

# Atlantic Basin Gas Market Integration

Prof. David Victor, Director

Mark Hayes, Research Fellow

Program on Energy and Sustainable Development

Stanford University

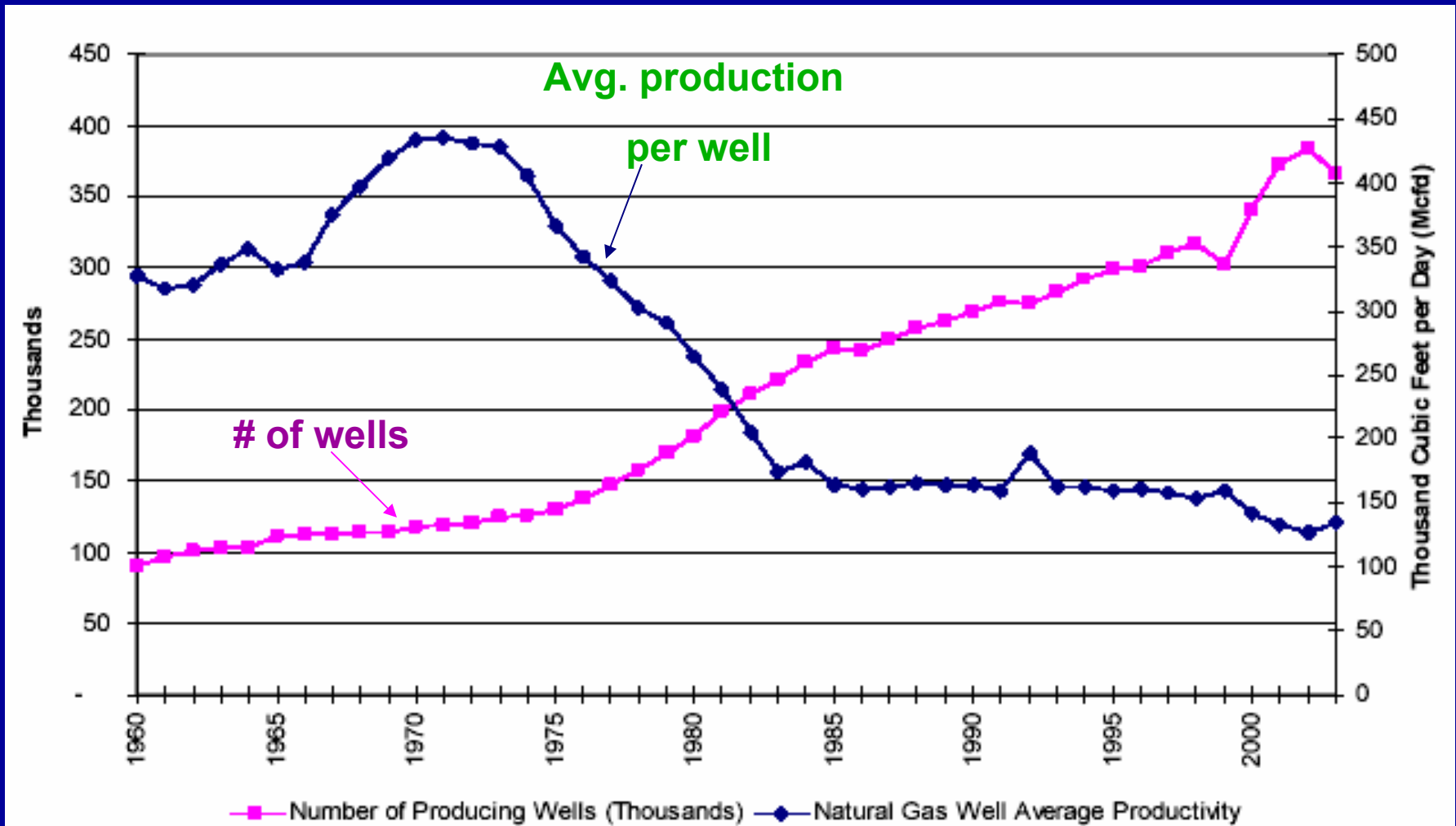
<http://pesd.stanford.edu/>

# Outline

1. Demand/Supply for gas & LNG in the Atlantic Basin
2. Revolution in LNG Trade
3. Simulating Future LNG Cargo Flows and Price Formation
4. Implications & Conclusion

