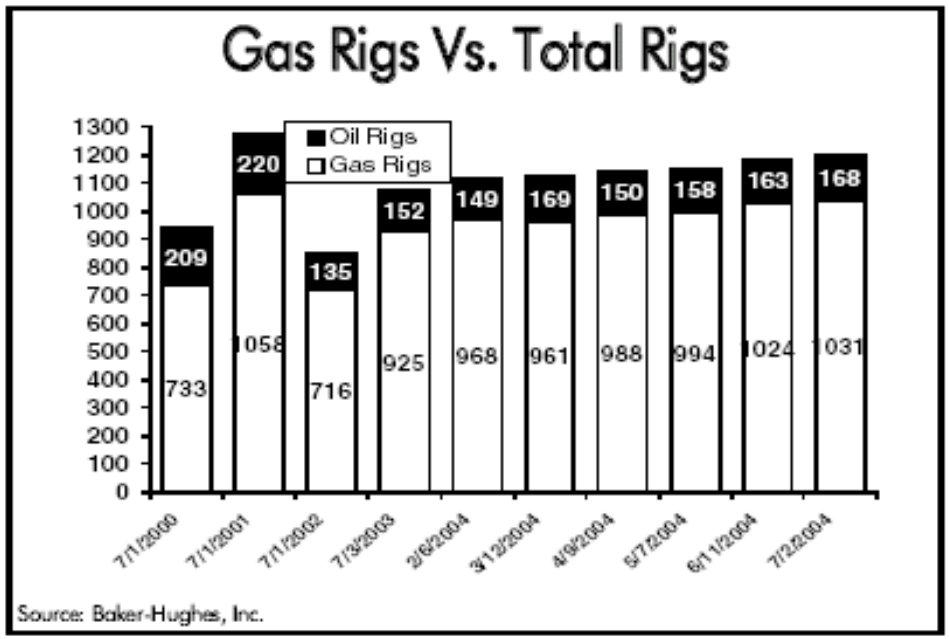
Gas storage statistics have their complications

The 2002-2003 storage drawdown had at least as much to do with the concurrent energy sector financial liquidity crisis as with wellhead deliverability's failure to keep up with demand.



Source: U.S. Department of Energy, Energy Information Administration report , July 8, 2004

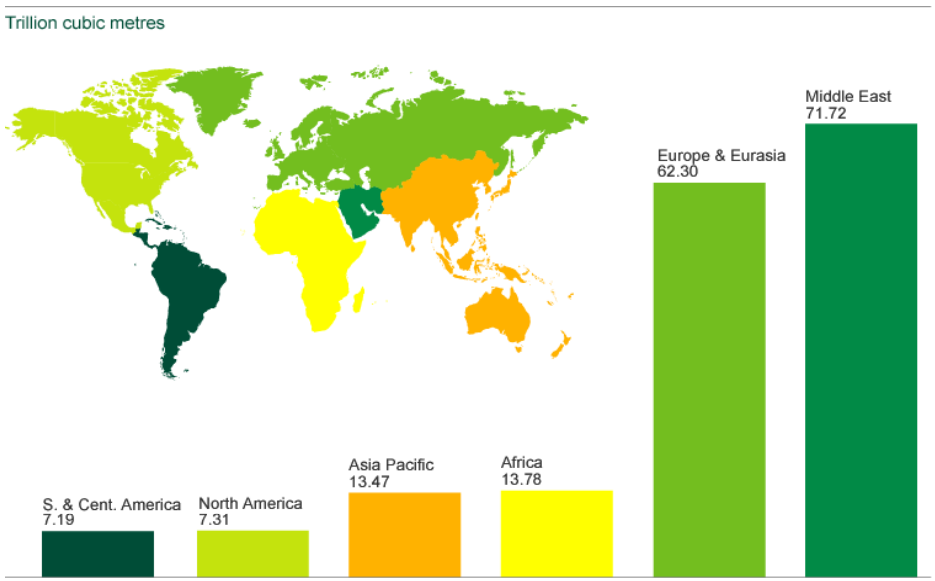
Yeah, but what about the rig count?



That's a whole other story.

A change of focus

US gas deregulation in the 1980s unleashed capital and technical innovation to exploit defined gas producing basins. By the late 1990s, the international oil majors with large US holdings realized an evolving set of circumstances compelled a change in capital allocation priorities.

