

# LNG - THE CHALLENGE OF INCLUDING AN INTERNATIONALLY TRADED COMMODITY IN A NORTH AMERICAN NATURAL GAS FORECAST

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# **U.S NATURAL GAS SUPPLY FORECASTS HAVE TENDED TO OPERATE ON FOUR UNWRITTEN ASSUMPTIONS**

- First, North American Gas Demand and the Supply Required to Meet it Are Effectively Isolated From Gas Markets in the Rest of the World
- Second, Economic Considerations Drive the Exploration and Development of Gas Reserves
- Third, Competitive Commodity Behavior Governs the Supply Response to Market Price Signals
- And Finally, the Adjustment of Supply to Price Changes is Instantaneous

**UNFORTUNATELY NONE OF THOSE FOUR  
ASSUMPTIONS APPLY TO IMPORTED LNG**

**AND THEREIN LIES THE CHALLENGE TO  
TRADITIONAL NORTH AMERICAN SUPPLY  
FORECASTING**

- The First Assumption - the Focus on North America - Enables the Forecaster to Match Supply and Demand in a Closed Regional Market System
- The Second Assumption - That Exploration and Development are Driven by Economics - is Ideally Suited to a Market-Oriented Economy, Such as the U.S.
- But it Ignores the Complex Geopolitics and Joint Venture Negotiations That Are a Powerful Influence on Energy Investment Behavior in Many of the Developing Countries

- The Third Assumption - That Price Response is Governed by Competitive Commodity Behavior - Enables the Model to Focus on Costs as the Determinant of Supply Prices
- It Thus Operates on the Premise That in a Competitive Commodity Market, No Supplier Can Retain Scarcity Rents and There is No Inherent Difference Between "Cost-Based" Pricing and "Market" Pricing
- And the Fourth Assumption - That the Response of Supply to Price is Instantaneous - Enables the Forecaster to Ignore the Complex Contract Negotiation Process and the Long Lead Times that Take Place Between the Decision to Proceed with a Major LNG Project and its Final Startup

# **THE TRADITIONAL FOCUS ON NORTH AMERICAN GAS SUPPLY HAS MADE IT DIFFICULT FOR SOME TO ADJUST TO A WORLD IN WHICH NORTH AMERICA MUST COMPETE WITH EUROPE AND ASIA FOR LNG**

- It is Most Evident in the Common View that North American Terminal Siting is the Only Significant Obstacle to Increased LNG Imports
- LNG Delivery Systems Involve a "Chain" of Capital Investments in Which Terminals Are a Comparatively Small Part - 10% to 15% - of the Total LNG Chain
- Terminals are the "Tail" - The "Dog" Is Upstream

# NOT ONLY IS THE GREATEST SHARE OF LNG CHAIN CAPEX INVESTED OUTSIDE THE U.S., BUT

- Much of the LNG Demand Is Outside the U.S., as Well
- In 2004, the U.S. Imports Were Only 10% of World LNG Trade
- And, Since the Qatargas 1 Project in 1997 Initiated the Current Burst of Activity in International LNG, Approximately 160 Million Tons of LNG Have Been Committed on Long Term Contracts
- The Regional Commitment Balance is as Follows:

U.S.	14%
Europe	25%
Asia	38%
Destination Flexible	23%

# BECAUSE OF THE STRONG DEMAND FOR LNG IN OTHER MARKETS, IT IS INEVITABLE THAT U.S. IS EXPOSED TO EVENTS IN WORLD GAS MARKETS THAT AFFECT THE SUPPLY, DEMAND AND PRICE OF LNG

- During the Past Three Years, There Have Been a Number of Disruptions that Have Affected World LNG Supply
  - A 2003 Fire at Malaysia's Tiga Liquefaction Plant
  - An Explosion that Destroyed Three Liquefaction Trains at Algeria's Skikda Plant in 2004
  - Guerilla Activity in Nigeria in 2005 that Shut Down Some Liquefaction for a Period
  - Gas Supply Problems at Both Indonesia's Arun and Bontang Facilities, the Former Compounded by Insurrectionist Activity
  - And Mechanical Problems that Have Temporarily Reduced Supply in:
    - Australia
    - Egypt
    - Qatar
    - Trinidad

