

# THE NORTH AMERICAN LNG REVIVAL

Based on a Paper Published in The Energy Journal -  
"The LNG Revolution" - by James T. Jensen

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## THE "GAS PRICE SHOCK" OF THE WINTER OF 2000/01 HAS HAD TWO IMPORTANT CONSEQUENCES

- It Has Raised Questions About the Ability of the North American Gas Industry to Support a High Growth Rate in Demand Without Putting Significant Upward Pressure on Prices
- And it Has Revived Interest in Higher-Cost Alternative Supplies, Such as LNG and Arctic Gas
- But After a Brief Return to Lower Price Levels, Concerns for U.S. and Canadian Production Levels Have Returned and LNG is Now Widely Expected to Play a Significant Role in Gas Supply

# THE 1999 STARTUPS OF THE NIGERIA AND TRINIDAD LNG PROJECTS - THE FIRST SIGNIFICANT EXPANSION OF ATLANTIC BASIN LNG CAPACITY IN NEARLY TWENTY YEARS - USHERED IN A NEW ERA IN LNG

- The Renewed Interest in Atlantic Basin LNG is Attributable to a Number of Factors
  - The Favorable Economics of Gas-Fired Combined Cycle Electricity Generation Has Made Gas the Fuel of Choice for Power Generation
  - The Substantial Reduction in LNG Costs Has Made Previously Uneconomic Trades Appear Attractive
  - Companies That Once Ignored Gas Discoveries Have Become Interested in Monetizing "Stranded Assets"
  - And Both Europe and the U.S. Have Become Concerned About Supplementing Traditional Supplies

## NIGERIA PROVIDES A USEFUL ILLUSTRATION OF THE EVOLUTION OF TODAY'S OPTIMISM ABOUT LNG ECONOMICS

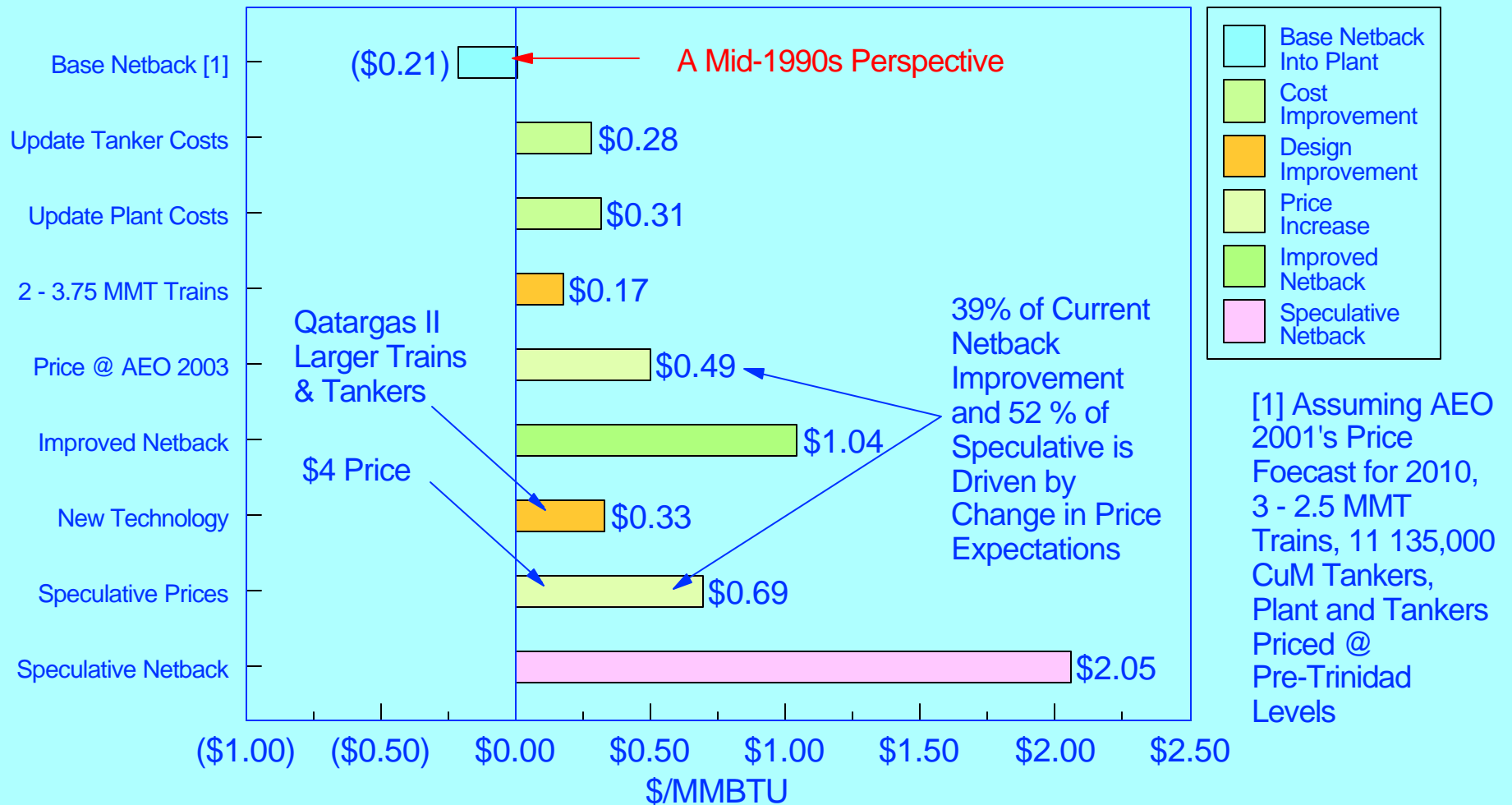
- In the Mid-1990s, a Consortium of Shell, AGIP, Elf and NNPC, Started Negotiations on What Has Become the Bonny LNG Project
- Initially the Sponsors Could Not Demonstrate Economic Feasibility for a Project Destined for Italian and U.S. Markets
- But by Taking Very Low-Cost Options on Seven Laid-Up LNG Tankers at a Time When the Price of Newbuilds Was at an All-Time High, They Cut Project Costs Enough to Make it Economic

- The Following Figure Illustrates the Economics that a New Nigerian Greenfield Project Destined for the U.S. Gulf Coast Might Have Faced in 1998, Given the Designs, Costs and Price Expectations of the Period.
- As is Evident, the Project was a Non-Starter Since the Initial Netback to the Inlet of the Liquefaction Plant was Negative (-\$0.21)
- Figure 1 Then Traces the Improvements in Netbacks As a Result of Using Current Cost Estimates for the Original Design, as Well as the Design Improvements in Plant Economics from Increasing Plant Sizes - Two 3.75 MM Ton Trains, Instead of Three 2.5 MM Ton Trains