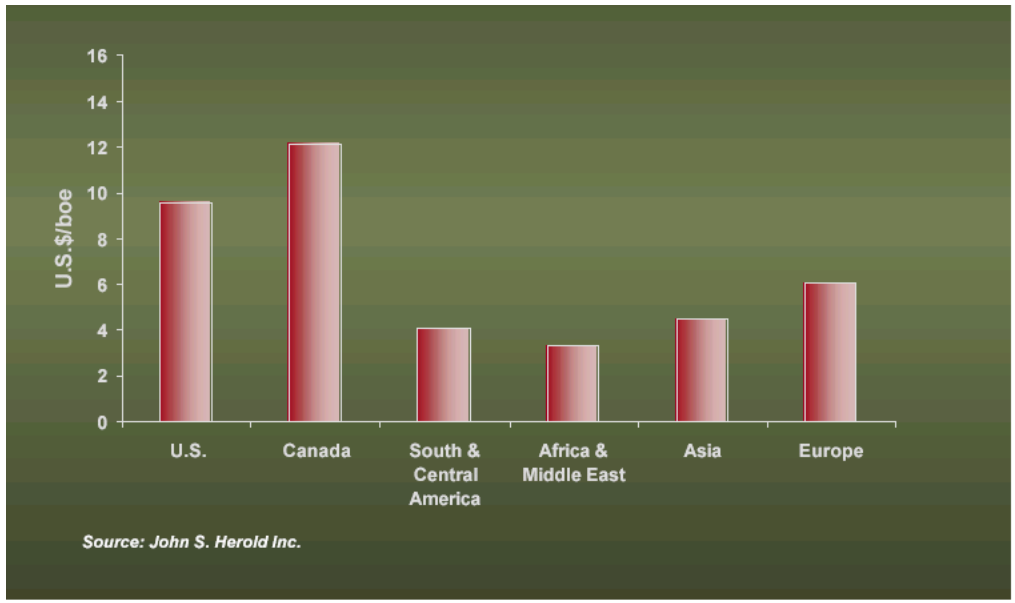


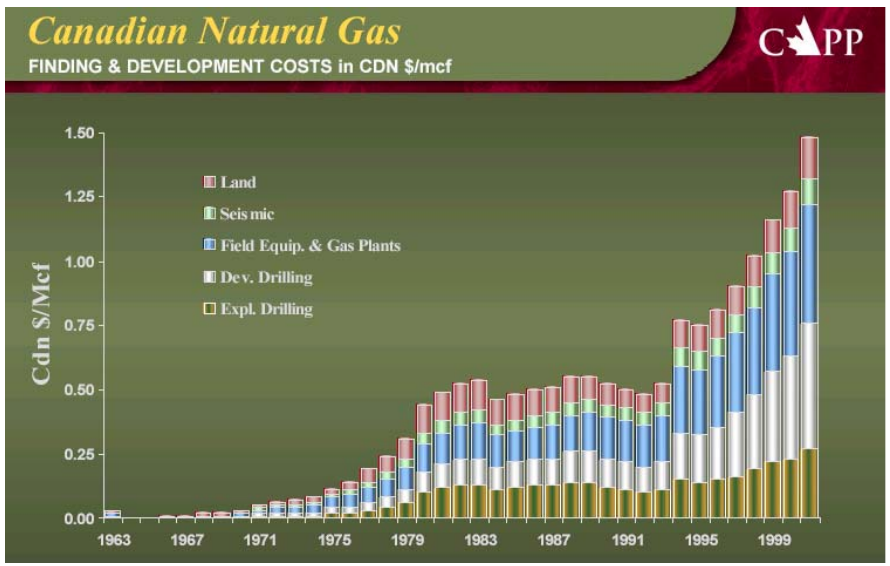
Globally, recent estimates of technically recoverable resources stand at some 20,000 Tcf, with 6215 Tcf of proved reserves on the books already.