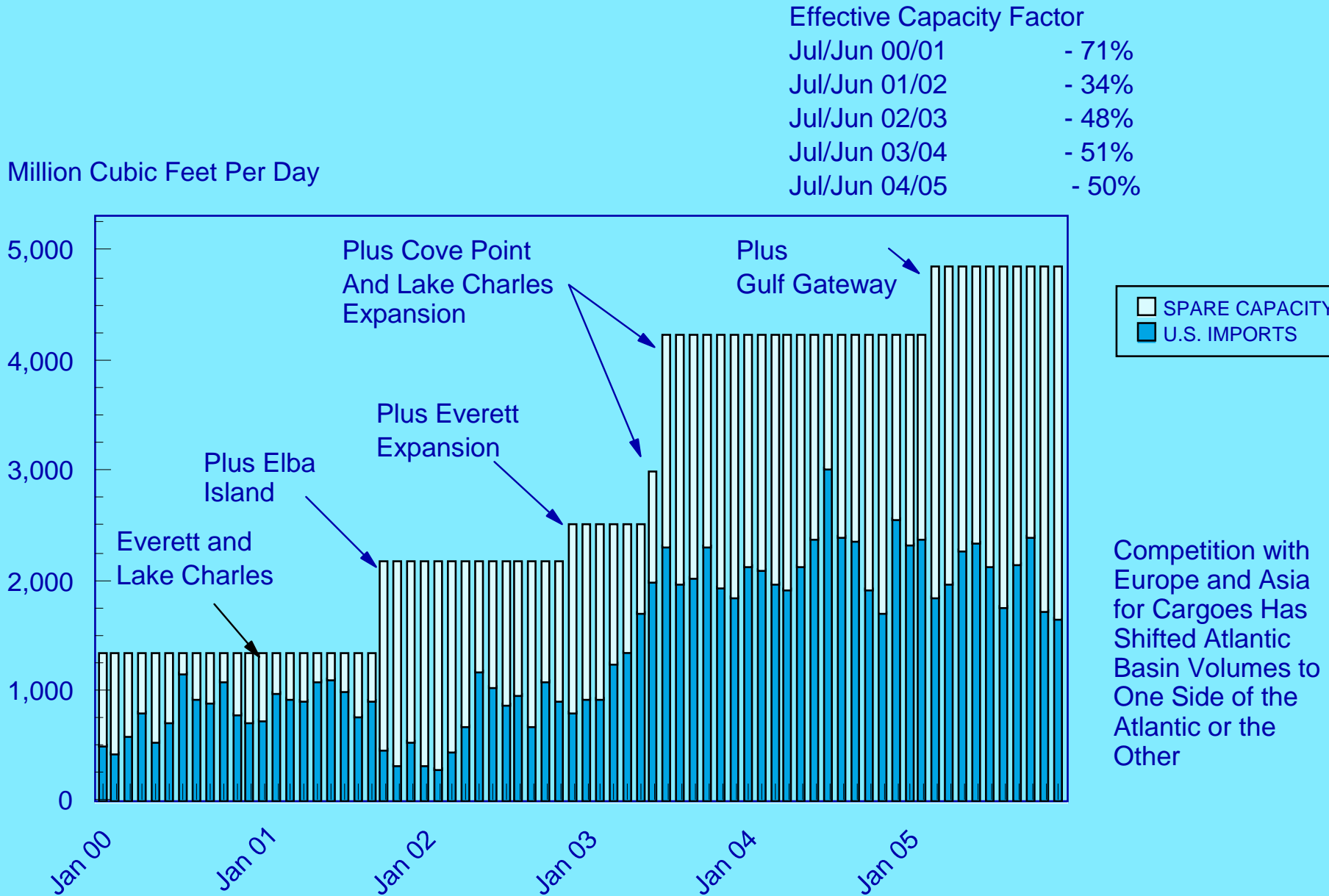


# NOR HAS DEMAND COME OUT UNSCATHED

- Events that Have Put Unanticipated Demand on World LNG Supply During the Same Period Include:
  - A Nuclear Upset at Tokyo Electric that Forced the Shutdown of Seventeen Nuclear Plants in 2003, Some for as Much as Two Years
  - A Recent Severe Drought in Spain that Has Boosted Gas-Fired Generation to Offset Reduced Hydropower
  - This Last Winter's Reversal of the U.K.'s Historic Position as a Net Gas Exporter to a Net Gas Importer
  - And Cold Temperatures in Europe this Last Winter
- It is Important to Note that When Competing with Europe for Tight Supplies, the U.S. is at a Transportation Disadvantage for All Sources Except Trinidad
- The Competitive Effect on U.S. LNG Supply is Evident in the Comparative Low Utilization Rate for the U.S.'s Growing Receipt Terminal Capacity

# Figure 1

## COMPARISON OF U.S. LNG TERMINAL IMPORTS WITH CAPACITY MILLION CUBIC FEET PER DAY



# **THE SECOND ASSUMPTION - THAT ECONOMICS ARE THE SOLE DRIVING FORCE FOR LNG SUPPLY FAILS TO RECOGNIZE THE COMPLEXITY OF THE INVESTMENT DECISION PROCESS**

- Upstream LNG Projects Are Characterized by Large Up Front Investments, Long Lead Times, "Lumpy" Supply Additions and Complex Negotiations Among the Various Stakeholders in the Project
- Because They Are Usually Joint Ventures and Because They Are Large Compared to the Partners' Capital Budgets, it is Often Difficult to Get a Final Agreement Among Partners to Proceed with a Project
- Prominent Among the Project Stakeholders are the Producing Governments (Where At Least Half of the CAPEX are Concentrated)

- The Project Approval Process Can be Likened to a Decision by Committee to Place a Multi-Billion Dollar Bet on an Investment
- And in Those Cases Where the National Oil Company is a Partner, One Committee Member Often Has an Inherent Conflict of Interest
- As an Agent of the Government's Tax Regime, it Wants to Maximize Government Revenues; With its Oil Company Hat on it Wants to Maximize Project Return
- The Involvement of Governments in the Decision Process Also Raises Questions of Political Risk, Not Only About the Stability of the Governments, But the Stability of Their Fiscal Regimes, as Well

- Political Problems Have Recently Been in the News About Such Potential LNG Suppliers to the U.S. as:

Bolivia - Election as President of a Populist Who Had Led the Fight Against an Earlier LNG Proposal

Equatorial Guinea - Charges of a Possible Coup

Indonesia - Separatist Problems Affecting the Arun Project; Independence of East Timor Affecting Bayu Undan and Sunrise LNG Projects

Nigeria - Workers Strikes and Guerilla Activity Curtailing LNG Output and Shutting in Oil Production

Venezuela - Civil Unrest Shutting in Oil Production

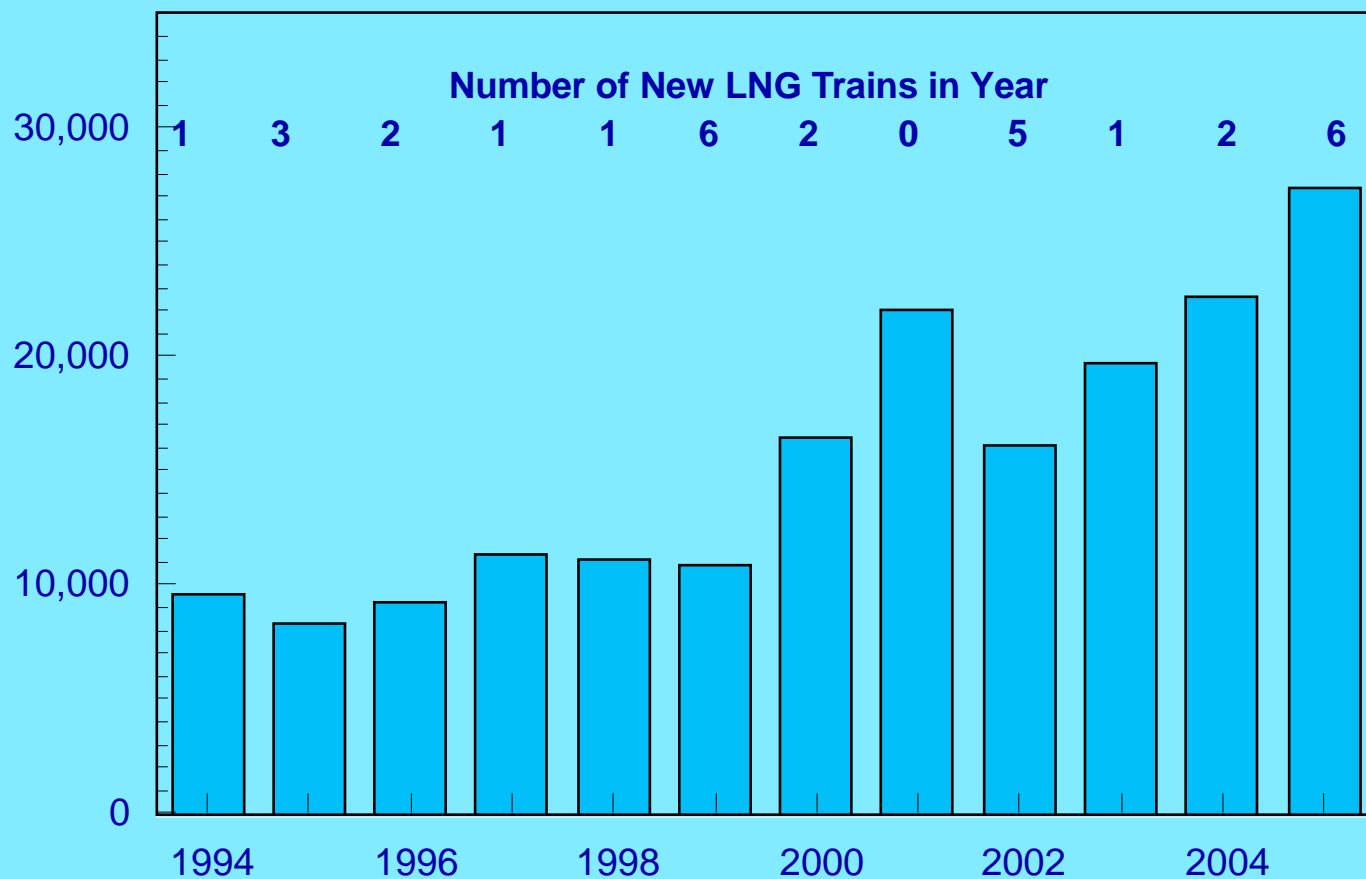
## **THE THIRD ASSUMPTION - THAT PRICE RESPONSE IS GOVERNED BY COMPETITIVE COMMODITY BEHAVIOR FAILS TO RECOGNIZE THE PROFOUND DIFFERENCE BETWEEN LNG AND ONSHORE GAS COMPETITION**