- But an Even Larger Contribution to the Improvement Comes from the Focus of These EMF Workshops - an Increase in Gas Price Expectations
- If One Accepts the Growing View That Supply/Demand Balances Will be Tight and Prices Will Escalate, LNG Economics Look Much Better
- A Substitution of the EIA AEO 2003 Price Forecast for the AEO 2001 Forecast Accounts for Nearly 40% of the total \$1.25 Netback Increase from These Demonstrated Improvements in the Pricing Outlook
- If One Were to Adopt the More Speculative Technology that Qatargas II is Considering - A 7.5 MM Ton Train and 250,000 Cubic Meter Tankers - Together with an Optimistic \$4 Gas Price, the Netback Would Increase Even Further

Figure 1

# THE EVOLUTION OF OPTIMISM ABOUT LNG IMPORTS THE CHANGING PERSPECTIVE OF U.S. NETBACKS FROM THE U.S. GULF TO A NIGERIAN GREENFIELD PLANT FROM 1998 TO 2003

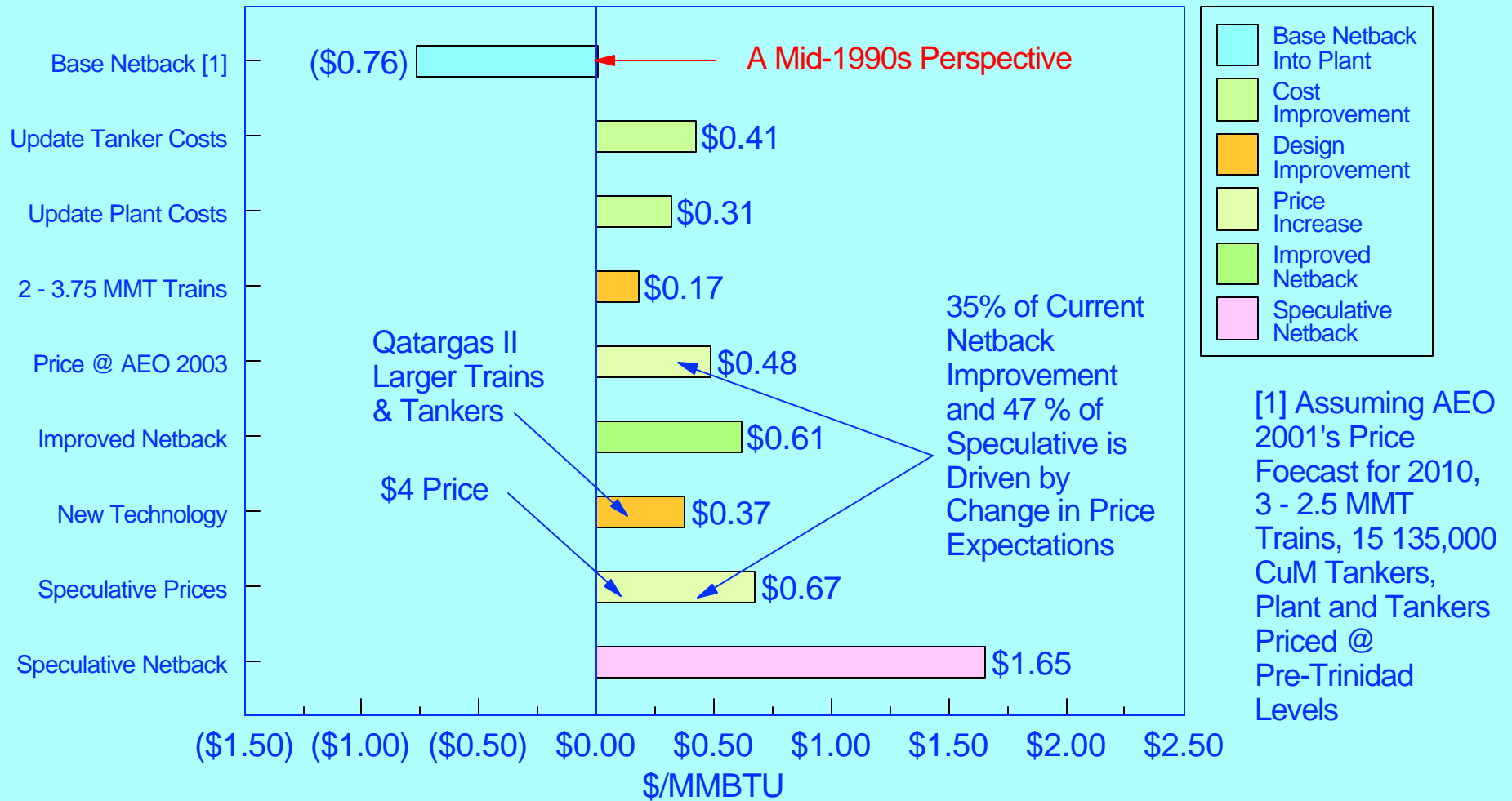


- While the Figure Does not Adjust for the Problems Inherent in Accommodating " LNG Super Tankers" in Our Limited Draft Ports, Work is Underway to Solve This Problem and It is Not Clear That Terminal Costs Necessarily Must Rise
- One of the More Intriguing Possibilities is the Use of Offshore Offloading Terminals (That Circumvent the NIMBY Problem with Onshore Terminal Approvals) When Combined With a Technology Developed by Conversion Gas Imports That Envisions Gas Injection into Salt Domes
- For a Middle East Shipper, the Cost Problem is Even More Acute Than it is for Nigeria (Which is Why Qatargas II is So Interested in Technical Innovation) But the Cost Improvements Also Make the Middle East Potentially Economic, As Well



Figure 2

# THE EVOLUTION OF OPTIMISM ABOUT LNG IMPORTS THE CHANGING PERSPECTIVE OF U.S. NETBACKS FROM THE U.S. GULF TO A MIDDLE EAST (QATAR) GREENFIELD PLANT FROM 1998 TO 2003



