The Solutions Network

Rochester, New York

Future Trends in Natural Gas

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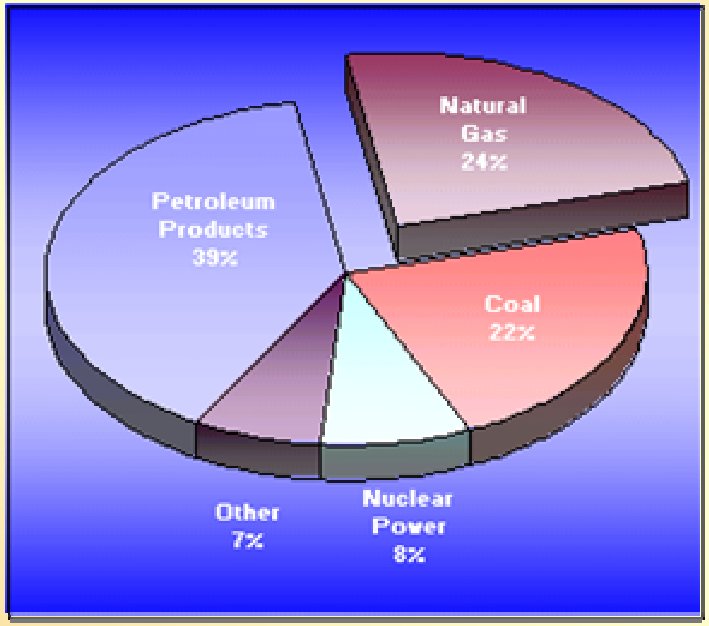
Overview

- Prices have tripled over the past 2 ½ years
- Just tip of the iceberg
- Expect:
  - Sustained higher prices
  - Periodic severe price spikes
  - Potentially severe shortages
- As Alan Greenspan repeatedly has emphasized, one of the most serious problems facing U.S. economy
  - No easy or quick solution
  - Current decline in prices just temporary reprieve
- Will impact electricity markets just as significantly as natural gas
- Hedging strategies key

Quick Primer

Pivotal Fuel

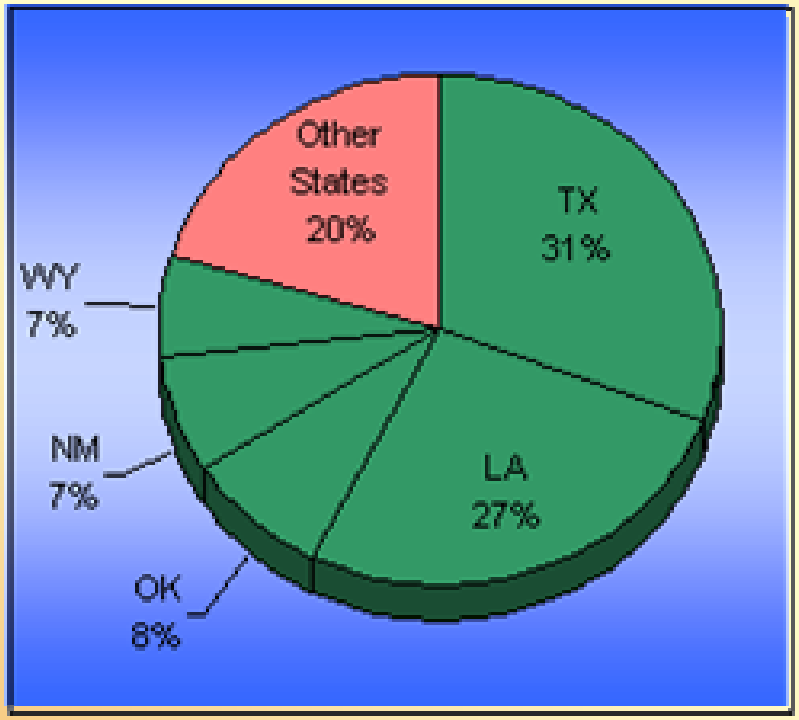
- Key component of U.S. energy supply



- Has been fuel of choice to meet expanding needs of:
  - Residential sector
  - Power industry
  - Manufacturers

Not like Oil

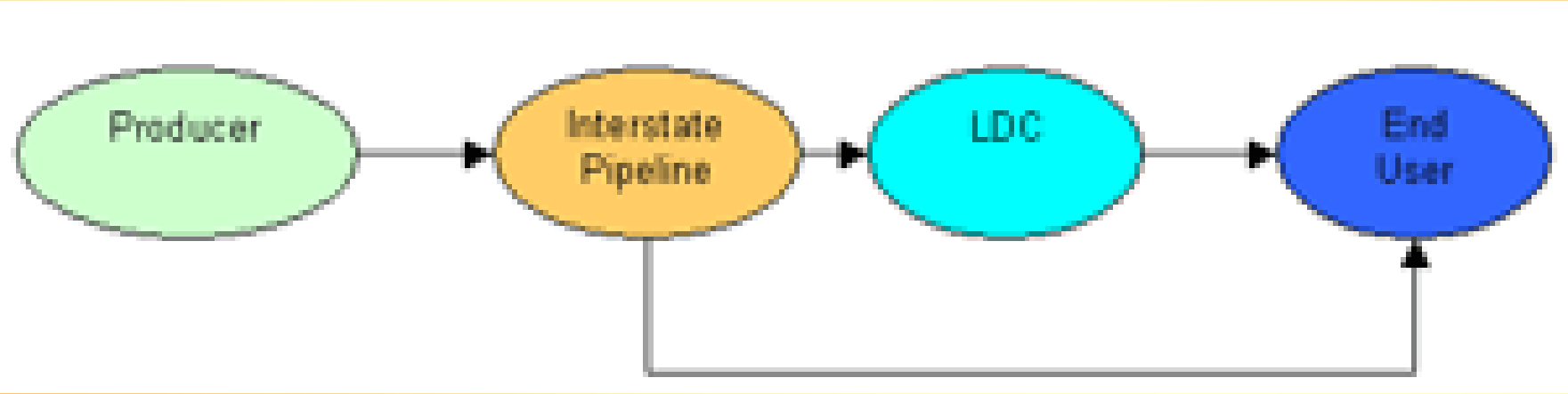
- 97% of current supply from North America
- 15-16% form Canada
  - Remainder from U.S



Delivery System

- Delivered to end-users over complex network of pipelines

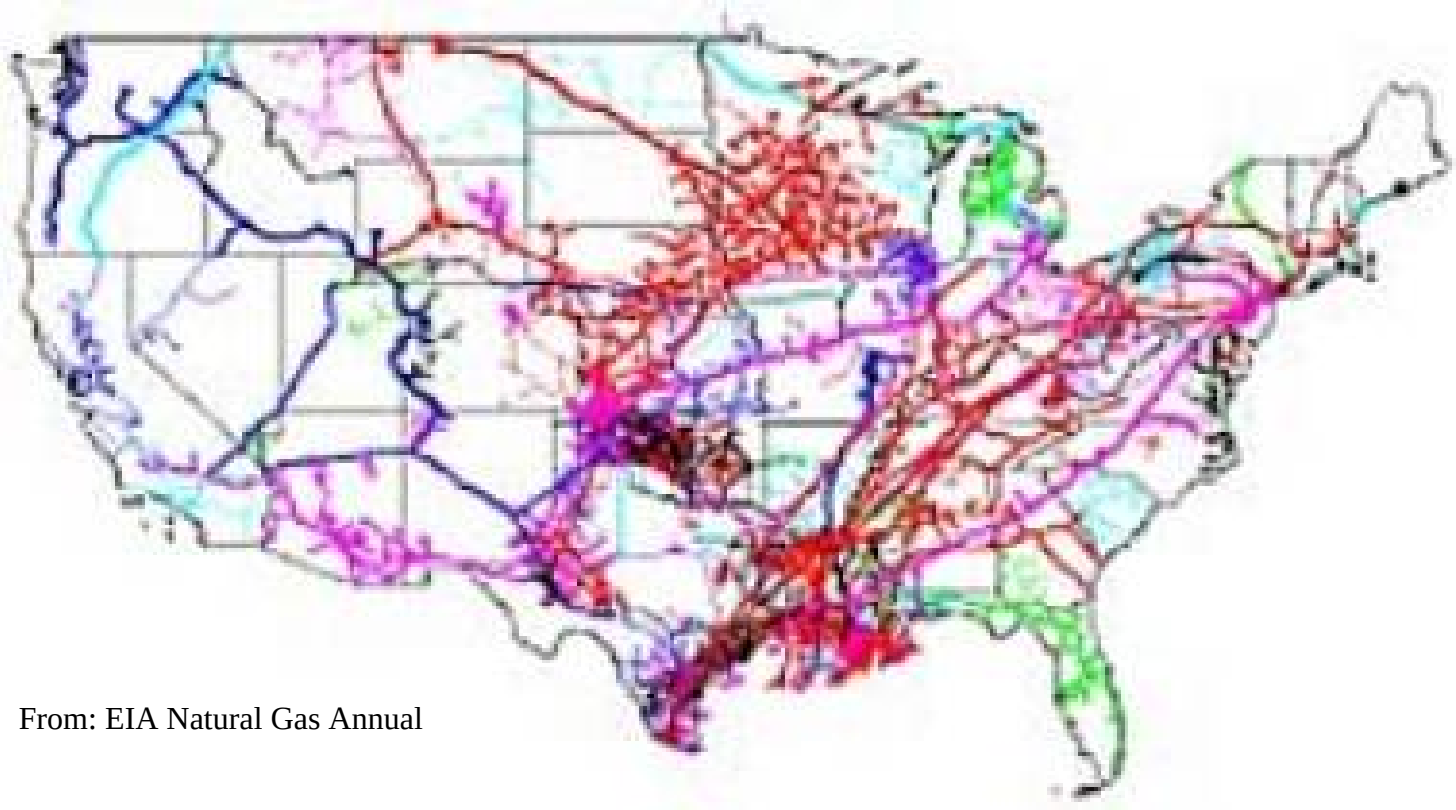
Delivery Chain



- 300,000 miles of interstate pipelines
- 1,000,000 miles of local distribution lines