- LNG Competition is Among a Limited Number of Projects - "Project Supply" - Rather Than Among a Very Large Number of Competing Producers - "Commodity Supply"
- The Sharp Difference in Transaction Activity Between Conventional U.S. Exploration and Development and LNG Projects is Illustrated by Figure 2
- Since 1994, the Number of Completed U.S. Gas Wells Has Varied from 8,354 to 27,335; In Sharp Contrast, the Number of New LNG Trains Completed Worldwide During the Same Period has Varied from Zero to Six

Figure 2

# THE NUMBER OF NATURAL GAS WELLS COMPLETED IN THE U.S. COMPARED WITH THE NUMBER OF LNG TRAINS COMPLETED FOR ALL WORLDWIDE MARKETS - 1994/2005

Annual Number of Wells Completed



Gas Wells

← Never More Than Six New Trains;

← Never Fewer Than 8,300 Wells

- LNG Projects Thus Bear Greater Resemblance to Major Supply Projects Such as the Arctic Pipelines Than They Do to Drilling in the Anadarko or Powder River Basins
- These Projects Have Traditionally Been Price Takers, Suppliers Assuming that Prices in the Marketplace Will Determine their Netbacks, not that Their Costs Will Determine Prices
- While LNG Prices Will Clearly Weaken in the Face of Plentiful Supply Offerings, LNG is Rarely the Marginal Source of Supply that Sets the Market Price
- Netbacks to the Wellhead Commonly Provide Economic Rents; These are Shared Between Investors and Host Governments According to the Terms of the Tax Regime



# **THE FOURTH ASSUMPTION - THAT SUPPLY, DEMAND AND PRICE READJUST INSTANTANEOUSLY TO REBALANCE INTERNATIONAL MARKETS IGNORES THE LONG INVESTMENT LEAD TIMES IN LNG PROJECTS**

- The LNG Supplies That Will Come on Line This Year for the Most Part Were Initiated Under the Market Conditions that Prevailed in the Year 2002 or Even Earlier; New Investment Decisions Finalized Today Will Probably Not be On Stream Until 2010
- In Addition, the Fact That Projects That are Expected to be a Part of Future Supply are Often Delayed or Even Cancelled, Makes an Orderly Balancing of LNG Supply and Demand Difficult
- Thus LNG Projects Do Not Smoothly Respond to Short Term - and Volatile - Price Signals When Demand Calls for New Supply

# LNG PROJECTS CONSIST OF A "CHAIN" OF INTERLINKED INVESTMENTS WHICH TRADITIONALLY HAVE BEEN HELD TOGETHER BY LONG TERM CONTRACTS

- While This Traditional Structure Has Been Under Fire, No New LNG Facility Has Been Launched Without a Long Term "Anchor" Contract
- Thus Industry Reliance on Long Term Contracting is Likely to Remain, Acting as a "Filter" to Determine the Flow of New Projects into the Market
- But Despite the Reliance on Long Term Contracts, the LNG Market is Becoming Increasingly Flexible
- This New Flexibility has Created the Possibility of Shifting LNG Cargoes to Those Markets With the Highest Netbacks, Thus Introducing International Price Competition and Regional Price Arbitrage into LNG Trade

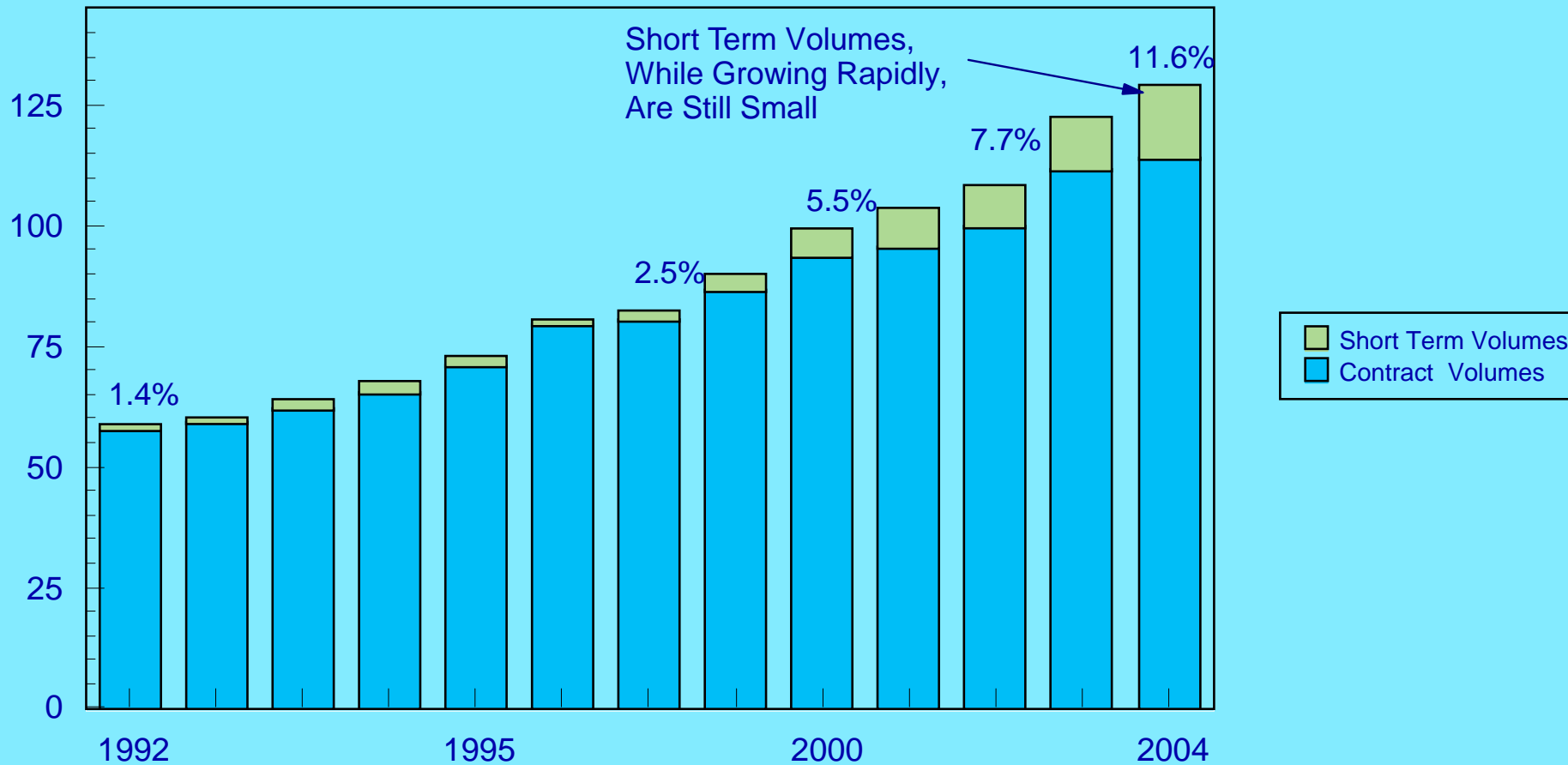
## **THE TRADITIONAL CONTRACT WAS A RELATIVELY INFLEXIBLE "DESTINATION CONTRACT"**