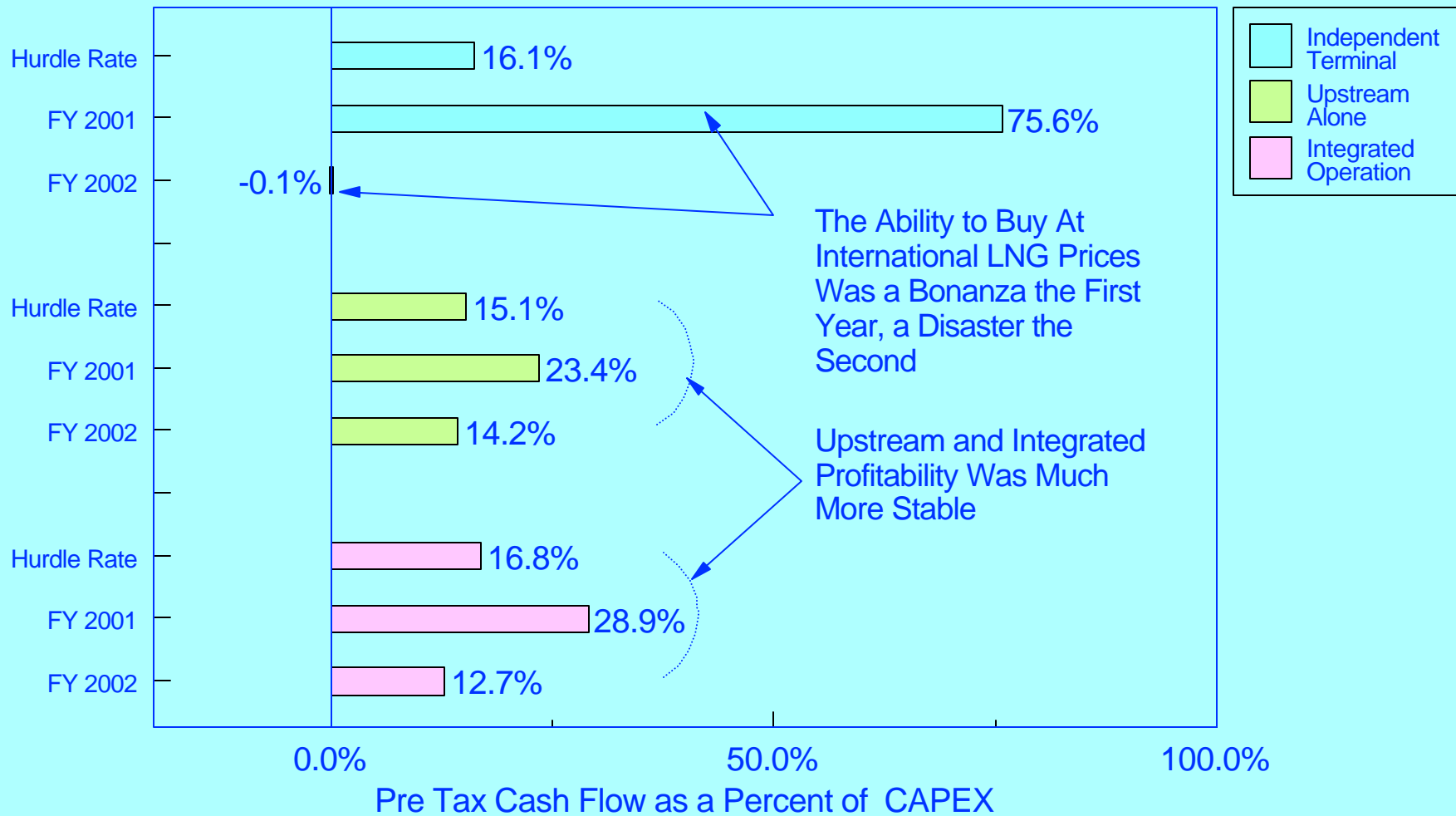
## THE 2000/01 PRICE SHOCK BROUGHT FORTH A LARGE NUMBER OF NEW TERMINAL PROPOSALS, MOST OF THEM FROM INDEPENDENT OPERATORS WITHOUT UPSTREAM LNG ASSETS

- The Initial Driving Force Was Presumably the Very Large Scarcity Rents Associated With the Ability to Buy in the International Surplus LNG Market and Sell into the High-Priced U.S. Market - A "License to Print Money"
- But When Prices Collapsed in Late Spring 2001, the Margins Also Collapsed
- Figure 3 Compares the Estimated Pre-Tax Cash Flow as a Percent of Capital Investment for a New Independent Gulf Coast Terminal Together With My Estimated Hurdle Rate to Justify the Investment Compared to That Which the Investment Might Have Experienced in July/June 2000/01 and Again for the Following Year

- The Estimated Margins are Based on the Experience at Lake Charles During the Period and Assume Operation at Design Capacity; On This Basis Everett Did Better
- The Impact on an Upstream Operation Selling to the Merchant Terminal Was Similarly Affected - More Profitable Than the Hurdle Rate the First Year, But Less Profitable the Second
- The Swings, However, Were Much Less Pronounced
- A Fully Integrated Operation From the Wellhead to the Terminal Outlet Would Have Experienced a Similar Pattern

Figure 3

PRE TAX CASH FLOW AS A PERCENT OF CAPITAL INVESTMENT FOR  
AN INDEPENDENT GULF COAST MERCHANT TERMINAL  
THE SHARP CHANGE IN PERCEIVED PROFITABILITY BETWEEN JULY/JUNE  
2001/02 AND JULY/JUNE 2001/02



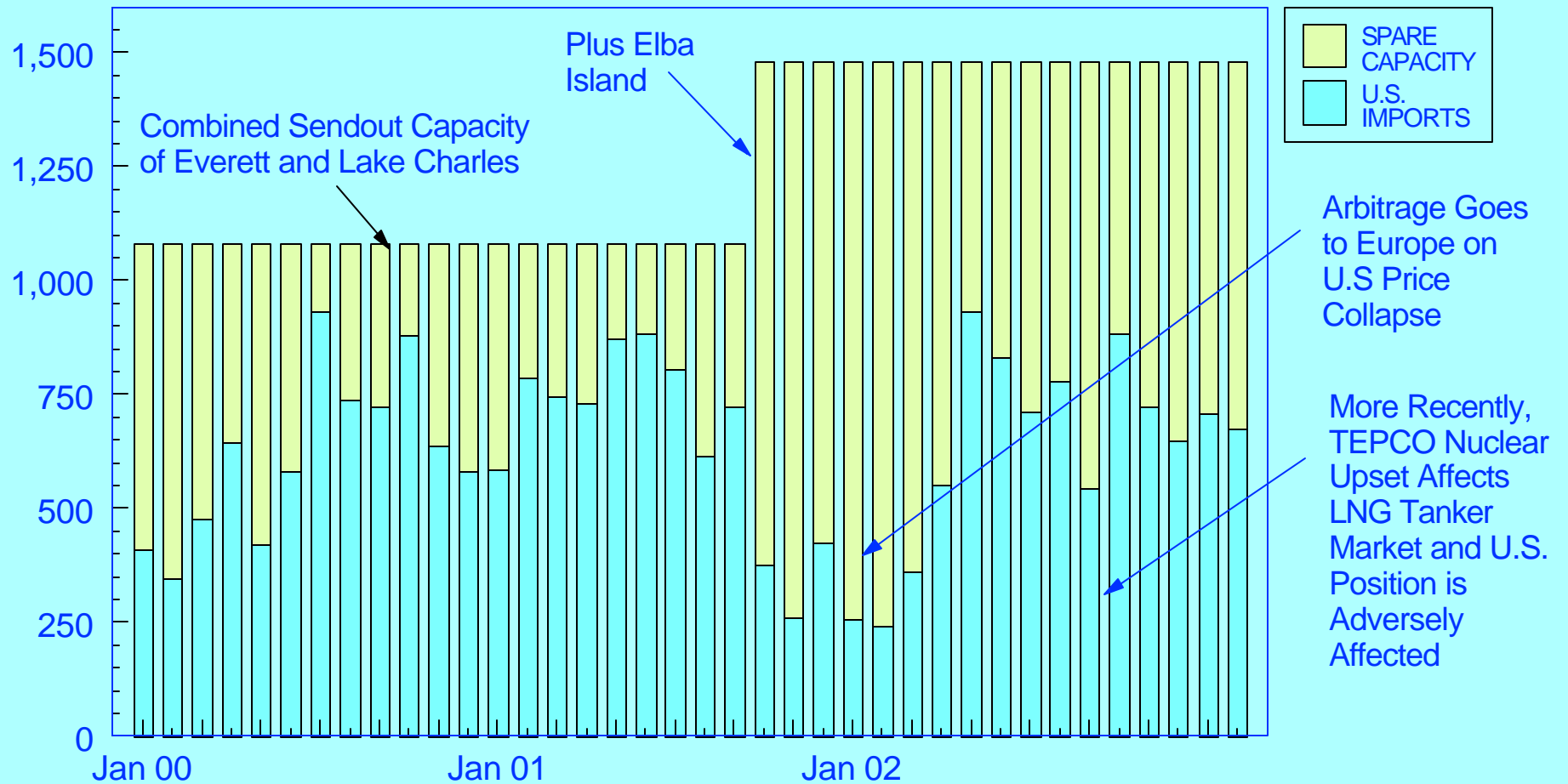
- The Figure Presumes Terminal Operation at Design Levels; Actual U.S. Terminal Throughput Was Much Lower Reflecting Competition With European Buyers for Cargoes
- For Example, During the First Year, the Operating U.S. Terminals Experienced a Capacity Factor of 70%; During the Second Year, However, the Capacity Factor Dropped to 38%
- Although the Second Year Included a Temporary Post 9/11 Terminal Closure, the Principal Reason Was That European Arbitrage Offered Better Netbacks to Suppliers
- More Recently, a Shutdown of 15 Nuclear Plants by Tokyo Electric Has Upset World LNG Supply/Demand Balances and Tanker Availability Patterns to the Detriment of U.S. Markets