Delivery Service Regulated

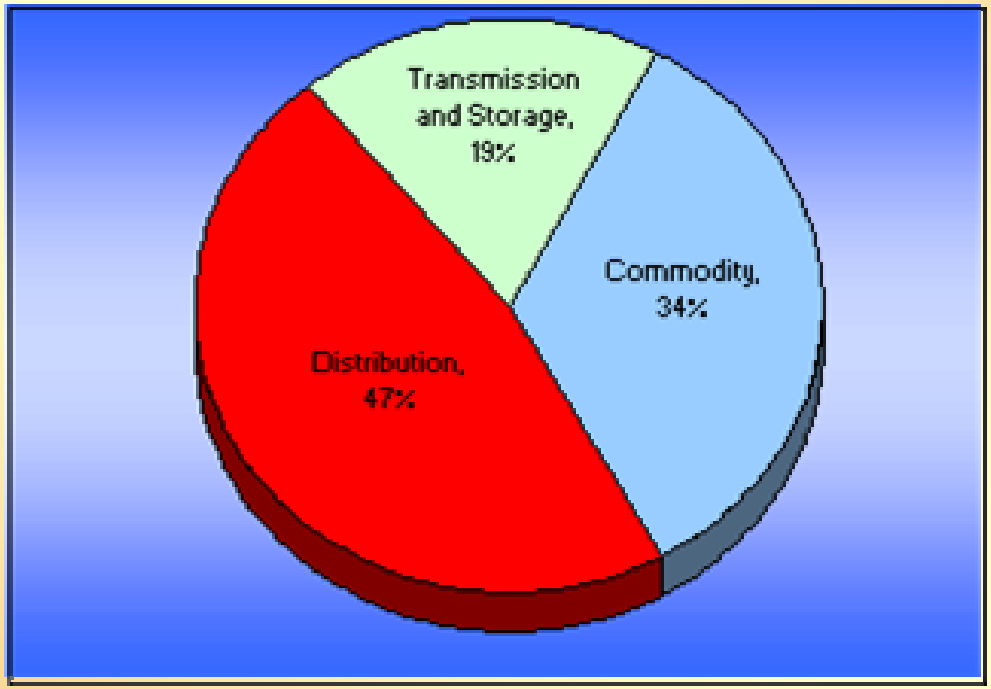
- Interstate pipeline service regulated by FERC



Service to Consumers

- Local Delivery Service regulated by state Public Utility Commission's (PUC's)

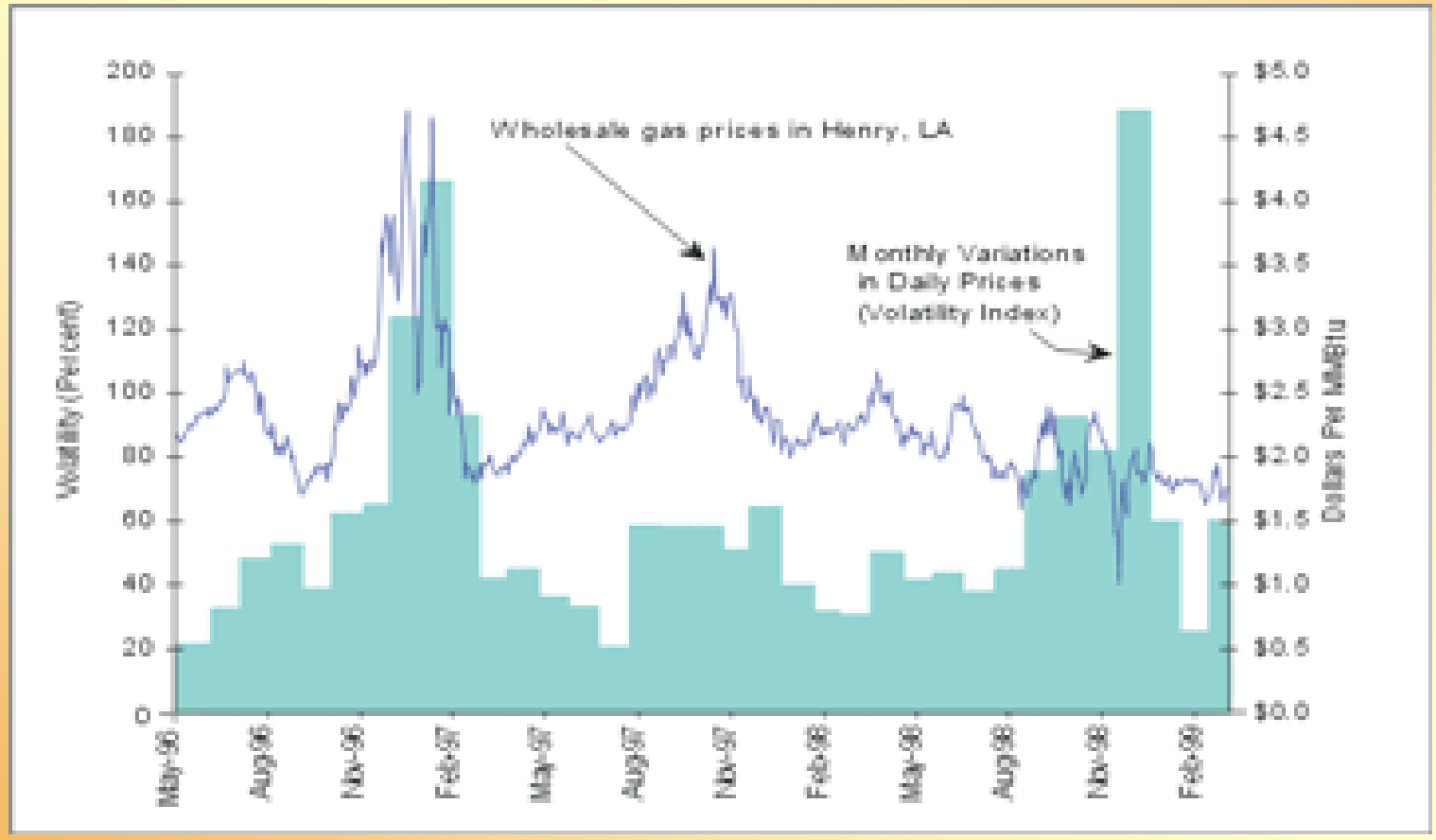
Components of Rates



- Larger users often able to buy commodity directly

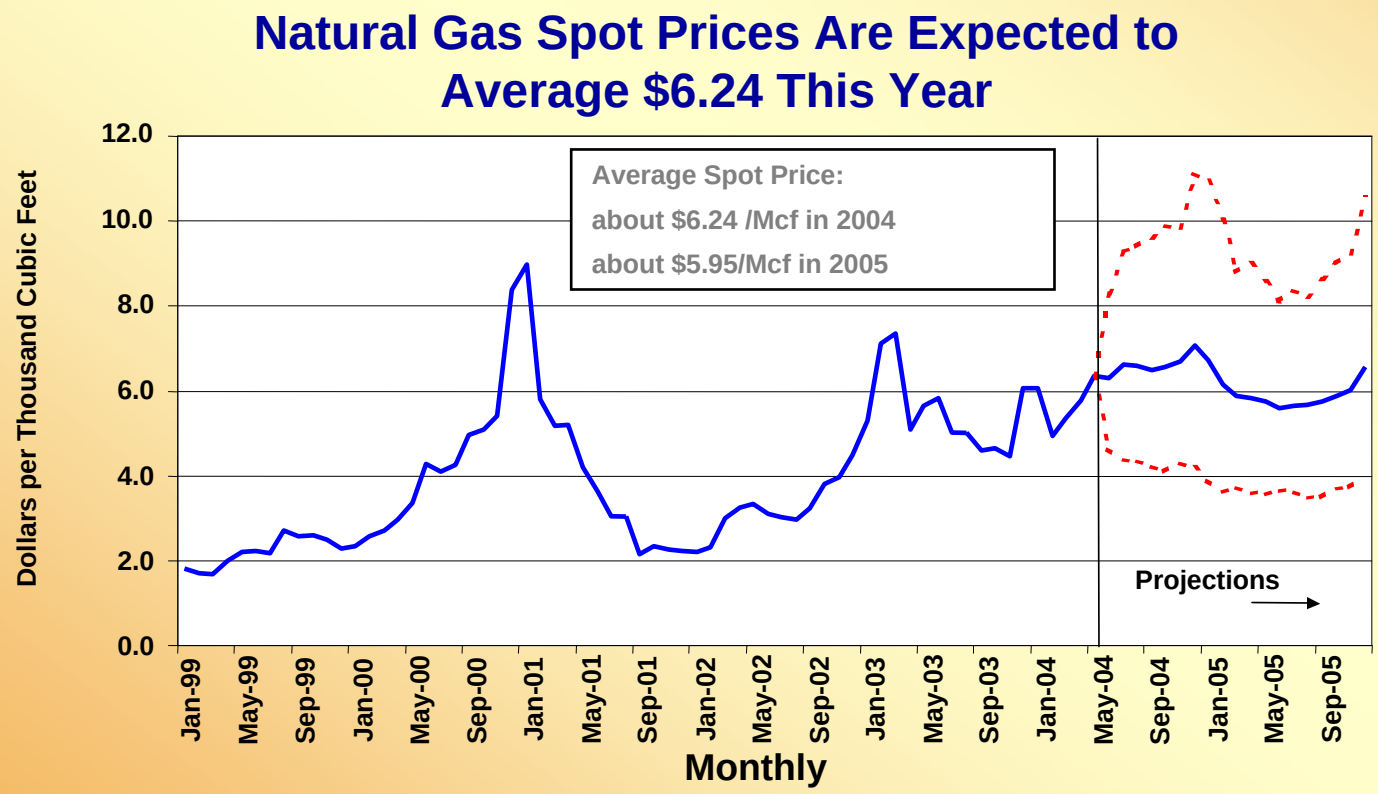
Tremendous Price Volatility

- Energy prices historically among most volatile of all commodities
  - Natural gas second only to electricity