- It Linked Specific Liquefaction Facilities with the Receipt and Regasification Facilities of Specific Customers, Usually with Dedicated Tankers
- The New Contracting Patterns are Much More Destination-Flexible and Permit Shifting Cargoes Among Markets as a Price Arbitraging Mechanism
- The New Flexibility Has Come About in Two Ways
  - (1) A Small, But Growing, Short Term Market, and
  - (2) A Trend by Suppliers Towards "Self Contracting" with Their Own Downstream Marketing Affilitates

Figure 3

# LNG TRADE SHOWING THE GROWING ROLE OF SHORT TERM SALES MILLION TONS OF LNG

Million Tons



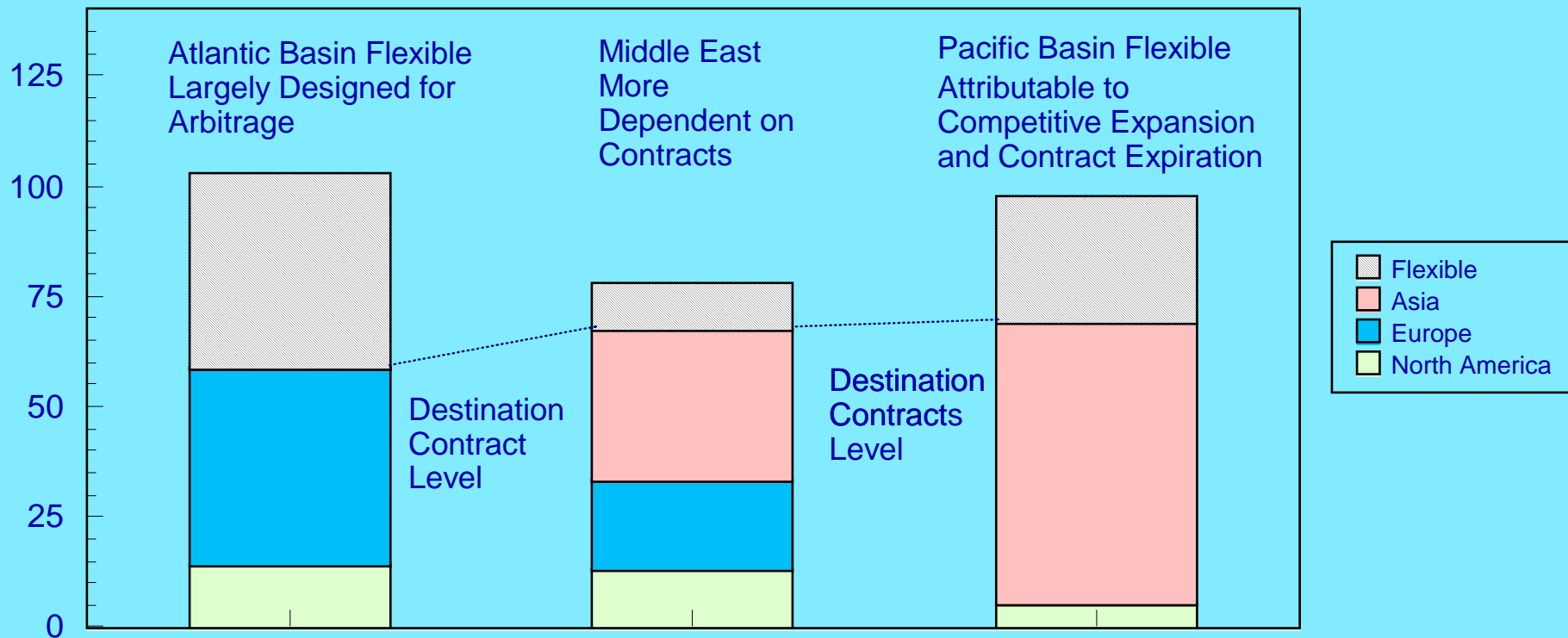
## **SELF-CONTRACTING GIVES THE SUPPLIERS DESTINATION FLEXIBILITY THAT WAS NOT AVAILABLE UNDER THE TRADITIONAL CONTRACTING SYSTEM**

- The Ultimate Market Destinations are Defined, Not by the Terms of the Contract, But by the Best Netbacks Available to the Supplier, Given His Portfolio of Liquefaction and Regasification Assets
- Some Idea of the Importance of these New Flexible Volumes is the Proportion of the Estimated Firm and Probable Capacity for the Year 2010 That is Still Committed to Destination Contracts Versus That Which Remains Flexible - Either as Uncommitted or Self-Contracted Volumes

Figure 4

# ESTIMATED [1] CONTRACTUAL STATUS OF FIRM AND PROBABLE LNG CAPACITY IN PLACE BY 2010 MILLION TONS OF LNG

Million Tons



[1] Jensen Estimates Assuming Current Schedules

- The Atlantic Basin Has Become the Major LNG Arbitrage Market, with Cargoes Being Shifted Among Nigeria and Trinidad on the one Hand and the U.S. and Spain on the Other; the U.K.'s Growing LNG Imports Will Make it an Important Arbitrage Partner in the Future
- The Middle East Remains the Most Dependent on the Traditional Long Term Contract, But Much of its Focus Has Switched from the Pacific Basin Market to the Atlantic Basin Market
- The Pacific Basin also Shows a Large Flexible Volume in 2010
- It is a Product of Competitive Expansion of New Greenfield Facilities Coupled with Major Contract Expiration Later in the Decade

# THE PRICE MOTIVATION FOR ATLANTIC BASIN ARBITRAGE BEHAVIOR IS ILLUSTRATED BY RECENT LNG NETBACKS FROM THE U.S. GULF COAST AND FROM SPAIN TO TRINIDAD AND NIGERIA