BP Statistical Review of World Energy 2004 © BP

Finding and development costs were rising

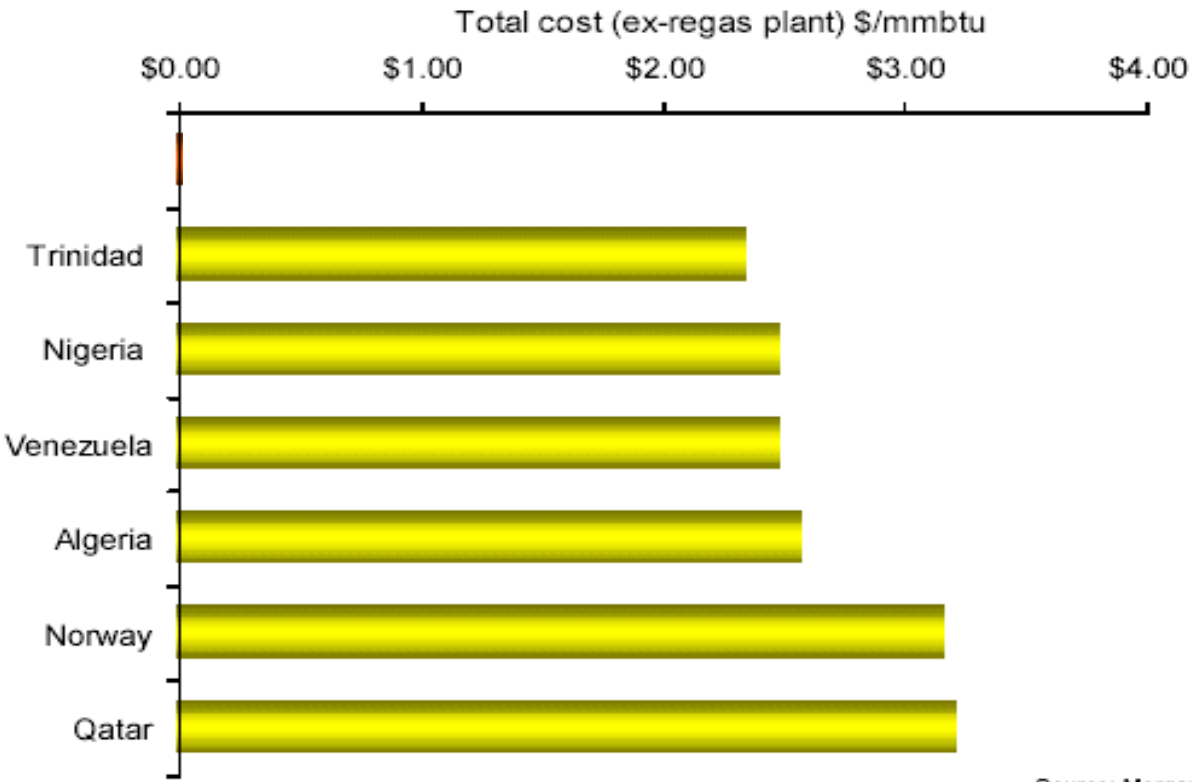
There was and is a wide and growing disparity in the regional unit cost of finding and developing new gas production around the world





LNG production and transportation costs were falling

LNG could now supply North American gas requirements at reasonable price risk.