Volatility Increasing Rapidly

- Recent Energy Information Agency (EIA) forecasts confirm



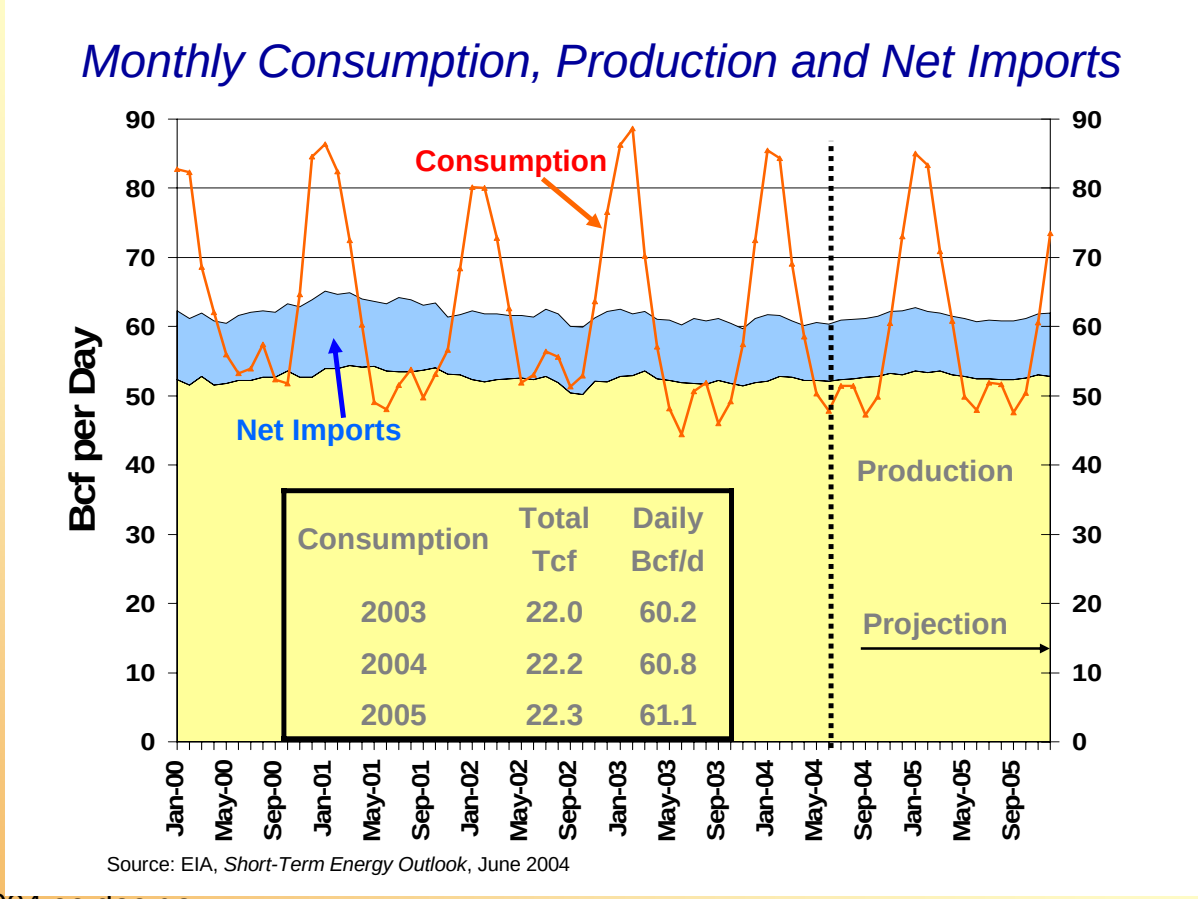
Weather Driven

- Highly sensitive to weather
  - Difficult to predict with confidence even a few days in advance

Hotter than Normal Summer?

Storage Cycle

- Consumption Fluctuates significantly by season
  - Production does not

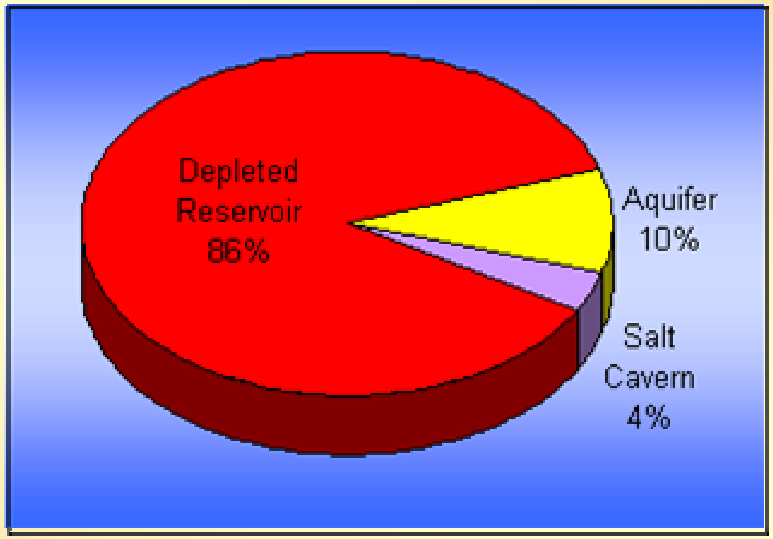


Solution = Underground Storage

- Approximately 3,450 BCF of Capacity
  - Roughly 15% of annual demand

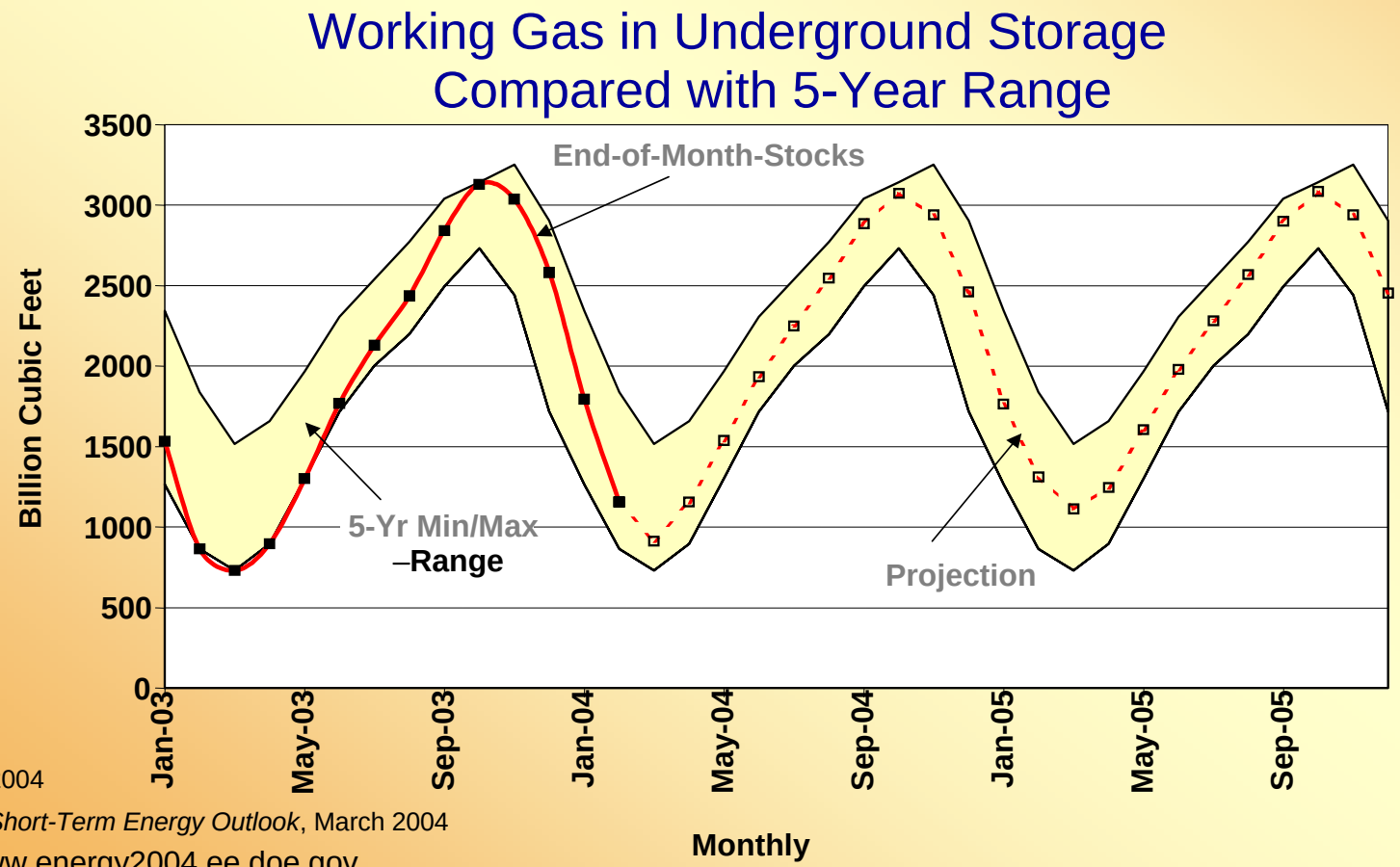
Location of Failure

Type



Annual Cycle

- Natural gas injected and withdrawn from storage during year to balance supply and demand