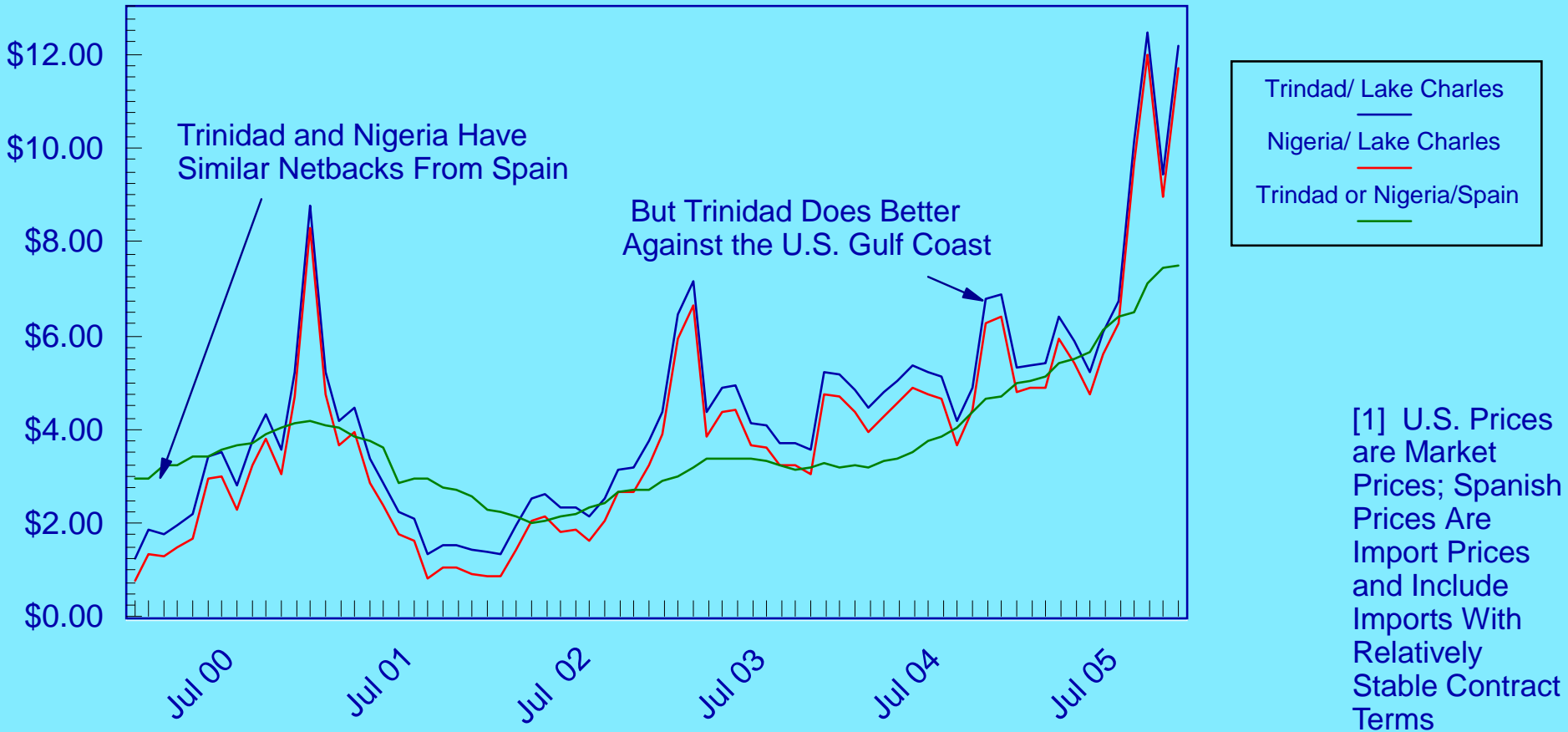
- The Greater Volatility of the U.S Netbacks is Largely Attributable to the Fact That the U.S. Henry Hub Price is a Spot Market Price; Spanish Border Prices Average Spot Prices With Those of More Stable Contract Volumes
- Thus Figure 5 Does Not Really Tell Us the Prices at Which Spain Has Competed for Spot Volumes
- Broadly Speaking, Trinidad and Nigeria Have Similar Netbacks from Spain, But Trinidad Has a Transportation Advantage to the Gulf Coast



Figure 5

# ILLUSTRATIVE NETBACKS [1] FOR SELECTED ATLANTIC BASIN ARBITRAGE PARTNERS - TRINIDAD AND NIGERIA TO SPAIN AND THE U.S. GULF COAST

\$/MMBtu



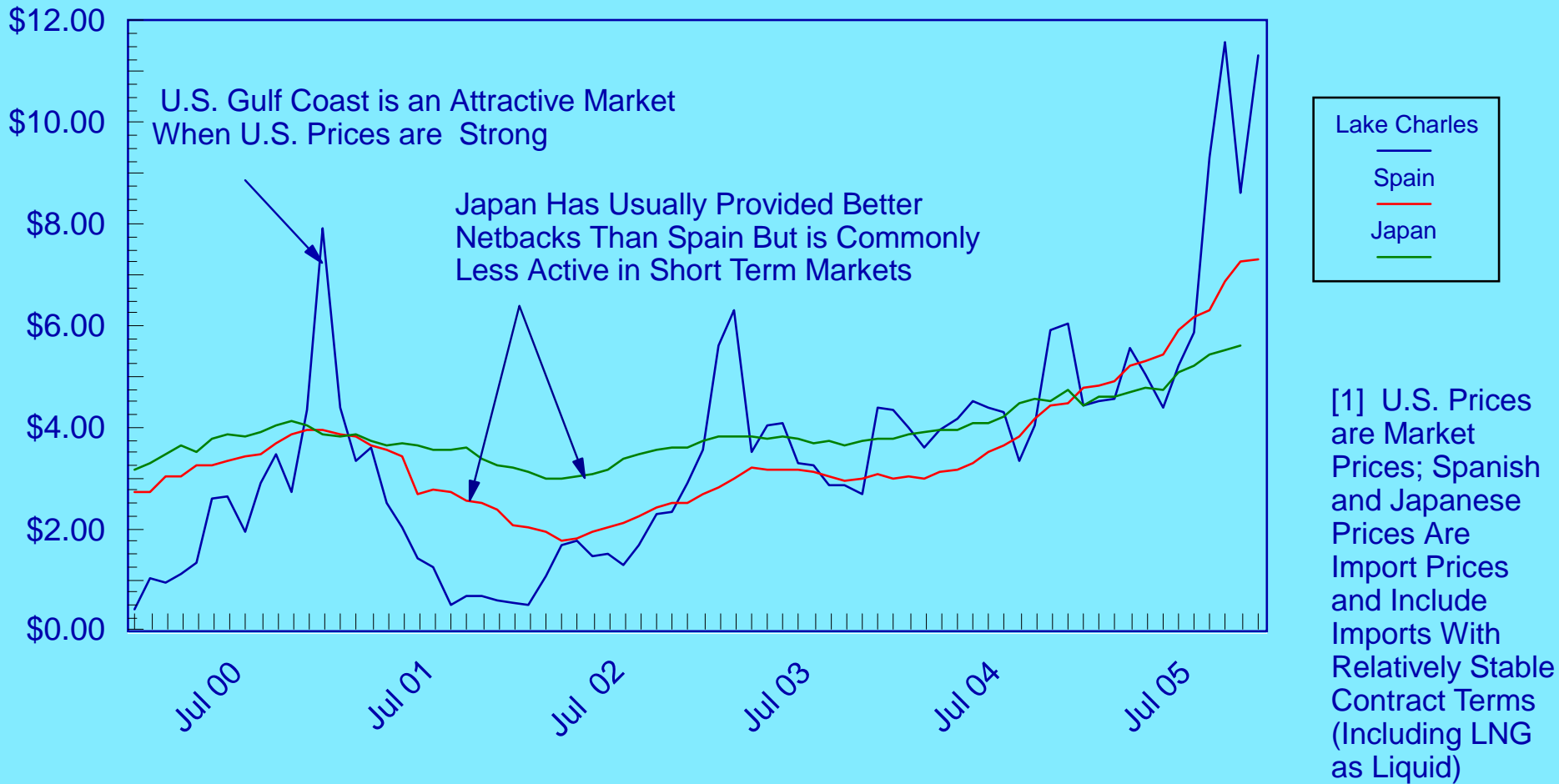
# **THE CENTRAL LOCATION OF THE MIDDLE EAST BETWEEN ATLANTIC BASIN AND PACIFIC BASIN MARKETS ENABLES IT TO SHIP EITHER EAST OR WEST AS MARKETS DICTATE**