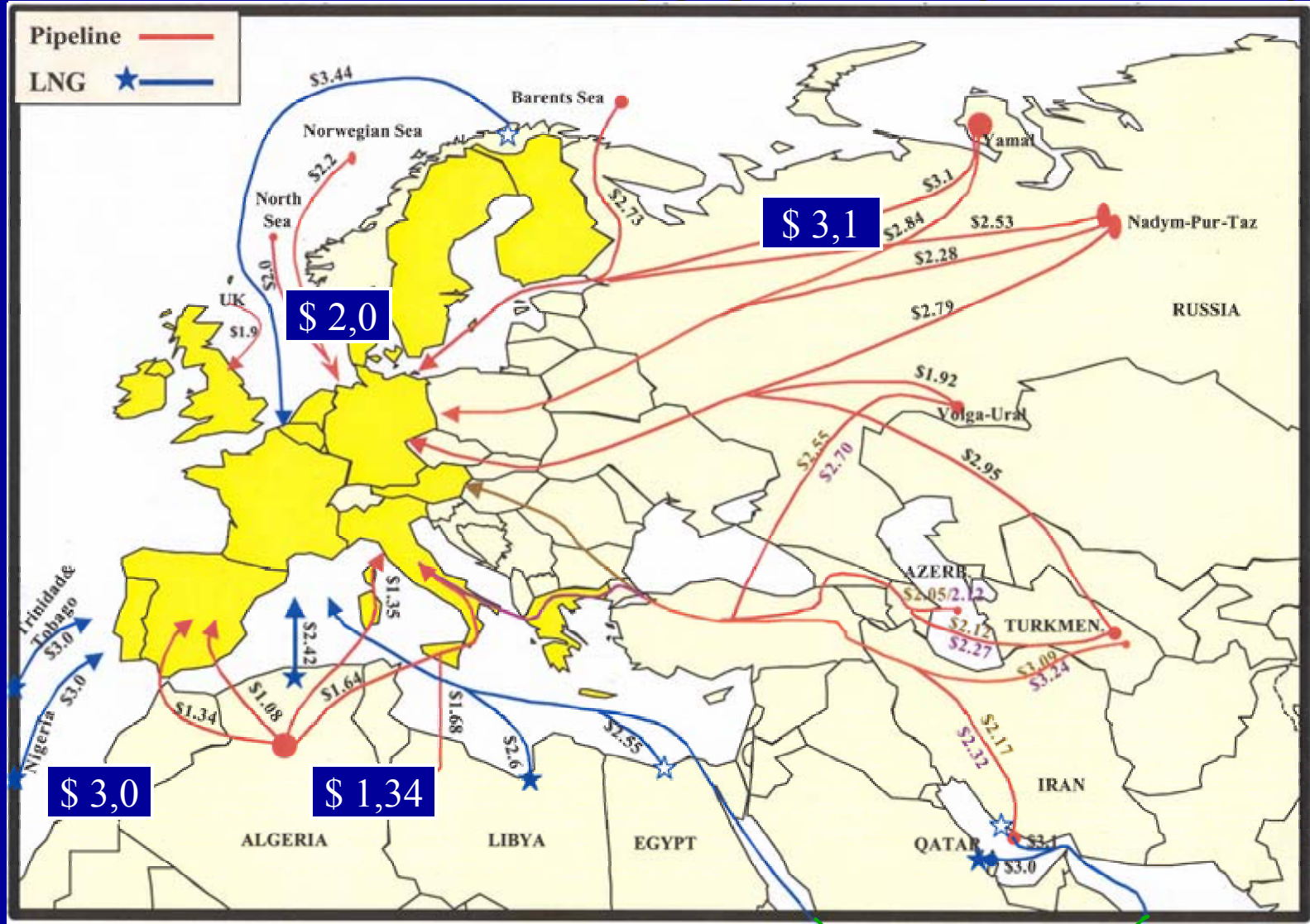
**Part 1:**  
**Demand/Supply for gas & LNG in the  
Atlantic Basin**