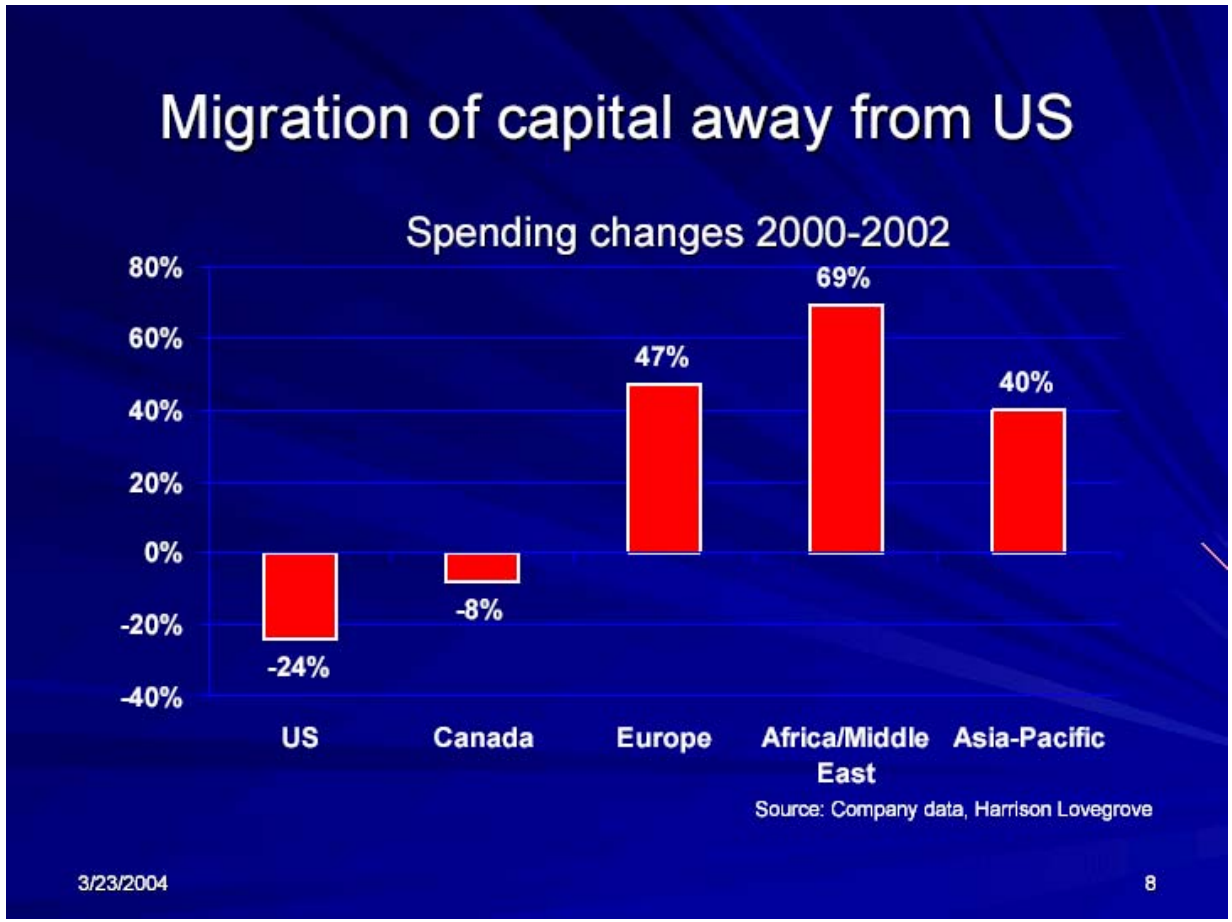


Source: Morgan Stanley, June 2003

Variability of delivered cost of LNG into the North American gas transmission network is primarily due to transportation distances, but liquefaction technology, gas stream composition, government royalties and field development costs all have a role.