- Thus it is in a Position to Play the Price Arbitraging Role Between Northeast Asia and the Atlantic Basin
- And it Can Also Play a Role in the Atlantic Basin Arbitrage by Favoring Either European or North American Destinations

Figure 6

# ILLUSTRATIVE NETBACKS [1] FROM THE U.S. GULF COAST, SPAIN AND JAPAN TO THE MIDDLE EAST SHOWING ARBITRAGE PATTERNS

\$/MMBtu



# THIS PAST YEAR HAS RAISED SERIOUS QUESTIONS ABOUT FUTURE LNG PRICE FORMATION

- In the Midst of a Growing Debate About the Value of Oil-Linked Pricing Clauses in Long Term Contracts, LNG Has Experienced Several Patterns of Disruptive Market Behavior
  - Sharply Higher Oil Prices
  - Liquefaction Supply Problems and Tight LNG Markets
  - The U.S. Katrina Disruptions
  - The U.K.'s Role Reversal from Exporter to Importer
  - Adverse Weather in Europe
- Not Only Have These Confused the Pricing Issue, but the Market Does Not Seem to Have Functioned as Smoothly in Allocating Gas Supply as One Might Have Expected
- One Source of Friction Has Been the Difference in the Response of the Restructured Gas Markets and the Contract-Dependent Markets to Higher Oil Prices

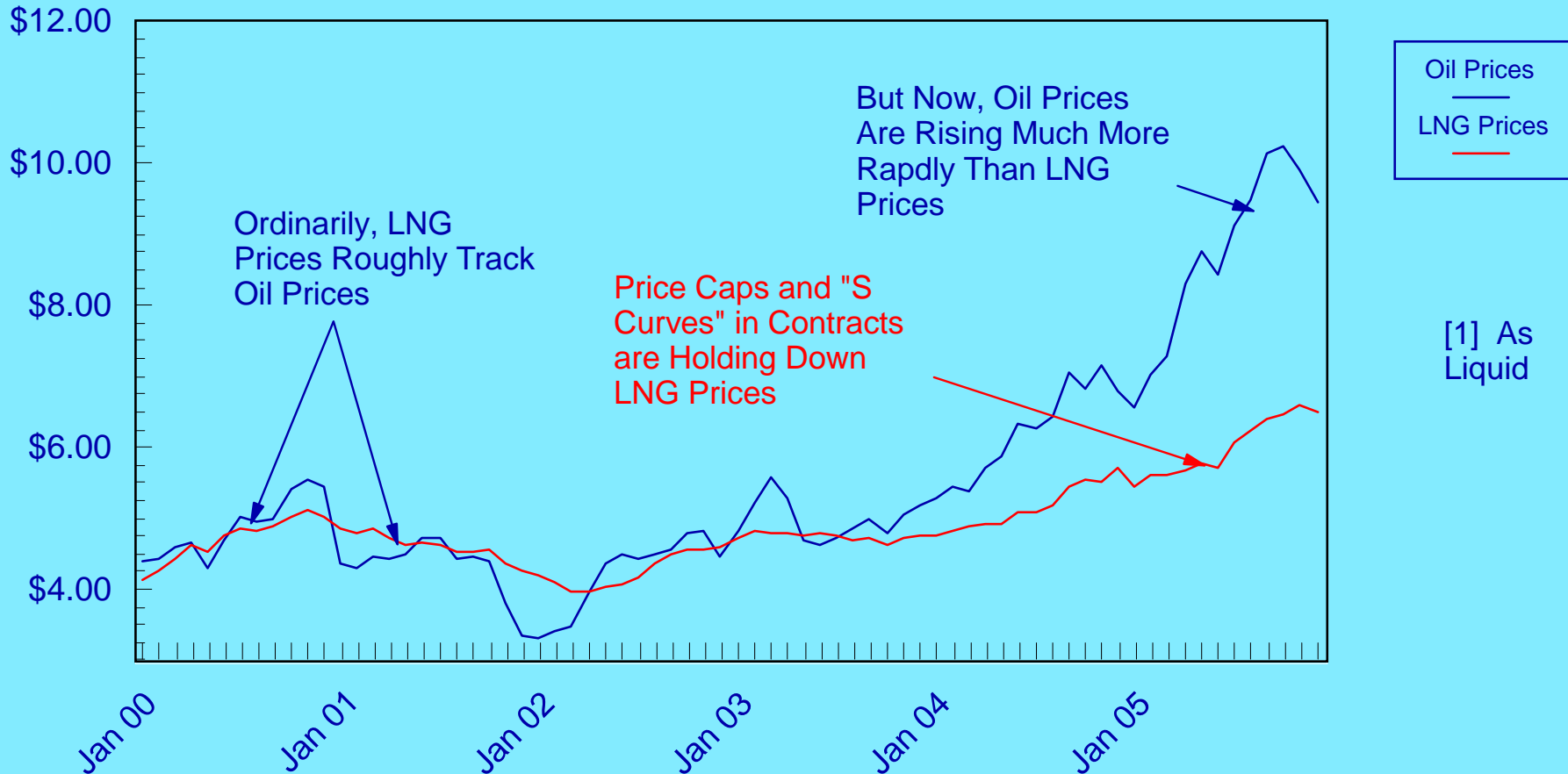
# **OIL AND GAS PRICE RELATIONSHIPS DIFFER IN THE FOUR MAJOR LNG IMPORT MARKETS - NORTHEAST ASIA, NORTH AMERICA, THE U.K., AND THE CONTINENT - AND THUS THEIR RESPONSE TO HIGH OIL PRICES MIGHT BE EXPECTED TO DIFFER**

- Traditional Long Term Contracting Still Dominates Northeast Asian LNG Trade
- The Traditional Contract Commonly Tied LNG Prices to The Japanese Customs Clearing Price for Crude Oil - JCC or the "Japanese Crude Cocktail"
- To Protect Buyers from Oil Price Shocks, Price Caps and "S Curves" Were Common
- These Price-Limiting Clauses Have Served to Insulate Japanese Import Volumes from Much of the Recent Surge in Oil Prices

Figure 8

# JAPANESE CUSTOMS CLEARING PRICE FOR CRUDE OIL (JCC) COMPARED WITH LNG IMPORT PRICES [1] IN \$/MMBTU

Price in \$/MMBtu



- The Price-Limiting Clauses Have Also Created a Substantial Difference Between Buyers' and Sellers' Negotiating Positions on Prices in New Contracts
- Sellers Argure That the High Prices in the U.S. and Europe Represent the New World Market Price for Gas
- But Buyers Do Not See Any Cost Justification for Such a Significant Increase from Traditional Price Levels
- This Has Been Partly Responsible for a Stalemate in Contract Negotiations
- It Has Also Raised Serious Questions About What Will Ultimately Determine LNG Price Levels
- An Interesting Question - "Does the Insulation of Japan From Full Oil Price Tracking Give It the Ability to Cross Subsidize Spot Market LNG Purchases to the Disadvantage of the Liberalized Gas Markets?"