Figure 4

# COMPARISON OF U.S. LNG TERMINAL IMPORTS WITH CAPACITY MMCFD

Effective Capacity Factor  
Jul/Jun 00/01 - 70%  
Jul/Jun 01/02 - 38%

MMCFD



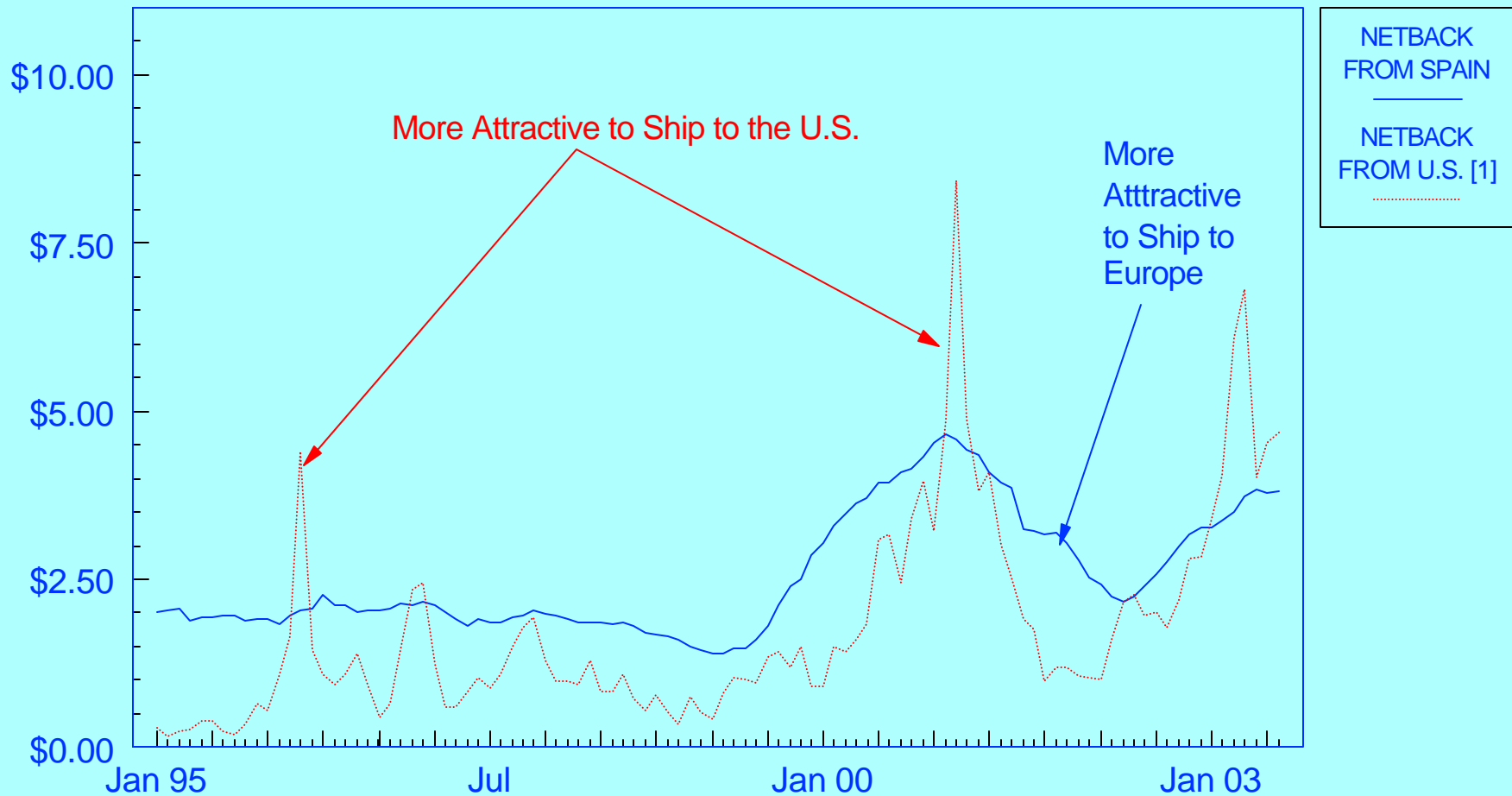
Jensen

- An Active Atlantic Basin Arbitrage Market Has Developed in Recent Years
- It Principally Involves Supplies from Trinidad, Nigeria and Algeria Trading Off the U.S. Terminals Against Spain and Belgium on the European Side
- Figure 5, Using Lake Charles Against Huelva, Spain, Indicates How it Works
- Everett, Because of its Favorable Basis Differentials Over Henry Hub, is an Even Better Arbitrage Partner Than Lake Charles

Figure 5

ILLUSTRATIVE NETBACKS TO THE LOADING PORT THAT A  
HYPOTHETICAL NIGERIAN SHIPPER WOULD HAVE REALIZED  
SHIPPING TO THE U.S.GULF COAST OR TO SPAIN  
ASSUMING FULLY ALLOCATED TANKER COSTS