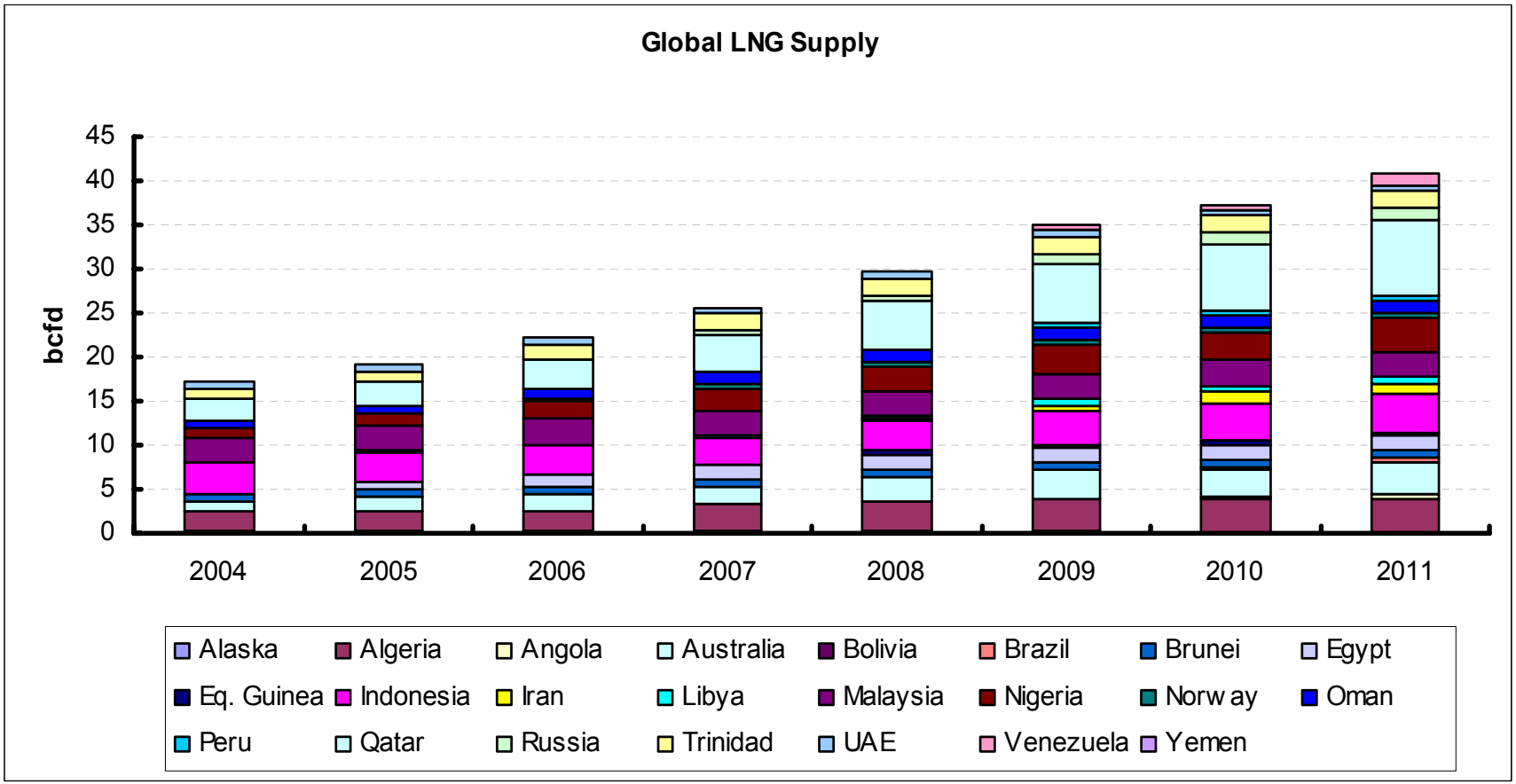
Something had to change

For the international majors with large stranded gas assets around the world, it made more sense to divert capital away from traditional North American E&P toward building the logistical infrastructure to monetize those assets in Asian, European and North American gas markets – and divert they did.



This capital commitment to global gas is substantial

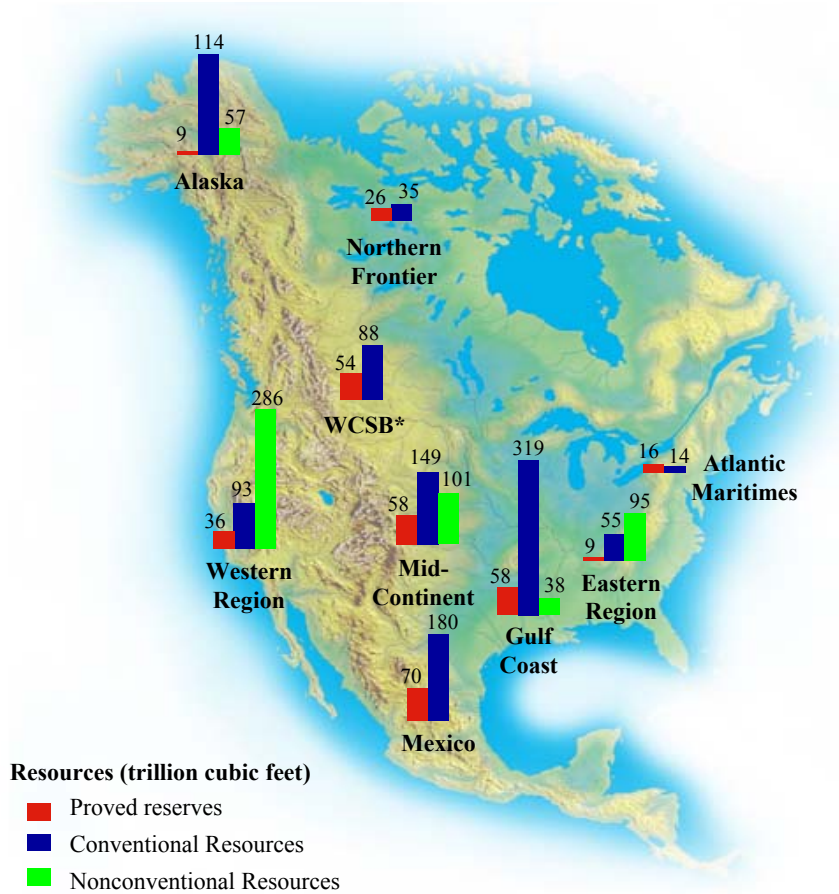
Each incremental Bcf/d of LNG production and delivery capacity represents an incremental capital cost of US$3-5 billion.



Source: Wood Mackenzie

North American gas resources did not disappear

North American Natural Gas Resource Estimates by Supply Region



* WCSB = Western Canadian Sedimentary Basin

Cheap and abundant gas reserves are getting harder to find. However, there remain plenty of recoverable reserves to be developed and produced if the price is right.

- The regional estimates at left indicate 293 Tcf of proven reserves and about 2,000 Tcf of technically recoverable resources
- Recent updates of technically recoverable reserves for the U.S. Rocky Mountain states alone range from 225 to 383 Tcf (below)

Assessment Agency	Technically Recoverable Resources	Proved Reserves	Additional Technically Recoverable Resources		
			New Fields/ Reserve Growth	Tight Gas/ Shales	Coalbed Natural Gas
PGC (2002)**	288	50	175	N/A	63
NPC (1999)*	382	36	155	137	54
EIA (2003)	383	50	52	225	56
USGS (2002)***	226	43	13	127	43

* *Assumes advanced technology as of year 2010; coalbed natural gas resources include low Btu gas resources.*

** *Combines tight gas, gas shales, and conventional gas.*

*** *Includes only five gas basins in the Rocky Mountain States (Paradox-San Juan, Uinta-Piceance, Greater Green River, Powder River, and Montana Thrust Belt).*

Source: U.S. Department of Energy Office of Fossil Energy, *Rocky Mountain States Natural Gas,* September 2003.