# N. America -- # of Wells vs. Avg. Productivity



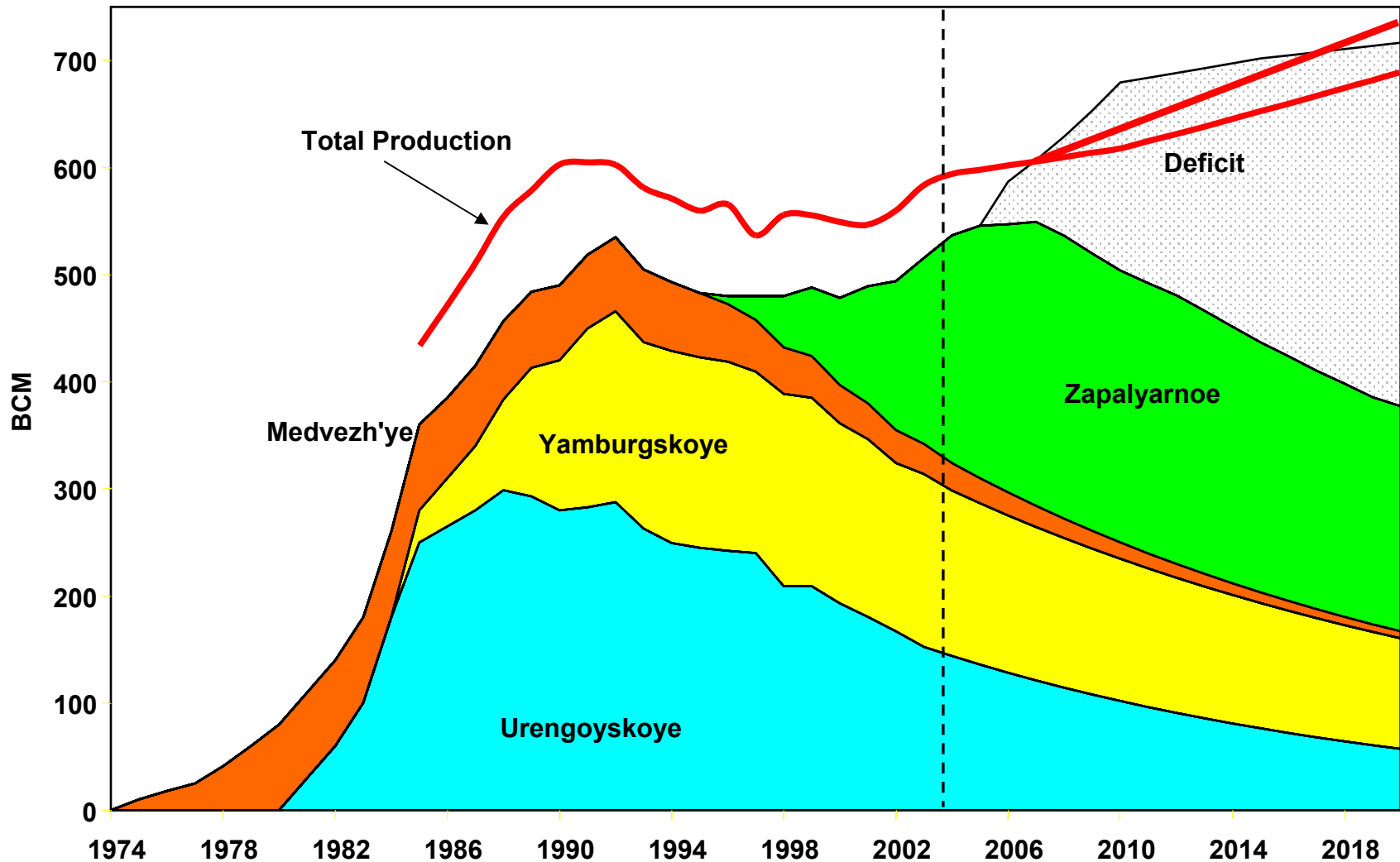
US EIA

# EU-25 Natural Gas Supply Costs (2005-2030)