\$/MMBTU



[1] Assuming a \$0.35 Regasification Charge on the U.S. Gulf Coast

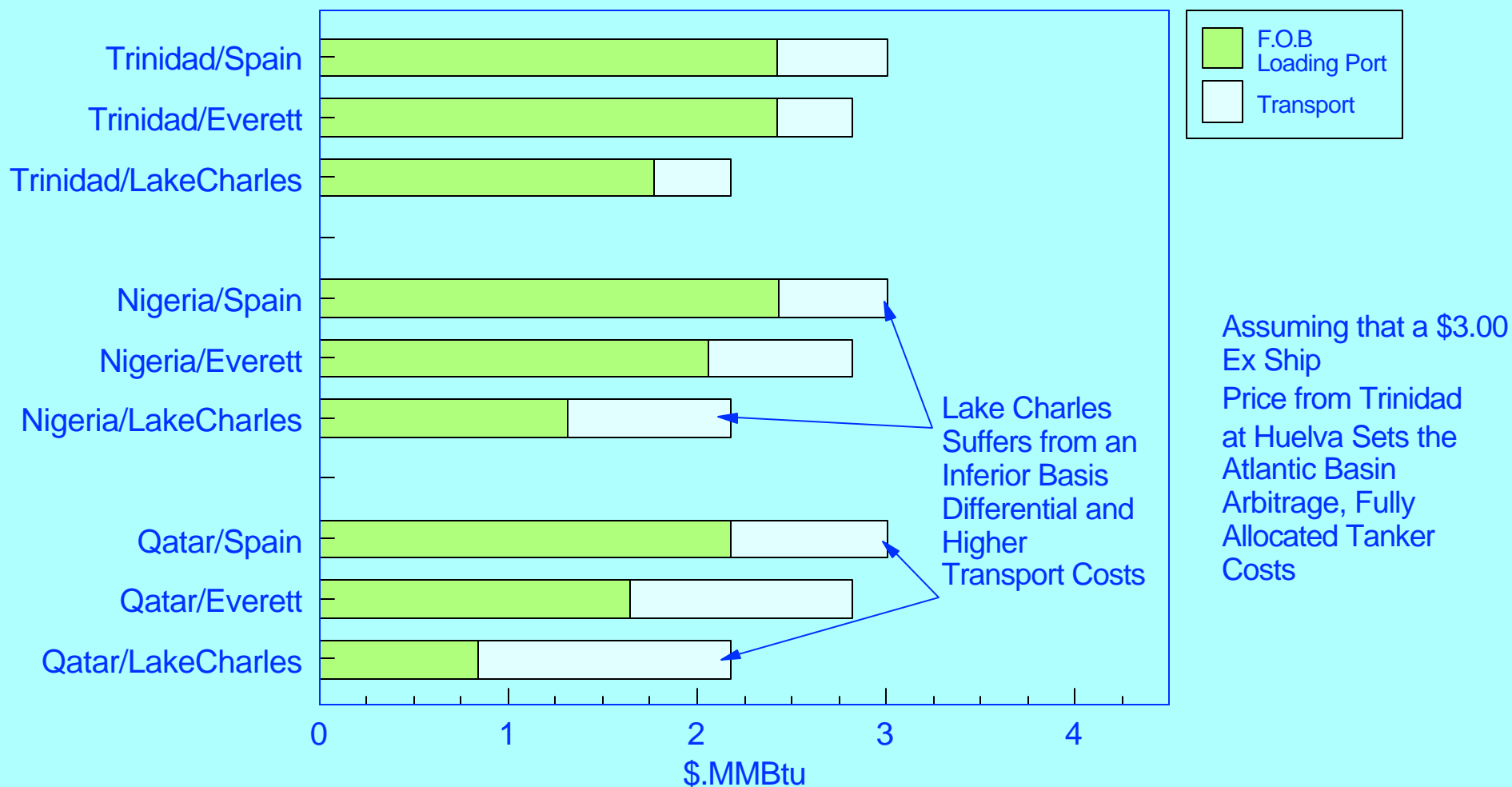


- Everett, Like Cove Point, is a Very Desirable Destination for LNG Imports, Because (1) It Enjoys a Significant Basis Differential (a Premium of About \$0.55 Over Henry Hub Prices) and (2) It is Closer to Most LNG Suppliers, Thereby Minimizing Transport Costs
- Figure 6 Illustrates the Effect on the Netback (As Liquid) to the Loading Port of the Combined Basis Differential and Transport Saving for Three Different Supply Sources
- The Figure Assumes that the Atlantic Basin Arbitrage has Settled at Parity out of Trinidad for Either Huelva, Spain or Everett as a Basis for Price Formation (at an Ex Ship Price of \$3.00 at Huelva)

Figure 6

# NETBACKS TO TRINIDAD, NIGERIA, AND QATAR LOADING PORTS FROM EUROPEAN AND U.S. TERMINALS

ASSUMING THAT A \$3.00 EX SHIP DELIVERY FROM TRINIDAD TO HUELVA, SPAIN IS ARBITRAGED AGAINST A TRINIDAD DELIVERY TO EVERETT



## THE APPEAL OF THE UPSTREAM BASIS DIFFERENTIALS AND SHORTER TRANSPORT HAULS ARGUES FOR NEW TERMINAL SITING ON THE EAST COAST

- Unfortunately, It Has Proved All But Impossible to Gain Siting Approval for Such East Coast Locations Because of Local Popular Resistance
- Therefore, Atlantic Basin Terminal Options Seem to Have Settled on Three Different Alternatives
  - 1) Gulf Coast Locations Where the Long History With Oil/Chemical Sites Minimizes Local Opposition
  - 2) Foreign Locations, Such as Nova Scotia, New Brunswick, the Bahamas or Mexico, Where Siting Approvals May Be Easier to Obtain But the Gas Must Be Further Moved by Pipeline
  - 3) Offshore, Where Environmental Approvals are Less Stringent