Sources: US Potential Gas Committee, Canadian Gas Potential Committee.

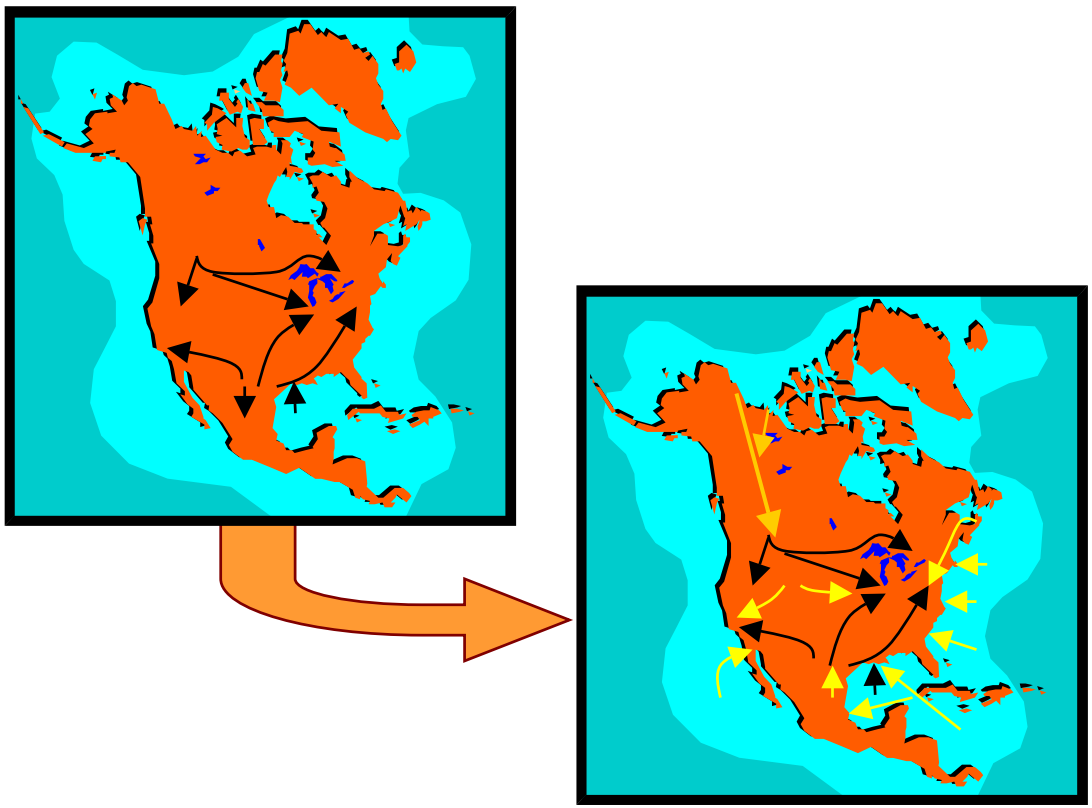
The passing of the torch has not been seamless, however

Independent producers, with their lower overheads and more modest definition of an “elephant”, are now aggressively purchasing “retired” acreage and one another to build critical mass in producing basins. Expenditures on North American exploration and development among the independents were up 15-20% in 2003 and, from preliminary reports, are to likely be up a similar amount in 2004.

We are witnessing the hiccups of a structural transition in the business of North American natural gas supply, not the arrival of local resource exhaustion, unavoidable shortages and inexorably rising costs.

The ongoing shift in North American gas supply

Although the North American gas crisis is overstated and self-correcting through normal price-motivated industry mobilization, some things have changed.