Source: OME, 2001

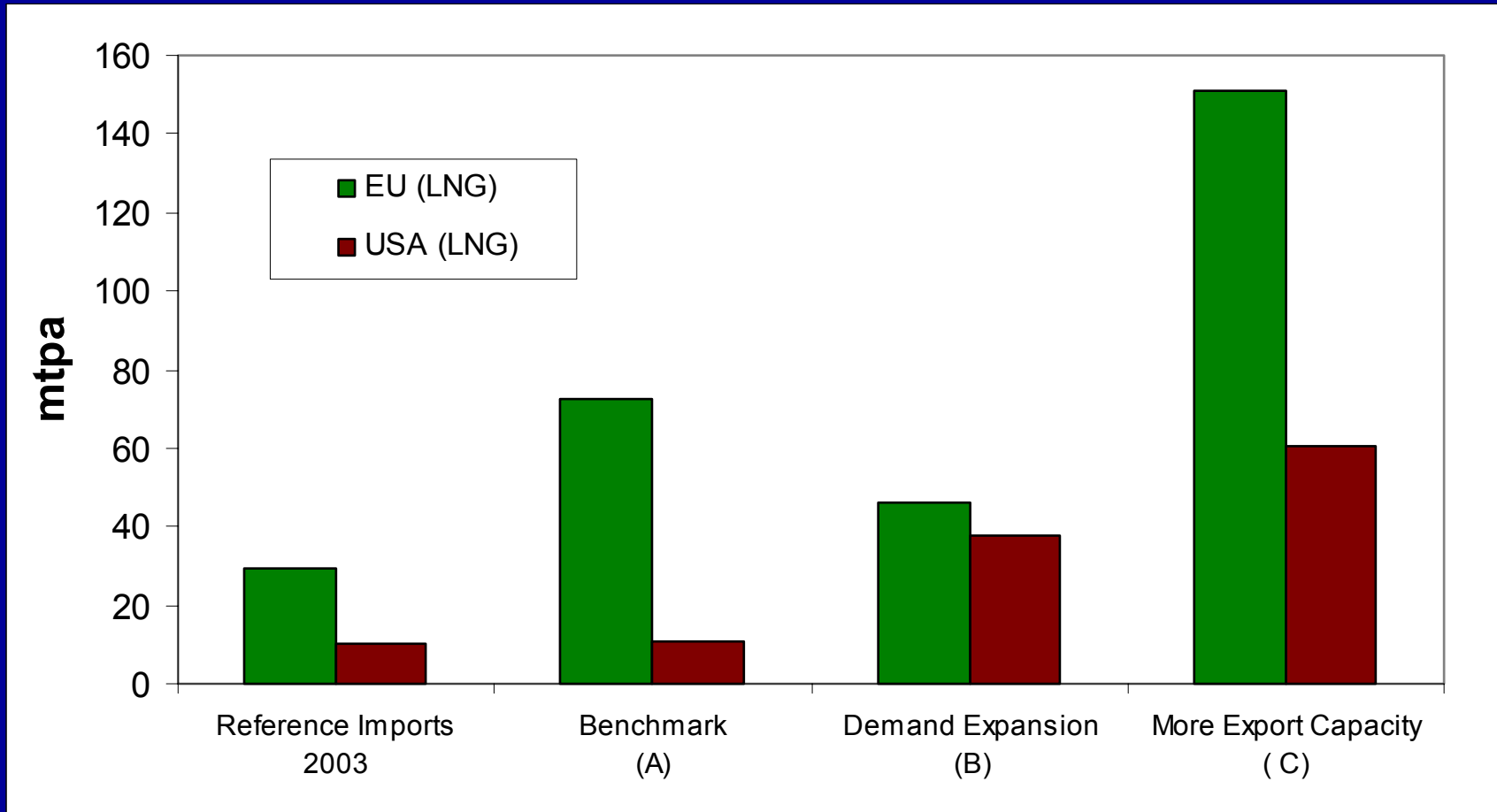
# Russian Gas Production from Major Gas Fields: Historical and Projections