## THERE ARE PLUSSES AND MINUSES WITH EACH OF THESE ALTERNATIVES

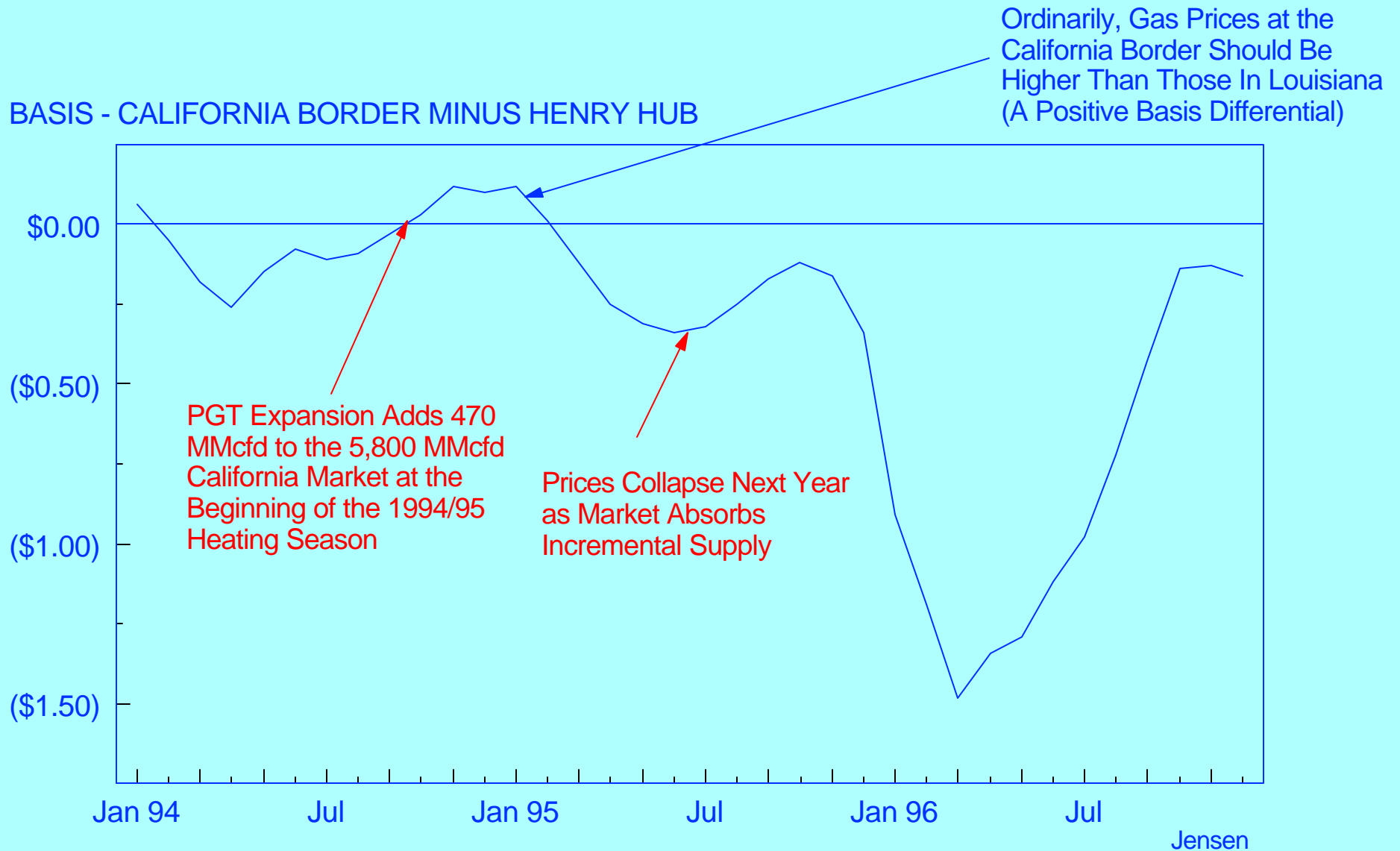
- The Gulf Coast Terminal Options Forfeit the Basis Advantage and the Shorter Distance From Sources
- But They Are Easier to Approve - Sempra's Hackberry, LA Facility is Already Authorized - And They Have Access to the Heart of the Pipeline Grid System
- The Foreign Locations Lose Some of their Basis Advantages Through Onward Pipelining and They Can Easily Overload Local Markets With Negative Pricing Consequences

- The Offshore Locations Have Come into Greater Favor With the November 2002, Enactment of the the Deepwater Port Act Amendment (DWPA). The Legislation Shifts Regulatory Responsibility for Offshore LNG Facilities from the Federal Energy Regulatory Commission to the Maritime Administration and the U.S. Coast Guard.
- El Paso's "Energy Bridge" Concept and ChevronTexaco's Port Pelican Offshore Floating Barge are Examples of Offshore Terminal Approaches
- There is Now a Great Deal of Interest in Innovative Offshore Technical Concepts and Breakthroughs are Very Possible in This Area
- Supposedly, ExxonMobil Has Considered Combining an Offshore Terminal with the Conversion Gas Imports Technology that Gasifies into Salt Domes

- For the California Market, there are Similar Problems in Siting, With the Mexican Baja California Terminal Approach in Great Favor
- But California is Remote from Most Existing Supply Sources and it is a Market That Can Easily Be Overloaded, Thus Introducing the Concept of "Basis Risk" into the Feasibility Analysis
- California's Experience with the Expansion of the Pacific Gas Transmission System from Alberta in 1994 Illustrates the "Basis Risk" Problem

Figure 7

"BASIS RISK" - COLLAPSE OF THE CALIFORNIA BASIS DIFFERENTIAL FOLLOWING THE 1994 EXPANSION OF PACIFIC GAS TRANSMISSION  
THREE MONTH MOVING AVERAGE