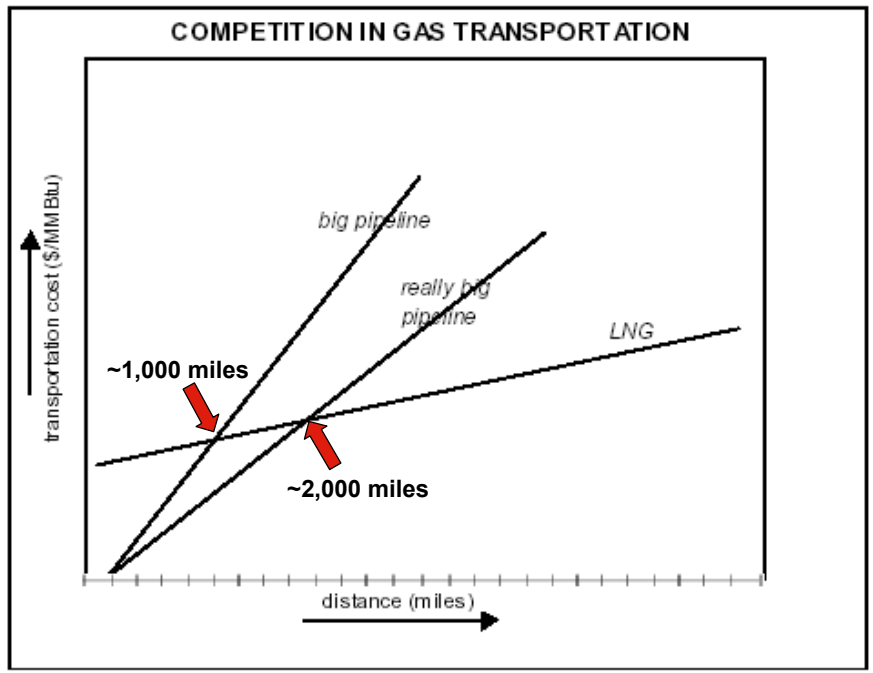


- **We have left the world of $2.00 gas – adequate reserve replacement will require:**
  - **Deeper wells**
  - **More remote drilling objectives**
  - **Supplemental LNG resources**
  - **New pipeline and storage infrastructure**
  - **More cost per unit for new flowing supplies**
- $3.00 - $4.00 should do quite nicely, thank you

Appendix: Five-minute LNG short course

What is LNG?

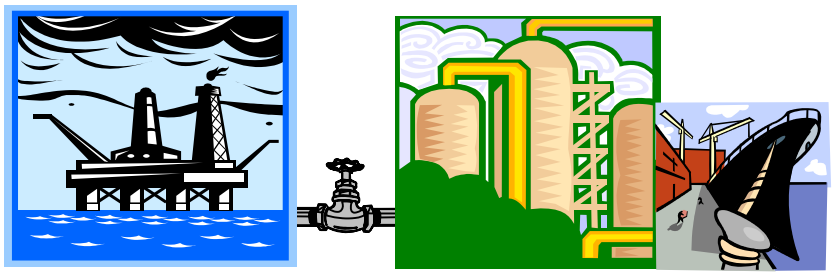
- Liquefied natural gas (LNG) is simply natural gas in its liquid phase
  - Think water vs. steam
- Underlying economics of LNG manufacture and transportation:
  - One cubic foot of natural gas = ***1,000 Btu***
  - One cubic foot of LNG = ***600,000 Btu***
  - Energy concentration vastly *reduces gas transportation costs* over long distances
  - Problem: gas needs to be cooled to ***-260 Fahrenheit*** before it condenses to liquid phase, which is costly
  - Application: use liquefaction-transportation process to monetize only ***stranded gas assets***
    - Stranded gas assets are large gas fields located far from any significant commercial market, e.g., Qatar, Nigeria, Alaska North Slope



Source: U.S. Department of Energy

LNG industry description and cost structure

The LNG industry produces and liquefies natural gas in remote locations, transports the LNG to major gas markets in Europe, Asia and North America, stores and then regasifies the LNG for ultimate redelivery to gas consumers.