From: Caruso 2004

Sources: EIA, *Short-Term Energy Outlook*, March 2004

Two Markets for Commodity

- Physical delivery
- New York Mercantile Exchange (NYMEX)
  - Futures
  - Call options and puts
  - Straddles
  - Basis swaps

Trading Hubs

- Physical delivery generally tied to major hubs

Futures = High Risk

- Not for feint of heart

http://www.nymex.com/jsp/index.jsp
2004 New York Mercantile Exchange

The Emerging Natural Gas Crisis

Overview

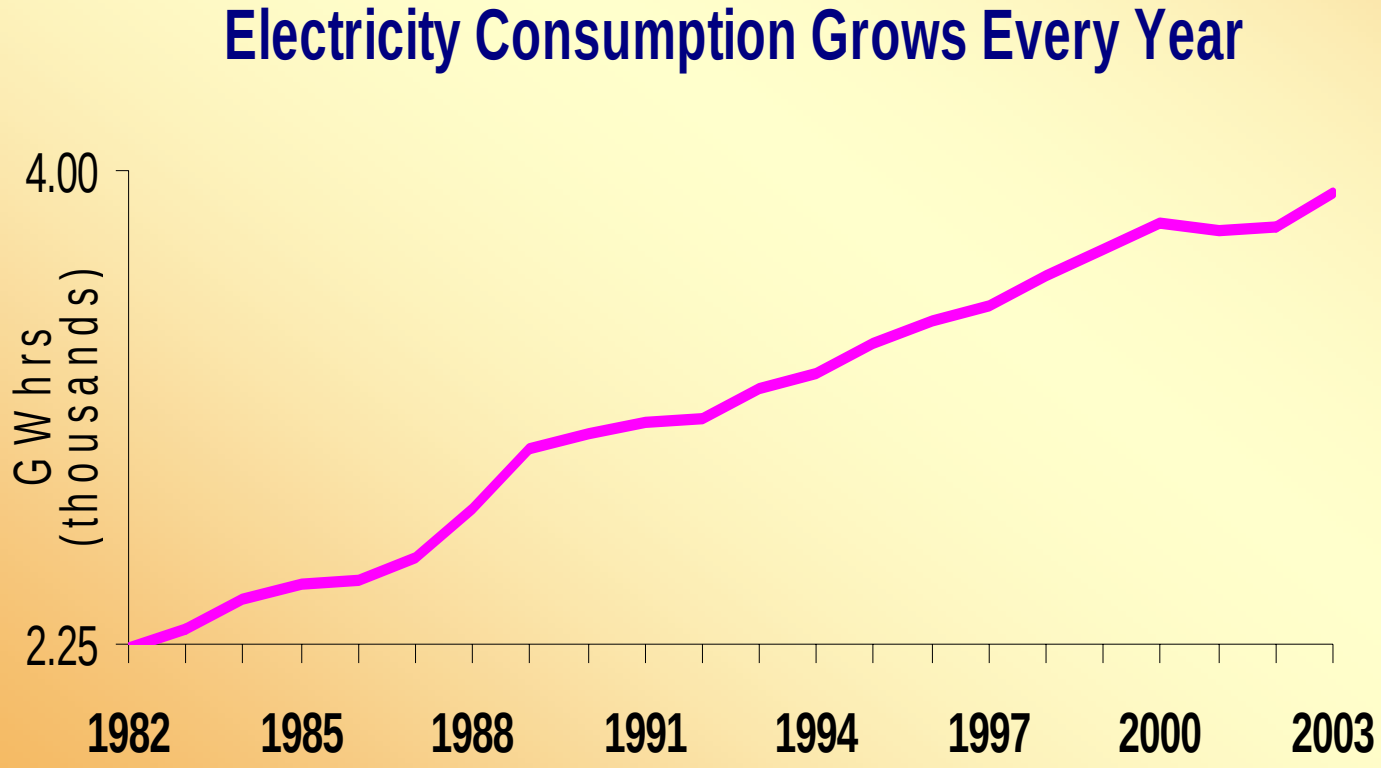
- U.S. faces *massive* short fall in natural gas supplies that will persist throughout the rest of the decade
  - In BTU terms, by 2010, equivalent to 1.5X current level of oil imports from Saudi Arabia (i.e., 1.8 million barrels/day)
- Not only or even primarily a short-term problem
  - No easy solutions
- Minimum of 7 to 10 years before natural gas supply gap can be narrowed significantly
  - On average, likely to result in price increase of at least $4-6/MMBtu
- Requires urgent, high level coordinated action to address
- Success in addressing crisis likely to have major repercussions for health and competitiveness of North American economy for much of the next decade

Collision of Tectonic Plates

- Train wreck about to occur stems from collision of two tectonic plates set in motion long ago:
  1. After several decades of development, production from most conventional on-shore fields in U.S., Alberta and Near-Shelf region in Gulf has either hit plateau or entered into a period of *rapid* – and irreversible -- decline
     - Particularly severe in shallow waters off Gulf Coast
       - Until recently, most important U.S. source of new supply
  2. Shift to natural gas as near-exclusive fuel to meet incremental electricity needs of U.S. economy
     - Due in part to:
       - Delayed impact of Clean Air Act requirements enacted long ago
       - 20-year period required to work off huge generation surplus left over after oil price shocks of ’70’s

Electricity Growth Requires Increased Supplies of Electricity

- Demand for electricity generally increases <u>every</u> year
  - Even I n'01, despite most severe manufacturing recession in 22 years, decline still = only 0.2%

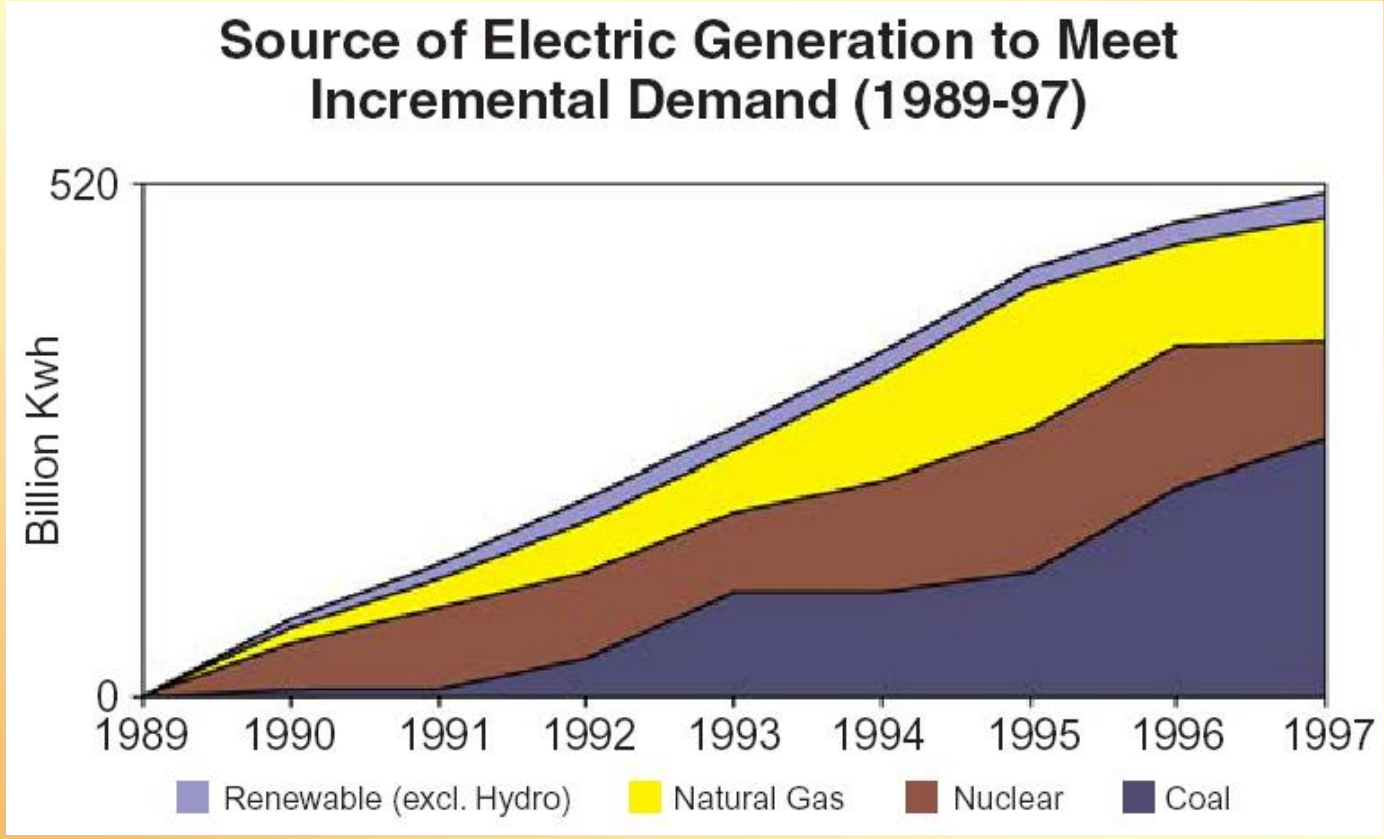


Engine of Economic Growth

- Since 1980, U.S. electricity consumption has grown by more than 75%
- Even with increases in energy efficiency, requires 0.70 to 0.75% increase in electricity production to achieve each 1% growth in GDP
  - Electricity production accounts for an increasing percentage of U.S. energy supply every year
- Lifeblood of the economy
- If no longer feasible to expand supplies of electricity, growth of U.S. economy likely to be brought to a halt
  - Would require many years to changeover infrastructure sufficiently to change dramatically relationship between electricity consumption and economic growth
- Even with increased efficiency, electricity production currently projected to increase 30% over next 15 years