# **IN SHARP CONTRAST TO JAPAN, THE U.S. HAS COMPLETELY RESTRUCTURED ITS GAS INDUSTRY**

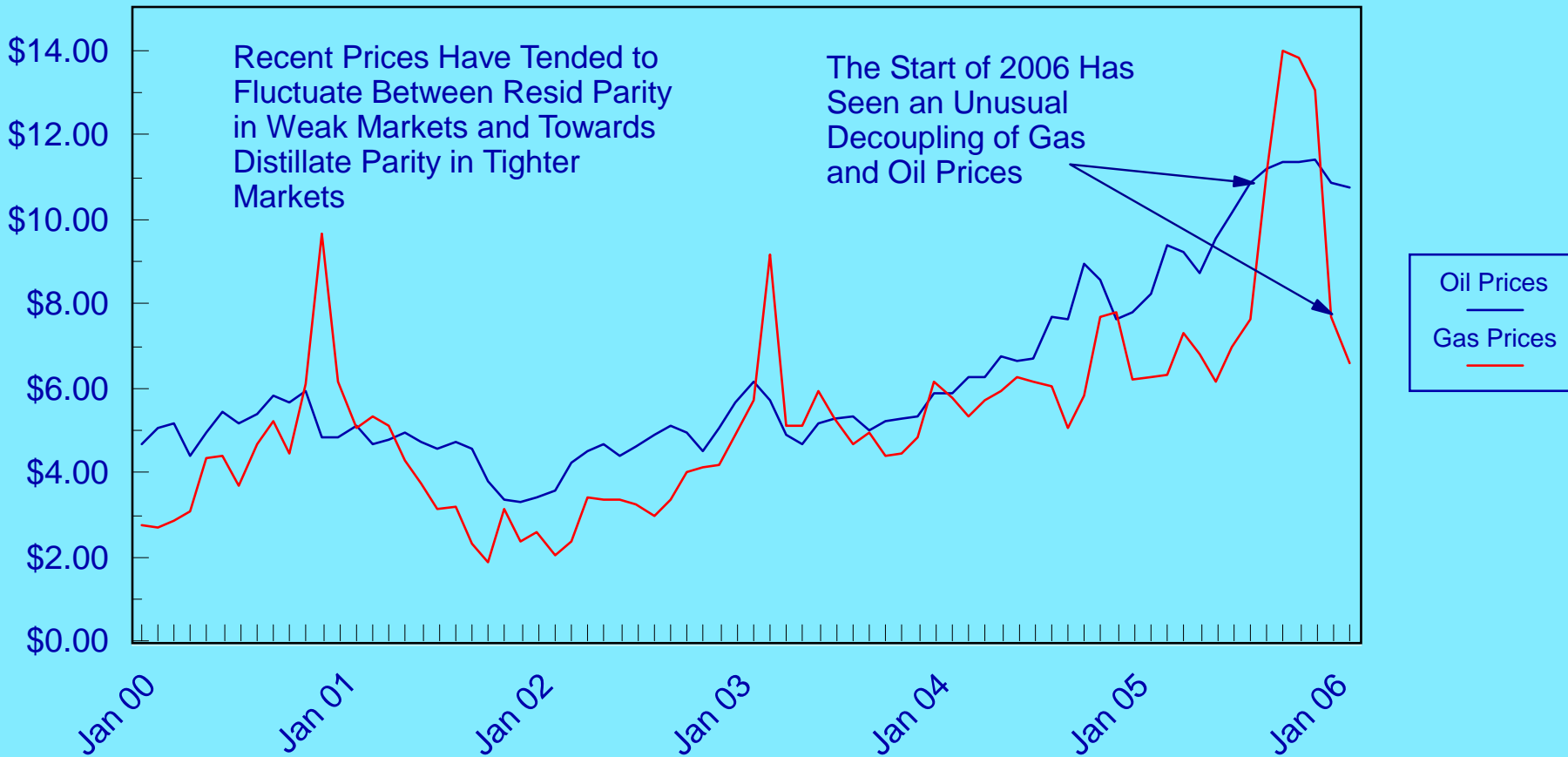
- Few Long Term Contracts Remain and the Contractual Linkage to Oil Has Completely Disappeared
- While the Working Assumption for a Time was That "Gas-to-Gas Competition" Made Oil Prices Irrelevant, an Indirect Linkage has Been Restored in Tight Markets Through Switching to Oil in Dual-Fired Boilers
- Weaker Markets Tend to Move Prices Towards Residual Fuel Parity; Stronger Markets Towards Distillate Parity
- The Start of 2006 Has Seen the Return of Gas-to-Gas Competition - Decoupled From Oil Prices - for the First Time in Four Years
- Another Question - "Is U.S. Oil Price Decoupling Only Temporary?"



Figure 9

# WTI CRUDE OIL PRICE COMPARED WITH HENRY HUB SPOT GAS PRICES IN \$/MMBTU

Price in \$/MMBtu



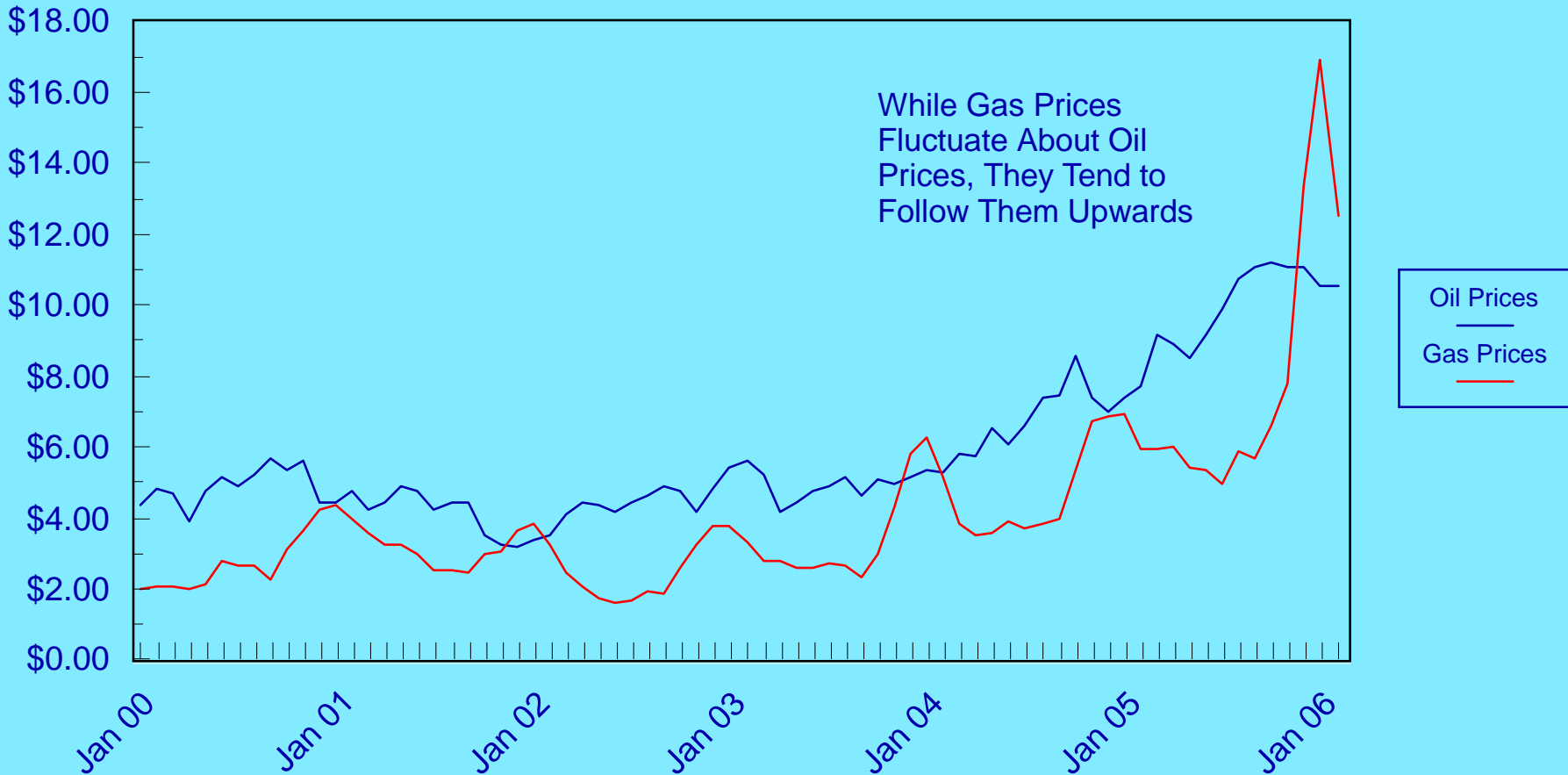
# **THE U.K. - LIKE THE U.S. - ALSO HAS A RESTRUCTURED GAS MARKET WHILE MOST OF THE CONTINENT REMAINS LARGELY CONTRACT-DEPENDENT**