## BUT FOR ALL OF THE ATTENTION BEING PAID TO THE NORTH AMERICAN TERMINAL SITING AND INVESTMENT ISSUE

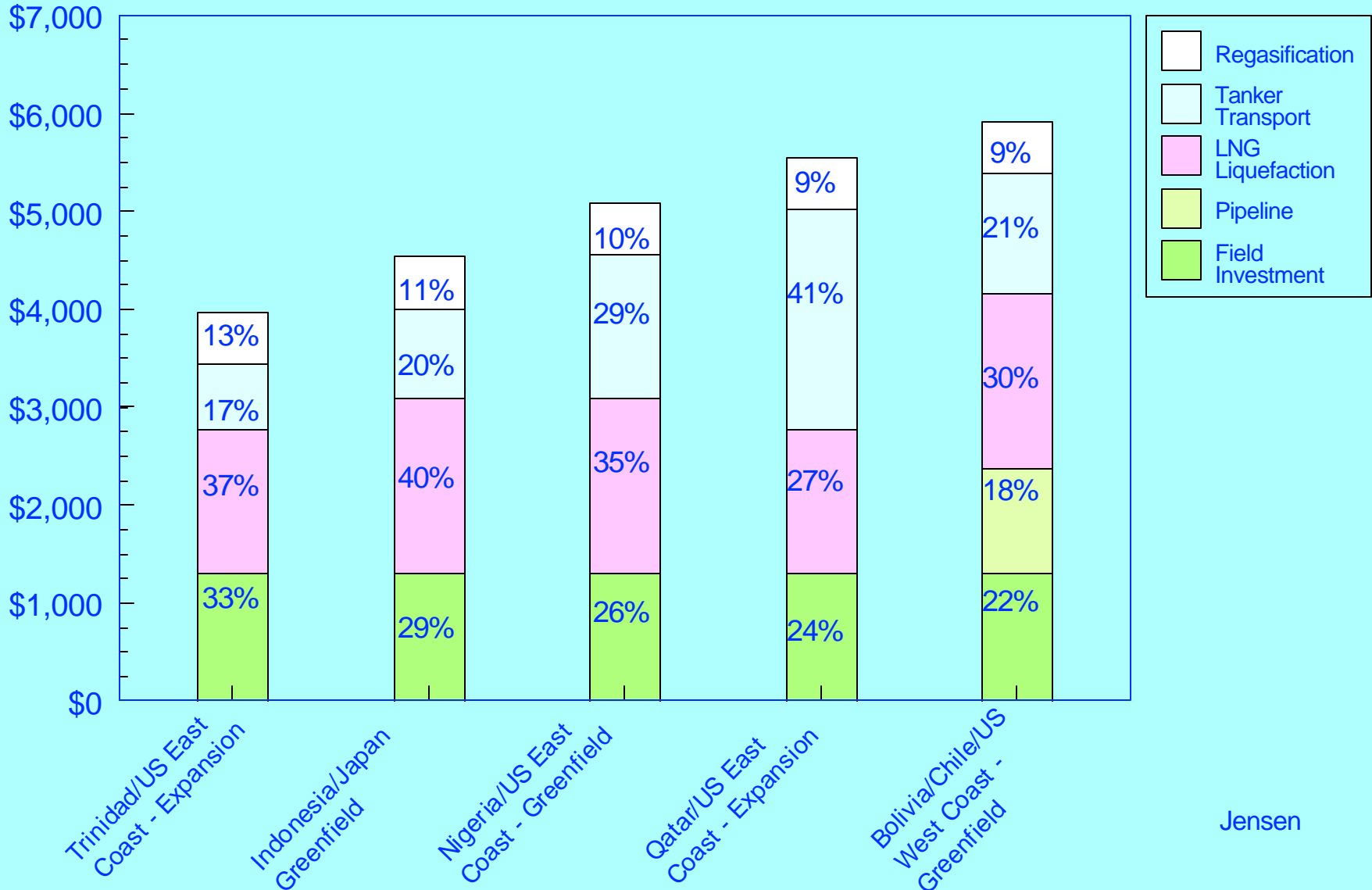
- Terminals Are a Comparatively Small Part of the Total LNG Supply Chain - They are the "Tail" - The "Dog" Is Upstream
- Thus the Issues of When and How Much LNG Will be Available to U.S. Markets is Heavily Dependent on Decisions Made About Upstream Investments
- Figure 8 Illustrates the Portion of the Capital Investment Required for Different Functions for Several LNG Trades
- The Portion of the CAPEX in Regasification Varies from 9% to 13 % of the Total; Conversely, the portion of Field and Plant CAPEX in the Producing Country Ranges from 51% to 70% of the Total



Figure 8

# ILLUSTRATIVE CAPITAL EXPENDITURE PROFILES FOR SELECTED LNG PROJECTS ASSUMING TWO 3.3 MMT TRAINS AND A FIELD INVESTMENT OF \$3.85/ANNUAL MMBTU

CAPEX - \$MILLION



# THE LNG BUSINESS HAS FREQUENTLY BEEN DESCRIBED AS A "CHAIN" WHOSE ULTIMATE SUCCESS IS AT RISK TO THE POSSIBLE FAILURE OF ITS WEAKEST LINK

- Traditionally, the "Chain" was Held Together By a Comparatively Rigid Set of Long Term Contracts Featuring the "Sale and Purchase Agreement" or SPA
- The Risk Sharing Logic of the SPA Was Embodied in the Phrase ... "The Buyer Takes the Volume Risk and the Seller Takes the Price Risk"
- Hence, Contracts Typically Included a Take-or-Pay Provision to Insure Buyer Offtake at Some Minimum Level and a Price Escalation Clause to Transfer Market Price Uncertainty to the Seller
- Commonly, Contracts Featured Oil-Linked Price Clauses

- Now, In the Atlantic Basin - For the First Time - This Traditional Structure is Confronting a Restructured Gas Industry Whose Logic Presumes that Gas Markets are Workably Competitive and That Commodity Competition is the Most Effective Model for the Industry
- This Clash of Structural Models for the LNG Industry - "The LNG Revolution" - Has Substantially Shifted the Balance of Risks and Rewards Among the Parties in Ways that are Not Yet Fully Understood
- How it Ultimately Plays Out Will Go a Long Way Towards Determining the Future Role of LNG in the U.S.

- The Initial Wave of Enthusiasm for Independent Terminals in North America Reflected The Thrust of the Newly Restructured Way of Doing Business
  
- But the Enthusiasm Has Cooled Significantly As:
  - The Difficulty of Siting New Terminals Became Increasingly Apparent
  - The Traders - Led by Enron - That Led the Charge Against the Old Order, Got Into Financial Difficulties
  - The Risks Inherent in Independent Terminal Operation Without Contract Protection Became Apparent in the Price Collapse of 2001/02 and the Competition With Europe for Cargoes
  - And the Upstream Players - Reluctant to Let the Scarcity Rents Associated With U.S. Terminal Ownership Escape Them - Have Now Contractually Tied Up Virtually All of the Existing U.S. Terminal Capacity

- Thus, the Momentum for U.S. Terminal Investment Seems to be Shifting in Favor of the Players with Upstream Assets - Where the Largest Investments and Risks Are Located
- FERC, in its "Hackberry Decision" Has Made the First Concession to the Old Order by Not Requiring "Open Access" to Terminals, Thus Recognizing the Suppliers' Argument that They Were Not Prepared to Invest in New Terminals Unless They Could Control the Throughput
- This Dispute is Also Active in Europe, But Has Not Yet Been Resolved There

## IF THE FOCUS ON NORTH AMERICAN LNG SUPPLY IS INDEED SHIFTING UPSTREAM, IT RAISES QUESTIONS THAT ARE NOT EASY TO DEAL WITH IN NATURAL GAS MODELS

- 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
- Prominent Among the Stakeholders are the Producing Governments (Where At Least Half of the CAPEX are Concentrated) Raising Questions of Political Risk, Not Only About the Stability of the Governments, But of Fiscal Regimes, as Well
- Thus LNG Projects Do Not Smoothly Respond to Short Term - and Volatile - Price Signals When Demand Calls for New Supply

## THE REFOCUSSED ATTENTION ON THE UPSTREAM PART OF THE CHAIN HAS RAISED A NUMBER OF ISSUES

- Will the the Long Term Contract Survive in a Restructured LNG Industry, and If So, What Will be the Balance of Long Term Versus Short Term Sales?
- How is Supply Affected by Political Risks?
- How Has the Balance of Risk and Reward Shifted As Between Buyers and Sellers?
- And What is Likely to be the Response of the Sellers to the New Environment?
- My Paper, "The LNG Revolution", Deals at Some Length With These Issues and I Will Not Labor Them Here, But Simply Summarize My Views