Major Turning Point

- Prior to late ’90’s, possible to meet incremental electricity needs of U.S. economy primarily thru increased utilization of existing coal and nuclear units:



Need for New Capacity

- By late 1990's, new capacity needed in every region of U.S.
- Industry in midst of far-reaching change
  - De-regulation of wholesale markets by FERC + statewide restructuring in states representing 2/3rd's of total U.S. load
  - Explosive growth of Independent Power Producer industry & power marketers
    - Darlings of Wall Street with 40:1 P/E ratios
- Developers strongly favored gas-fired capacity over coal
  - Shorter lead time and much lower (apparent) capital cost
  - Much lower permitting risk/perceived as "environmentally-friendly" choice
  - Widely believed supplies plentiful and prices would remain low

Choices Necessary

- Result = abrupt shift in U.S. energy strategy
  - $ 100 billion investment in new gas-fired plants

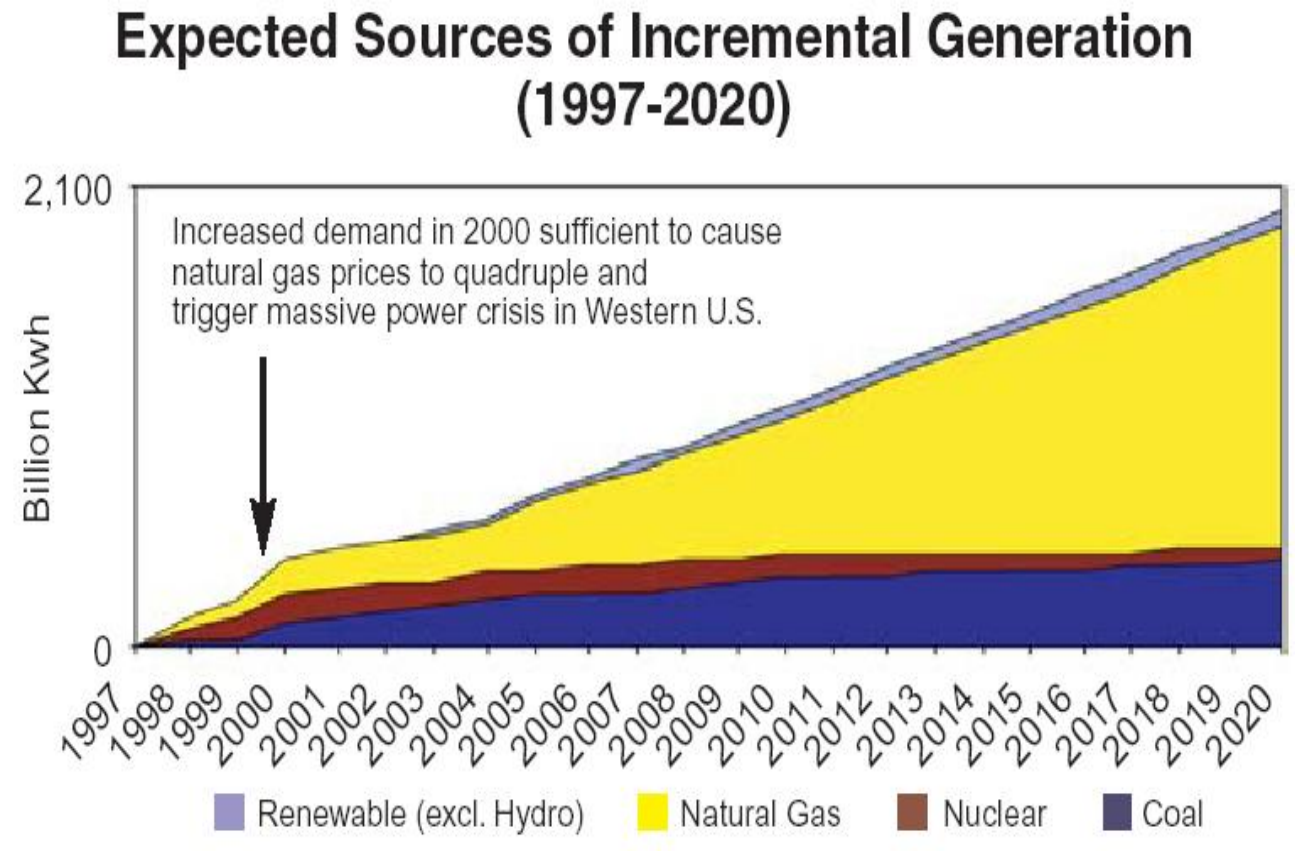
Gas-Fired Generating Capacity Added Since 1999

Year	Additions	Total Gas-Fired Generation	% of Total US Capacity
1999	22,641 MW	201,979 MW	25.4%
2000	25,527 MW	227,506 MW	27.7%
2001	41,372 MW	268,892 MW	31.0%
2002	54,701 MW	323,593 MW	34.7%
2003*	60,488 MW	384,081 MW	39.0%
2004*	10,404 MW	394,485 MW	40.0%
Total Additions	215,133 MW		

* Includes plants currently under construction but excludes all planned additions that have not yet broken ground

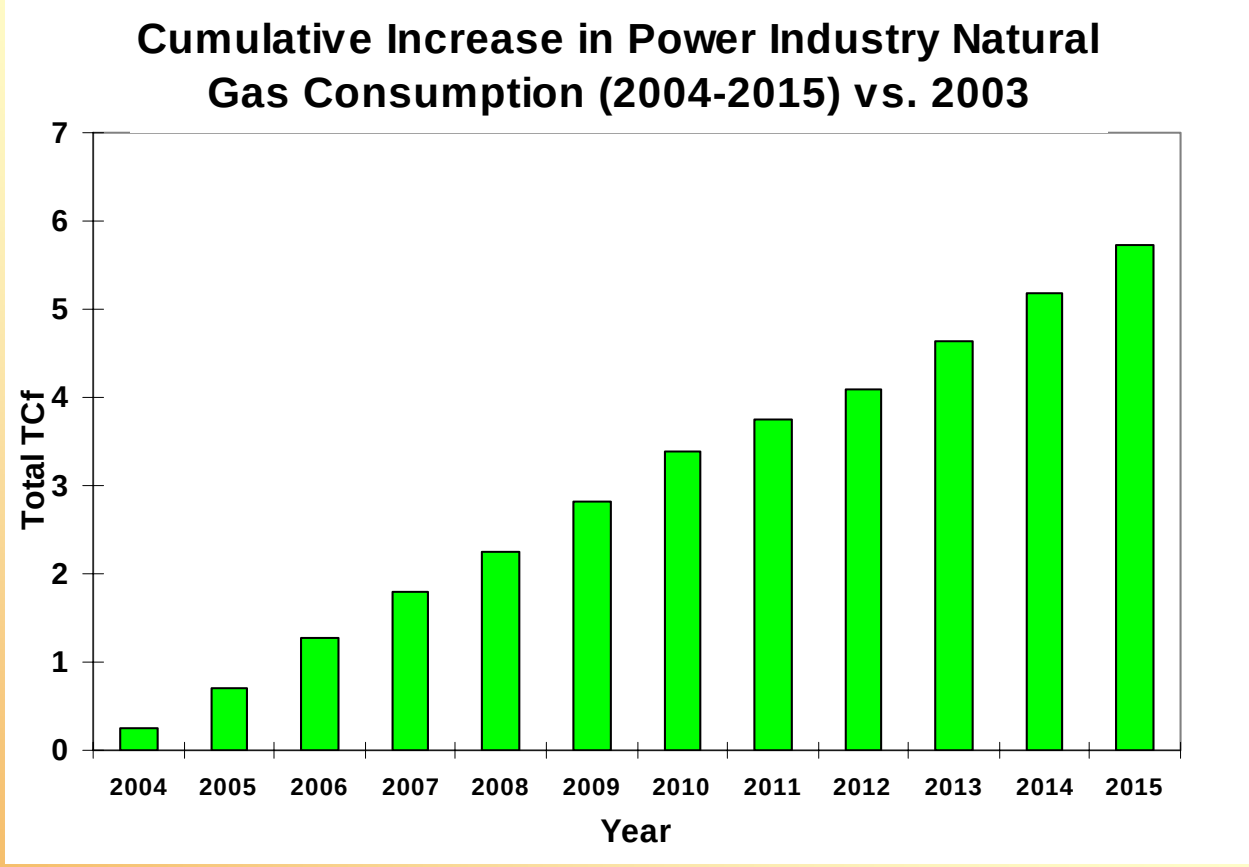
Massive Increase

- U.S. now dependent upon increased utilization of gas-fired units to meet virtually all of its incremental electricity needs



Primary Driver

- Power sector consumption of natural gas nearly certain to increase every year



Cumulative Increases *Huge*

- Increase likely to be > 3.4 TCf by 2010, > 5.7 TCf by 2015
  - No other current source of supply to meet incremental electricity needs of U.S. economy