- Thus, One Would Expect U.K. Price Behavior to Resemble that of the U.S. While the Continent Might Look More Like Japan
- But the U.K. - Previously in Surplus - Has Had No Reason to Develop an Indirect Link to Oil Prices as Has the U.S. and the Lack of a Liquid and Transparent Continental Market Makes it Difficult to See See How Continental and U.K. Prices Interact at This Point
- Thus, What Will Happen to U.K. Price Formation Now that It Has Become a Net Importer is Far From Clear
- Spain, the Major LNG Arbitrage Partner to the U.S. Also Has Some Contract-Protected Prices - Does it Have a Competitive Advantage Over the U.S. and the U.K.?

Figure 10

# BRENT CRUDE OIL PRICE COMPARED WITH U.K. NATIONAL BALANCING POINT SPOT GAS PRICES IN \$/MMBTU

Price in \$/MMBtu

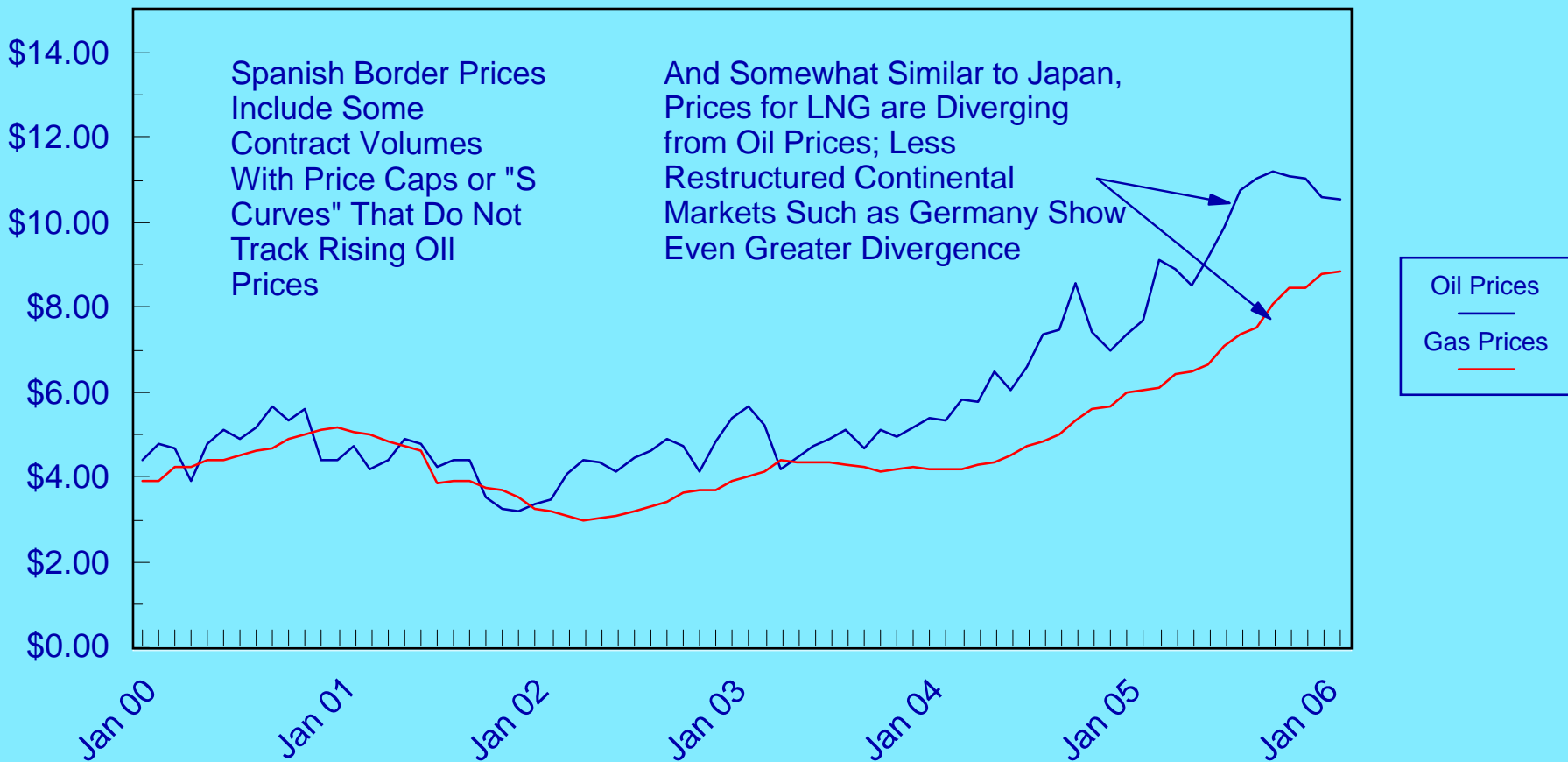


# Figure 11

## BRENT CRUDE OIL PRICE COMPARED WITH SPANISH BORDER PRICES

### IN \$/MMBTU

Price in \$/MMBTu



## WHAT DOES ALL THIS MEAN?

- North America is Moving from a Largely Self-Contained Gas Market to Reliance on LNG Imports at a Time of Great Uncertainty About the Outlook for Demand, Supply and Price of Internationally-Traded LNG
- The Principal Uncertainties in Developing an LNG Import Schedule Lie in How Rapidly Upstream Projects are Likely to Come on Line in the Face of Geopolitical Constraints and How Much Price Competition There Will Be for Those Supplies
- The Cost Structure for LNG and the Adequacy of U.S. Terminal Capacity - Assuming it Does Not Constrain the Upstream Supply Schedule - Are Probably Secondary Issues
- All of This Suggests the Importance of Developing a World Gas Model, Difficult Though That May Prove to Be