- No One Has Yet Been Willing to Launch a New LNG Train Without at Least Some Protection From Long Term Contracts - Hence, I Believe the Long Term Contract is Here to Stay and Will Provide the "Filter" That Controls New Supply Additions
- But Companies are Increasingly Willing to Make Investment Commitments With Volume Coverage That Might Have Been Regarded as Reckless at an Earlier Period - Thus a Sizeable Short Term Market Will Remain
- In the Newly Restructured LNG Industry, it is Increasingly Difficult to Find Buyers Who Can Deliver on the Traditional Volume Commitment (A Volume Obligation That is Tied to a Gas Market Indicator is a Substantially Weakened Obligation Since It is So Easy to Lay it Off In the Market)



- Hence, a Significant Part of the Market Risk Has Migrated Upstream
- And Political Risk Has Never Really Gone Away
- The LNG Industry Was Born in a Climate of Political Dispute, (Remember Algeria?) But For a Time the Industry Believed That the Issue Was a Thing of the Past
- But Recently, In Indonesia We Have Had the Aceh Rebellion in Western Sumatra and the Secession of East Timor, Both of Which Have Had a Negative Effect on LNG Plants and Proposals Such as Arun, Bayu Undan and Greater Sunrise
- And Two of This Winter's Political Upsets in Oil Supply Involved Countries That Are Expected to Be Sources of LNG for the U.S. - Venezuela and Nigeria

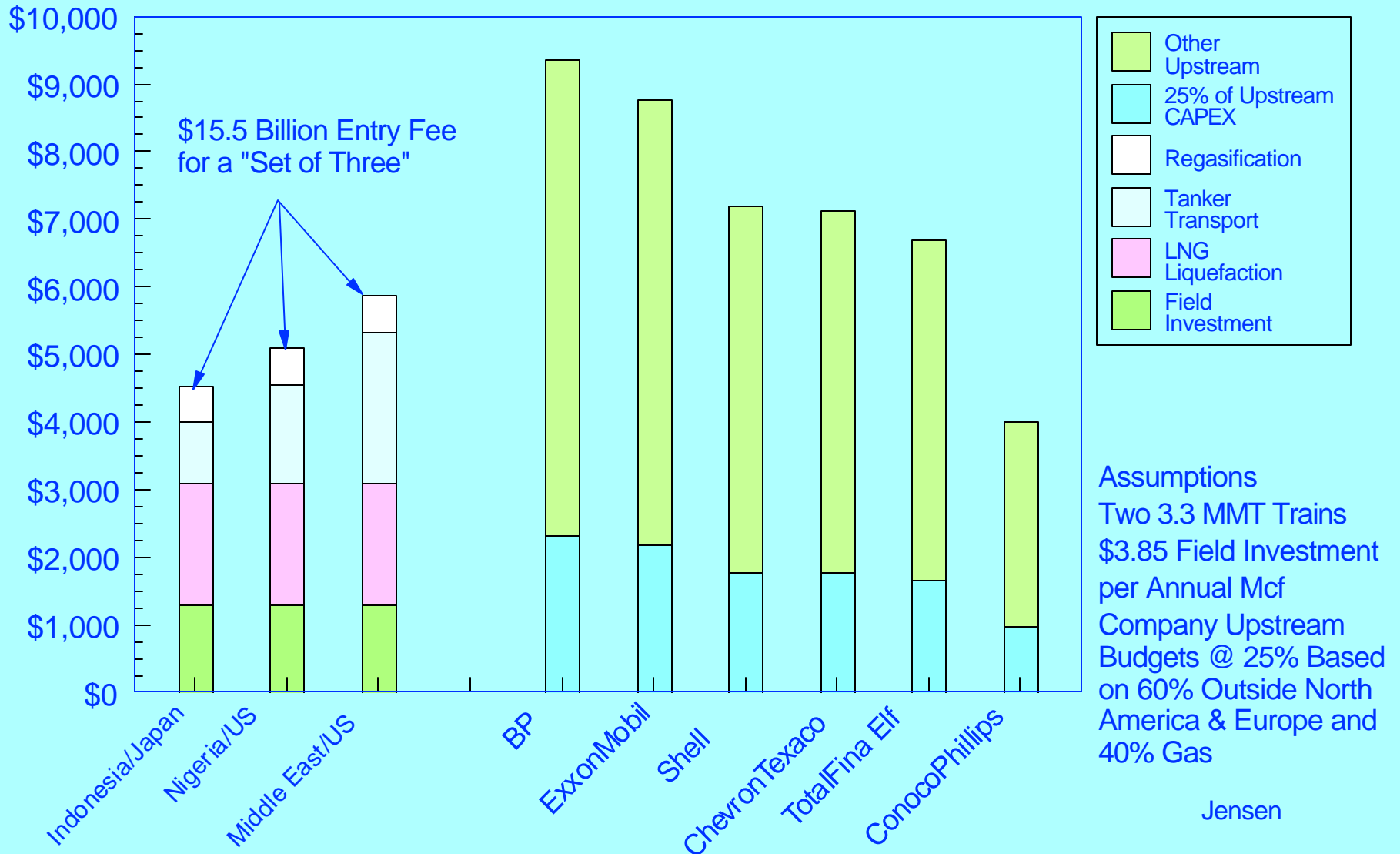
- While the Growing Diversity of Supply Sources Tends to Insulate Buyers from These Political Risks, Sellers With Investments in Affected Countries Can Only Spread the Risks by Investing in a Portfolio of Supply Sources
- The Long Term Contract Gave Sellers the Assurance That They Had Secure Outlets Without the Need to Integrate Downstream as the Industry Has Traditionally Done in Oil
- But If There is Less Security in the Long Term Contract, Downstream Integration Looms as an Attractive Option
- In the Face of These Market and Political Risks, Integrating Downstream and Creating a Diversified Supply Portfolio Would Seem to Make Good Sense as an Investment Strategy

- The Problem is That the Price Tag for the Highest Degree of Diversity is So Large That Few Companies Can Afford It
- Figure 9 Compares a "Greenfield Entry Fee" for What Might Be Described as a Fully Diversified LNG Portfolio to the 2001 Capital Expenditures of the Five Super Majors - the "Five Sisters" - (Together With the Smaller ConocoPhillips)
- After Adjusting the Budgets for Other Upstream Investments, the "Entry Fee" Remains Large Compared to Available Investment Dollars
- While There Will Be Many Individual "Niche" Opportunities For Other Companies in This Growth Business, It is Not for the Faint of Heart or the Undercapitalized

Figure 9

# THE GREENFIELD LNG PROJECT "ENTRY FEE" COMPARED TO THE UPSTREAM 2001 CAPEX BUDGETS OF SELECTED COMPANIES

CAPEX - \$MILLION



## IN CONCLUSION

- The Growing Optimism About LNG Imports Reflects Genuine Strides That the Industry Has Made in Cost Reduction, Progress That is Still Continuing
- But it Also Reflects Assumptions by the LNG Investors That North American Supply/Demand Balances Will Remain Tight and Prices Stay Higher Than Might Have Been Expected Several Years Ago
- But Projecting the Level of Imports is a Substantial Challenge Since Much of the Driving Force for New Projects Resides in the Suppliers and is Concentrated Upstream in the Producing Countries