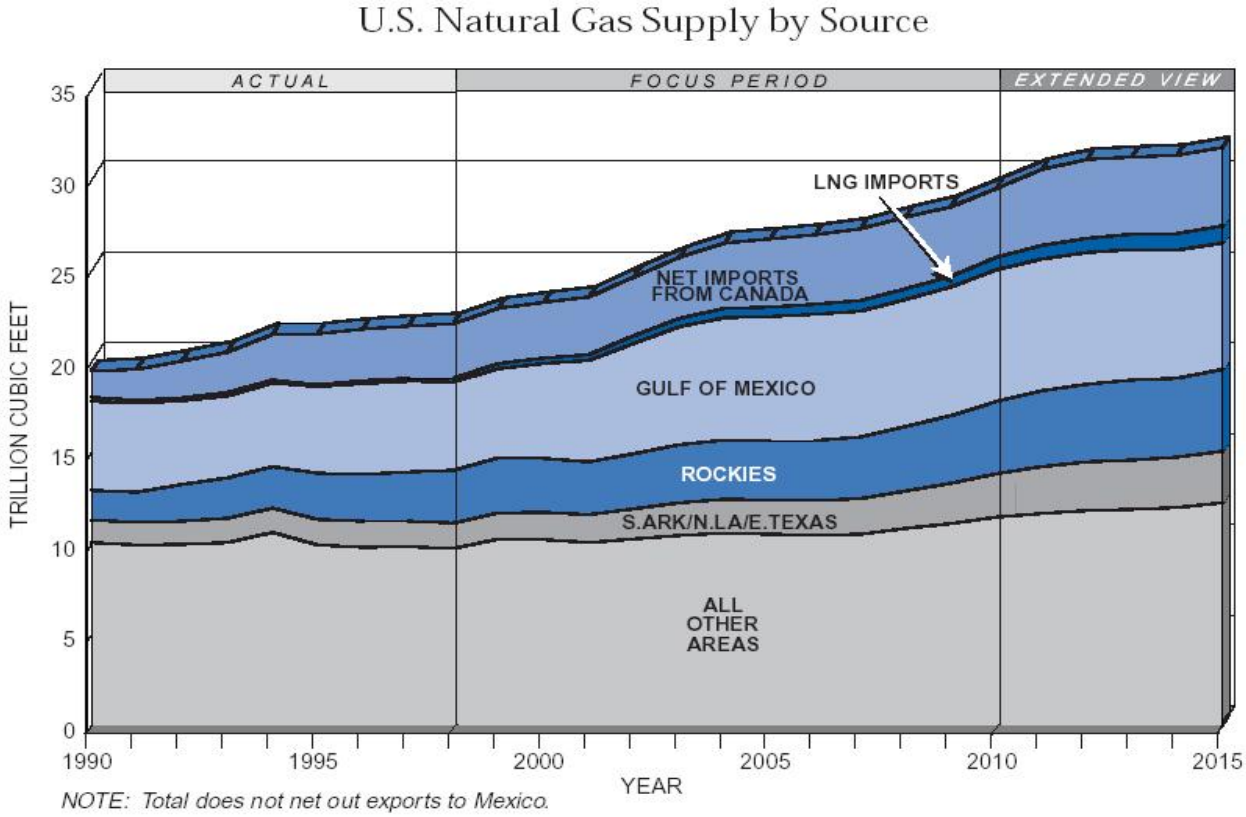
Projected Increase in Power Sector Natural Gas Consumption

Year	Increase	Increase vs. 2003	Total
2004	0.275 TCf	0.250 TCf	5.486 TCf
2005	0.462 TCf	0.712 TCf	5.948 TCf
2006	0.563 TCf	1.275 TCf	6.511 TCf
2007	0.522 TCf	1.797 TCf	7.033 TCf
2008	0.460 TCf	2.257 TCf	7.493 TCf
2009	0.568 TCf	2.825 TCf	8.061 TCf
2010	0.568 TCf	3.393 TCf	8.629 TCf
2011	0.353 TCf	3.746 TCf	8.892 TCf
2012	0.353 TCf	4.099 TCf	9.335 TCf
2013	0.546 TCf	4.645 TCf	9.881 TCf
2014	0.546 TCf	5.191 TCf	10.427 TCf
2015	0.546 TCf	5.737 TCf	10.975 TCf

Irreversible Decline in Supplies Available to North American Market

Until Recently, Natural Gas Supplies Perceived as Plentiful

- December 1999 National Petroleum Council (NPC)) Study forecast North American production increasing to 33.5 TCf by 2015 with little or no increase in price - Principally from lower 48 States



Disastrous Coincidence in Timing

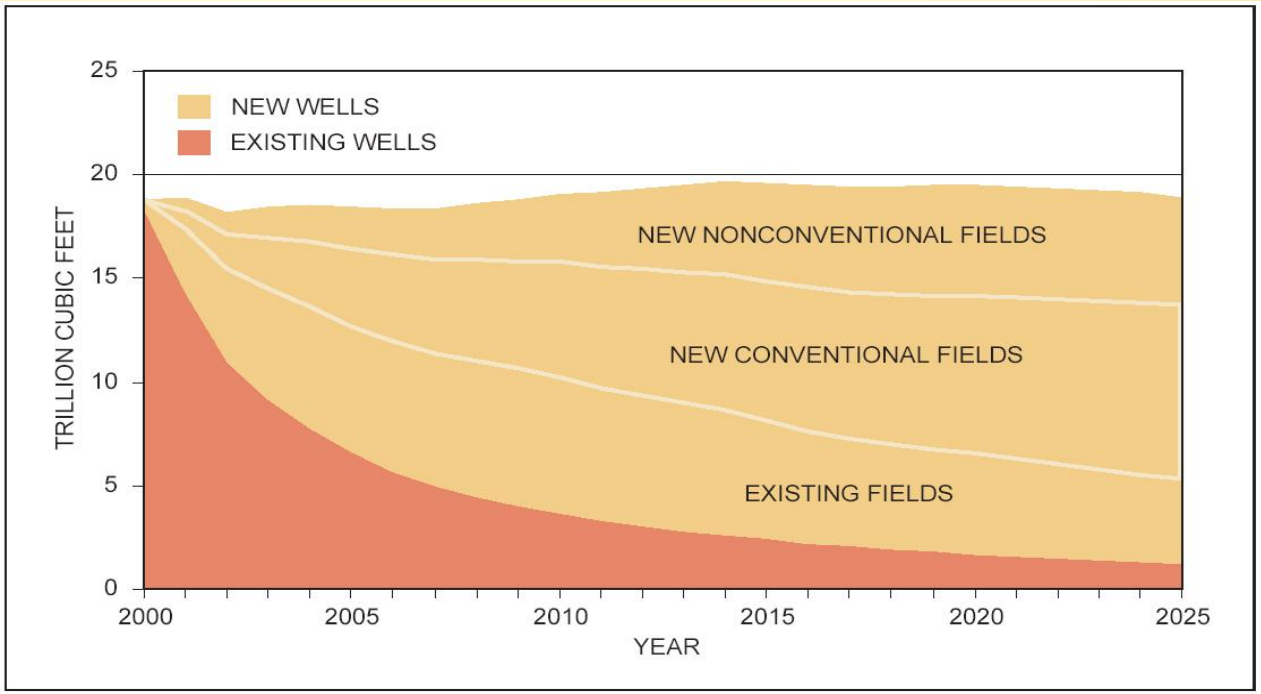
- Production from major sources in U.S. and Canada began to hit a wall in 2000-2001 time frame
  - Major turning point after 20 – 30 years of development of many fields
  - *Not* physically possible to reverse
- Massive ramp-up in drilling in late 2000/first three quarters of 2001 further depleted remaining inventory of attractive targets
- U.S. supply crisis further exacerbated by:
  1. Sudden, unexpected decline in imports from Canada
     - Due largely to same underlying causes as in U.S.
  2. Sudden, largely unexpected (and in all likelihood also continuing) rapid increase in exports to Mexico
- Net effect is to significantly exacerbate deficit

NPC Study

- New National Petroleum Council Study prepared for Secretary of Energy Spencer Abraham = landmark event
  - *Summary of Findings and Recommendations* and Draft of *Integrated Report* available at www.npc.org
- Most comprehensive assessment of North American supply and demand undertaken in many years
- Primary conclusions:
  - Findings of Council's earlier, December 1999 Study are ***no longer valid***
  - Major fields in U.S. and Canada aging far more rapidly than expected just four years ago
  - No longer realistic to expect ***any*** significant increase in supply from "traditional" North American sources (i.e., sources south of the Arctic Circle)

Huge Void

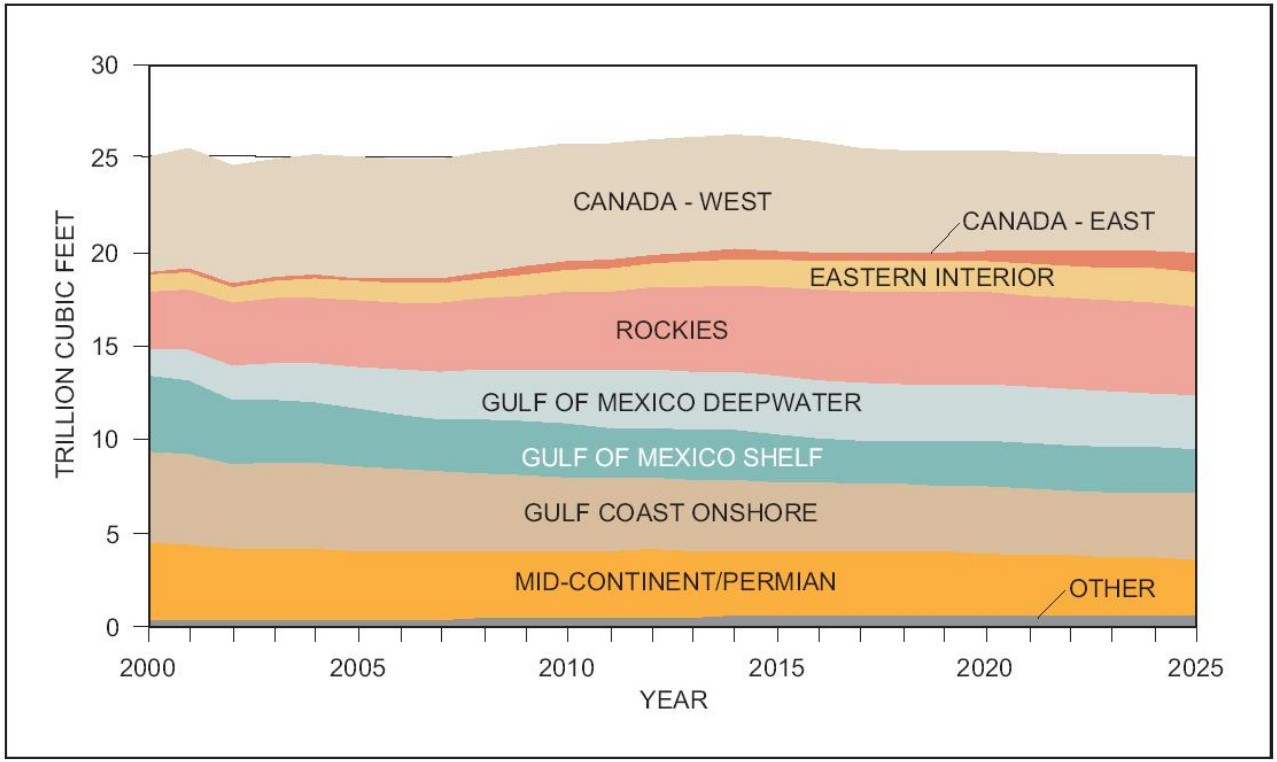
- New NPC Study finds conclusively that traditional sources of supply ***cannot*** meet this demand
  - Estimate of production for lower 48 States alone reduced by a stagger 16 BCf/day (i.e., just under 6.0 TCf/year)