Exploration & Production

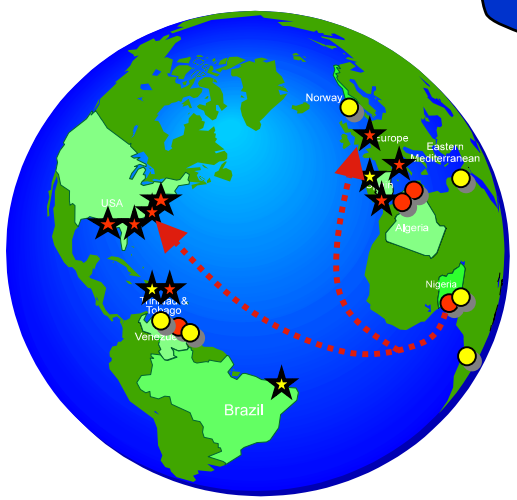
$0.50-$1.00/MMBtu

Liquefaction

$0.80-$1.20/MMBtu

Shipping

$0.40-$1.00/MMBtu

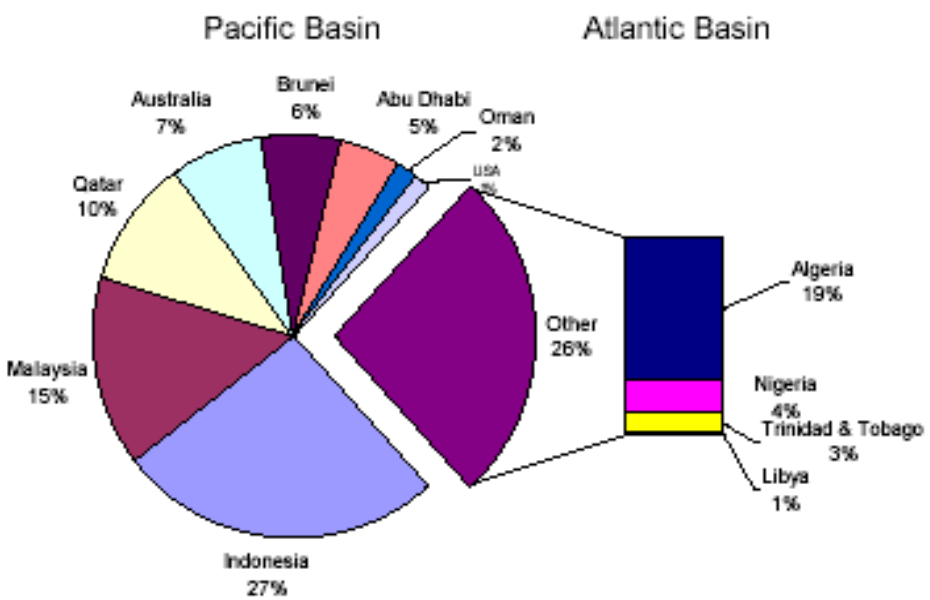


Storage & Regasification

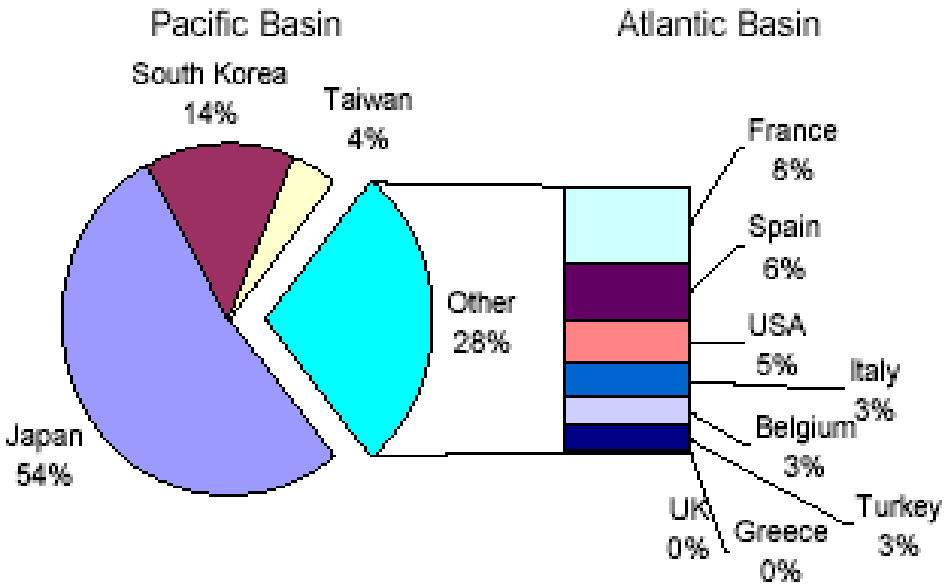
$0.30-$0.50/MMBtu

LNG Supply and Demand

LNG Producers



LNG Consumers



Helpful energy conversion factors

Natural Gas & LNG Energy and Volume Conversion Factors

From \ To	billion cubic metres NG	billion cubic feet NG	million tonnes oil equivalent	million tonnes LNG	trillion British thermal units	million barrels oil equivalent
	Multiply by					
1 billion cubic metres NG	**1**	**35.3**	**0.9**	**0.73**	**36**	**6.29**
1 billion cubic feet NG	**0.028**	**1**	**0.026**	**0.021**	**1.03**	**0.18**
1 million tonnes oil equivalent	**1.111**	**39.2**	**1**	**0.805**	**40.4**	**7.33**
1 million tonnes LNG	**1.38**	**48.7**	**1.23**	**1**	**52**	**8.68**
1 trillion British thermal units	**0.028**	**0.98**	**0.025**	**0.02**	**1**	**0.17**
1 million barrels oil equivalent	**0.16**	**5.61**	**0.14**	**0.12**	**5.8**	**1**

Units of Measure

1 metric tonne = 2204.62 lb. = 1.1023 short tons

1 kilolitre = 6.2898 barrels

1 kilolitre = 1 cubic metre

Source: BP Statistical Review of World Energy 2003.