Lower-48 Production, Existing and Future Wells

Production Has Hit Wall

- At best, increases in Rockies and from Deepwater projects in Gulf of Mexico will offset declines in other basins



U.S. Lower-48 and Non-Arctic Canadian Gas Production by Region

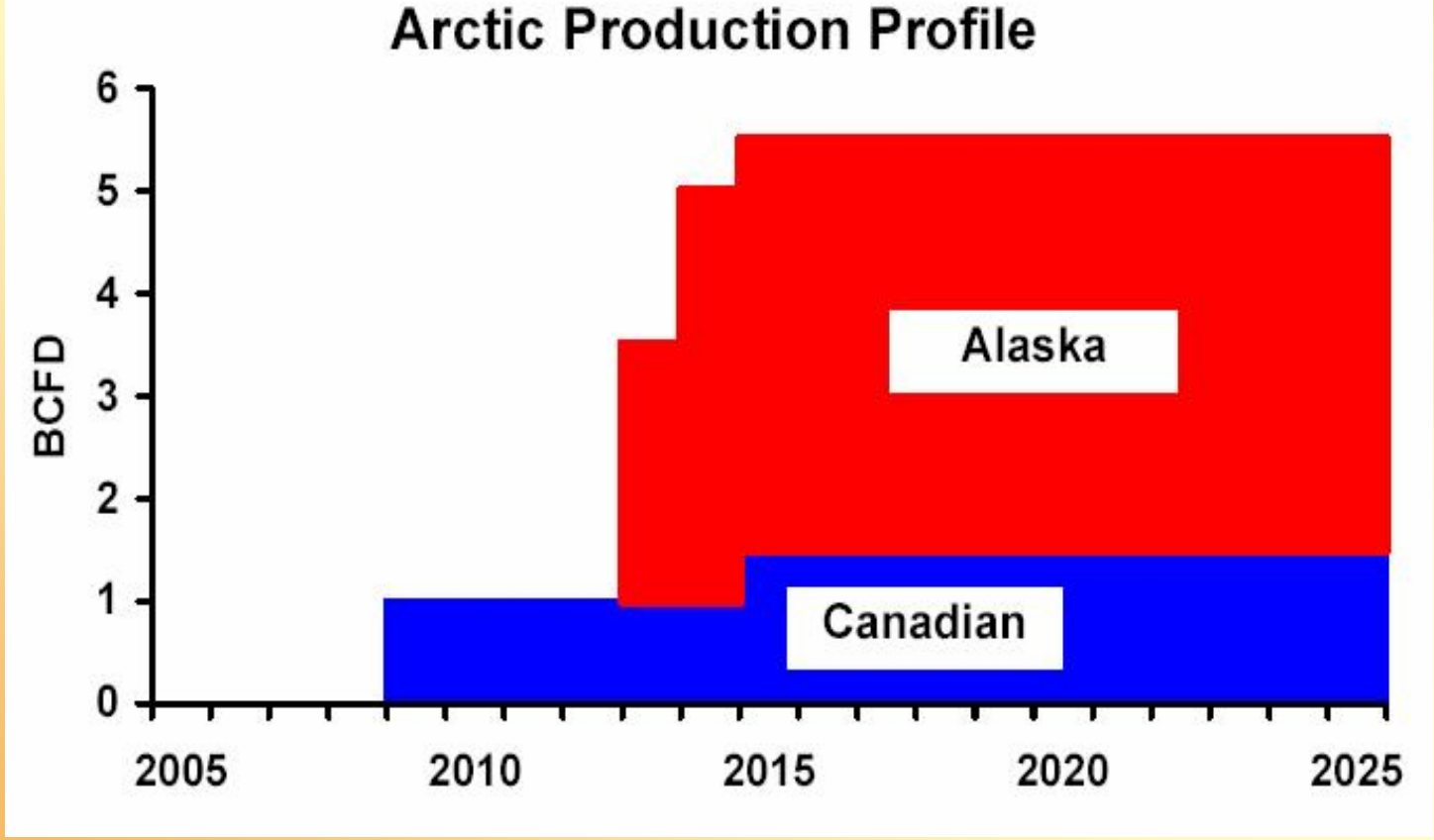
Far Longer Lead Times and More Distant Sources of Supply

- To obtain new supplies, necessary to complete large number of large-scale, highly capital intensive multi-year projects targeting far more distant sources of supply

Source	Required Capital Expenditures	Required Lead Time	Likely Increase in Supply
Mackenzie Delta in Canada (near Arctic Circle)	$4 -5 billion	At least 4-5 years	1-2 BCf/day -- all of which currently is expected to be dedicated to Tar Sand's Project
Prudhoe Bay	$20 billion	A decade or more	4.5 BCf/day
Ultra-deepwater platforms in the Gulf (i.e., 15,000-20,000 foot depth)	$500 million or more per platform	Minimum 5-7 years if technology can be developed; even then, could yield mostly oil, with only limited natural gas	0.5 BCf/day
LNG	$3-7 billion for each 0.5 BCf/day of additional supply	Likely to be at least 2009 before imports of LNG into the U.S. can be increased significantly	2-4 BCf/day by 2010

Alaskan Gas At Least a Decade Away

- 2013 -2014 = Earliest Potential In-Service Date
  - Likelihood of meeting = slim to none

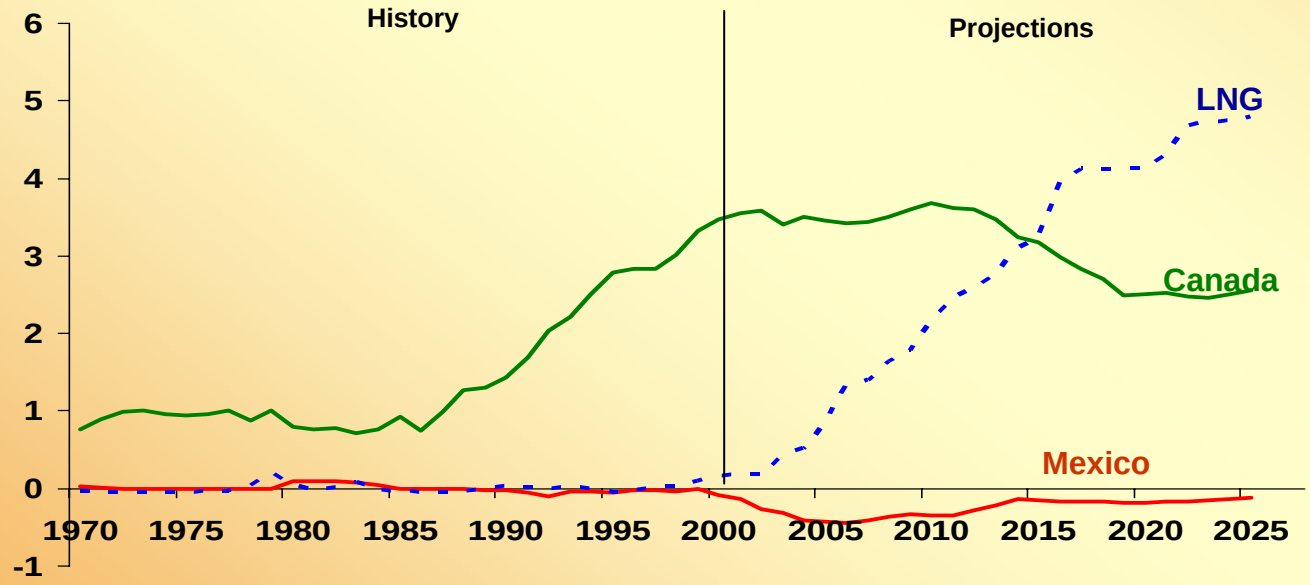


LNG = Lynchpin

- Plan to massively increase imports of LNG now lynchpin of U.S. energy strategy

Net U.S. Imports of Natural Gas, 1970-2025

(trillion cubic feet)



From: Caruso 2004 - Source: 2004 *Annual Energy Outlook*

Potential High Stakes Gamble

- Focus of public debate to date far too narrow
  - Siting of delivery terminals
  - Safety issues
- No question should and will be part of supply mix
- Primary issues =
  - What's realistic – in terms of both timing and amount ?
  - What are the potential costs and risks if we rely too heavily on imports of LNG as our primary strategy for closing the emerging natural gas supply gap?
- Stakes for U.S. are ***huge***
  - May be single most important strategic issue facing energy industry + U.S. economy today
- But = issue not yet even on radar screen of public policy debate
- State Commissioners by far group most likely to put it there

LNG Attractions

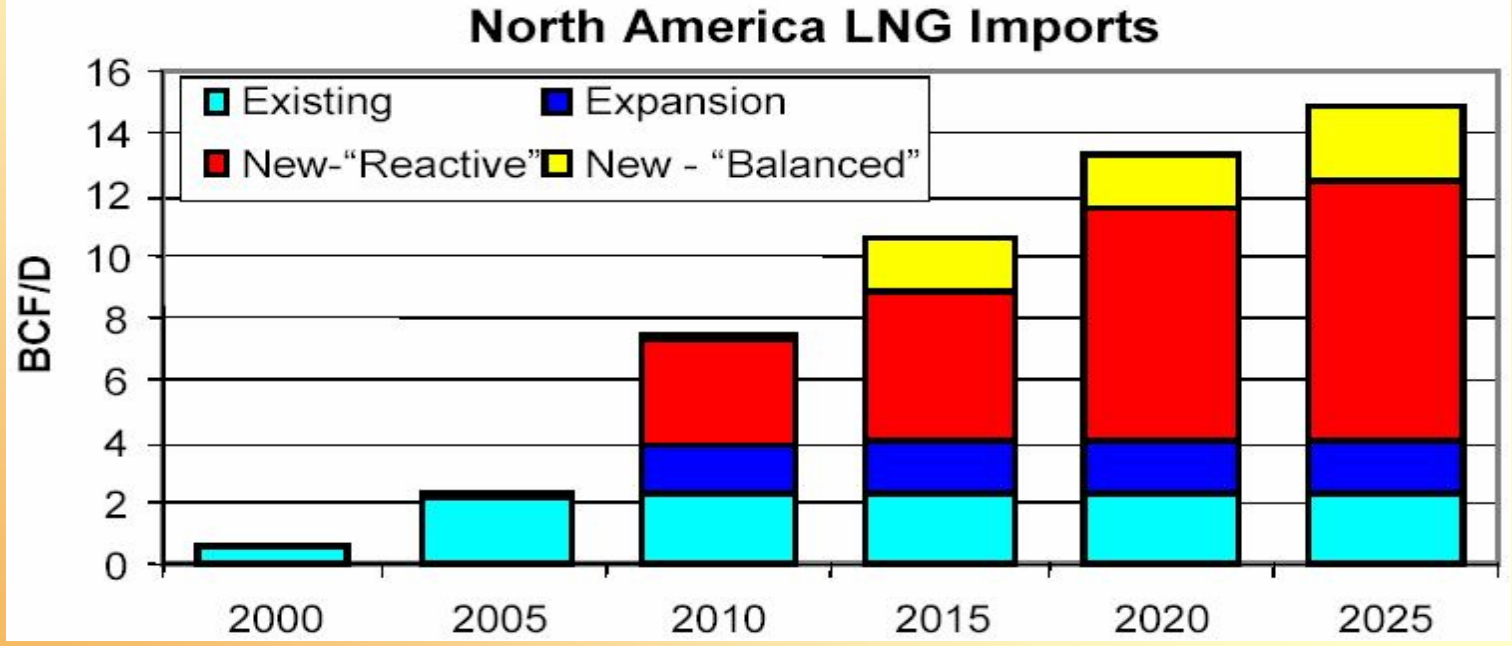
- Major perceived advantages:
  1. Large stranded natural gas reserves elsewhere in the world
     - Primarily in Qatar, Iran & Russia
     - Also smaller reserves available for development in Nigeria, Angola, Egypt, Norway, Australia, potentially other countries
  2. Potentially attractive all-in delivered *cost* to U.S. delivery terminals
     - $ 3.70/MMBTU or less
     - Partially compromised if terminals can only be sited in Gulf
  3. Producers willing to enter into long term supply commitments
     - But commitment may be to marketer, *not* ultimate buyer
  4. <u>NOT</u> Coal

Uncertainties and Myths

- But – many uncertainties remain
- Key facts to be aware of:
  - Only a limited number of new greenfield projects currently are under construction anywhere in the world
  - All or most of the output of most of these projects already committed to other markets
  - Other projects are not likely to be started until:
    1. Delivery terminals successfully permitted
    2. Definitive commercial agreements in place and financing obtained
    3. Place in line obtained for new tankers
  - This process could take years to complete
  - Once it has been, minimum of 48 to 54 months likely to be required before first commercial deliveries occur
  - Even the first tranche of “new” projects “targeted” for end of 2008 or 2009 may not come on line until well into the next decade
  - Second wave may not be completed until many years later

Near-Term Contribution of LNG Also Limited

- Likely to take until at least 2009 to 2012 before imports of LNG will make a major contribution
- Even then, offsets only a portion of increased demand



Global Competition

- Just as significantly:
  1. Many countries likely to be competing vigorously for limited global supplies
     - Likely to include
       - Major European players (i.e., particularly Great Britain, France, Spain)
       - China, India & Korean
     - Trans-border gas supply expected to require $ 3 trillion in new infra-structure over next 20 years
     - Realistically, will be many years before global supply catches up to global demand
  2. Naïve to assume that, at any time for many years to come:
     - Price will be set primarily based upon cost
     - Imports of LNG into the U.S. market will cover a large enough percentage of the U.S. supply gap to effectively constrain prices in the U.S. market

Huge Economic & Geopolitical Consequences & Risks

- Distant sources of supply largely beyond U.S. control
- Inherently vulnerable to:
  - Supply interruption
  - Terrorist attack at any point along the delivery chain
  - Exertion of political leverage against the U.S.
- Could lead to explosive tensions with Iran
- Heightens risk of international conflict in ways that may be difficult to predict
- Puts U.S. in direct competition with developing countries for increasingly scarce world energy supplies

No Competitive Economic Advantage

- Marketers who control LNG supply also potentially will have huge pricing leverage in the U.S. market – both short and long term
- Price volatility – already high – could be greatly exacerbated as U.S. is played off against European and Asian markets on a global scale
- ***Huge*** implications for U.S. job creation and balance of payments
  - Could add $ 50 billion/year or more to balance of payments deficit
- At same time:
  - Could – in fact *already has* – discouraged development efforts closer to home
  - May require structural changes in U.S. market and/or limit options for regulators
  - Does not offer *any* opportunity to provide U.S. industry with competitive advantage in competing in world markets, since cost for delivering LNG into the U.S. market will always be higher than for deliveries into the European and Asian markets

Unanswered Questions

- At a minimum, therefore, at least for the next several years, uncertainties will remain regarding several key issues:
  1. How rapidly can global supplies of LNG and global delivery capability be ramped up?
  2. Given the potential growth rate in world-wide demand, how long will it take before world-wide supply catches up with world-wide demand (if ever)?
  3. In the interim, what share of newly available supplies are likely to be captured by U.S. buyers?
  4. Who will control the pricing of these supplies (e.g., producers, marketers, etc.)?
  5. To what extent, if any, will the pricing of these supplies be based upon these costs?
- The global LNG market currently is a relatively small market which, until recently has experienced relatively modest growth in recent years
- No one can predict with any certainty, therefore, how these issues will be resolved

Bottom Line

- Most important energy policy choices of the past decade must be made soon
- Will these decisions be made as a result of a well-thought out, carefully considered decision-making process or instead made largely by default?
  - Experience of the last several years (including, in particular, the IPP/natural gas debacle that helped to create this crisis to begin with) does *not* suggest much basis for optimism
  - Policy-planning function appears to have almost entirely disappeared at both federal and state level
- What role, if any, should FERC and/or state regulators be playing in this process?
- Who else might fill the gap?

Major Alternatives

- At least two major alternatives: an “LNG only” strategy or a multi-prong, Apollo type program to reduce our vulnerability to severe dislocations in the natural gas market
- Multi-prong strategy definitively should *include* increased imports of LNG where we can lock in long-term supply from dependable sources of supply with firm dates for commencing delivery and fixed or capped prices
- In addition, however, also should include an array of other programs, potentially including, for example:
  1. Intensive efforts to improve energy efficiency at commercial office building and retail shopping malls (where the greatest waste currently occurs);
  2. Crash efforts to accelerate deployment of renewables;
  3. Crash efforts to replace or repower older, inefficient gas-fired plants, modernize and expand the output of existing coal-fired plants and achieve large-scale deployment of coal gassificatin

Major Alternatives (contd.)

4. Crash efforts to replace or repower older, inefficient gas-fired plants, modernize and expand the output of existing coal-fired plants and deploy coal gasification on a major scale
5. Major initiatives to reduce line losses on the existing T & D system

Potential Advantages

- U.S. companies have the ability to directly control timing of implementation
- Many of the proposed measures (energy efficiency, some coal-plant upgrades, etc.) can be achieved with a much shorter lead time – and therefore can help moderate natural gas prices much sooner
- Geopolitical and terrorist risks much smaller or even non-existent
- Could lead to significant job creation in the U.S.
  - Over a period of years, $ 100 billion or more in increased spending in U.S.
- Does not create ability on the part of producers or marketers to exert price leverage
- Does not exacerbate balance of payments problem
- Potentially could provide genuine competitive advantage to U.S. manufacturers (or at least allow these manufactures to avoid losing all of their historical advantage)

Summary

- Overall, the potential economic and strategic advantages of a balanced strategy are ***huge***
- Avoids the extreme risks of betting much of the future of U.S. economy for the next decade or two on an “LNG only” or “predominantly LNG” strategy
- However, will required concerted, coordinated national effort to achieve
- Right now, no one is pursuing
- Instead, we’re betting our economic future for two decades or more on an untried strategy with many risks and no material upside, other than the fact that it doesn’t necessarily require the same sort of leadership from government officials in order to implement

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