Source: IEA 2002, Stern, J.P. 2005

# EU & US LNG Imports circa 2015

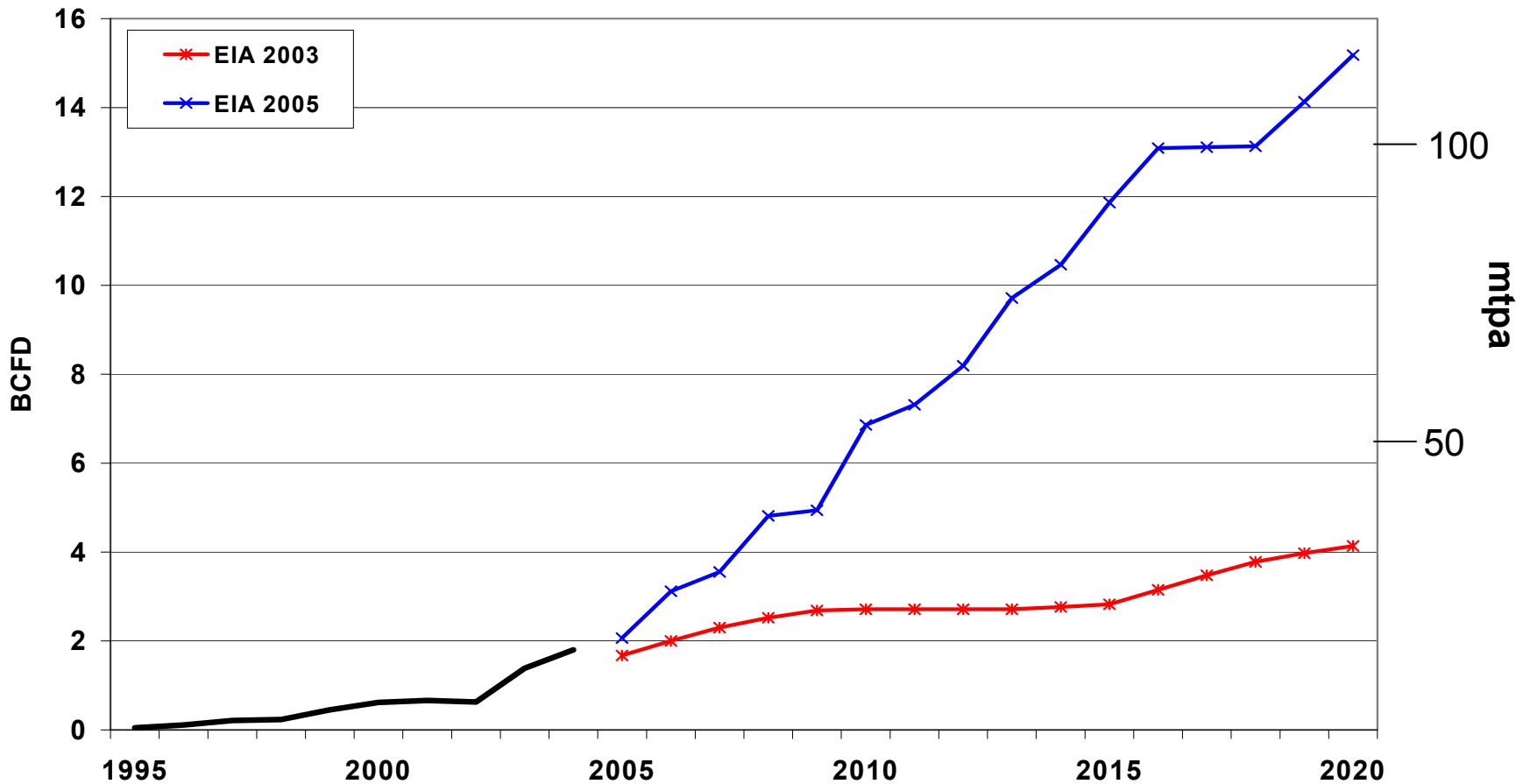
*million tonnes per annum (mtpa)*



Source: Holz & Hirschhausen, 2006

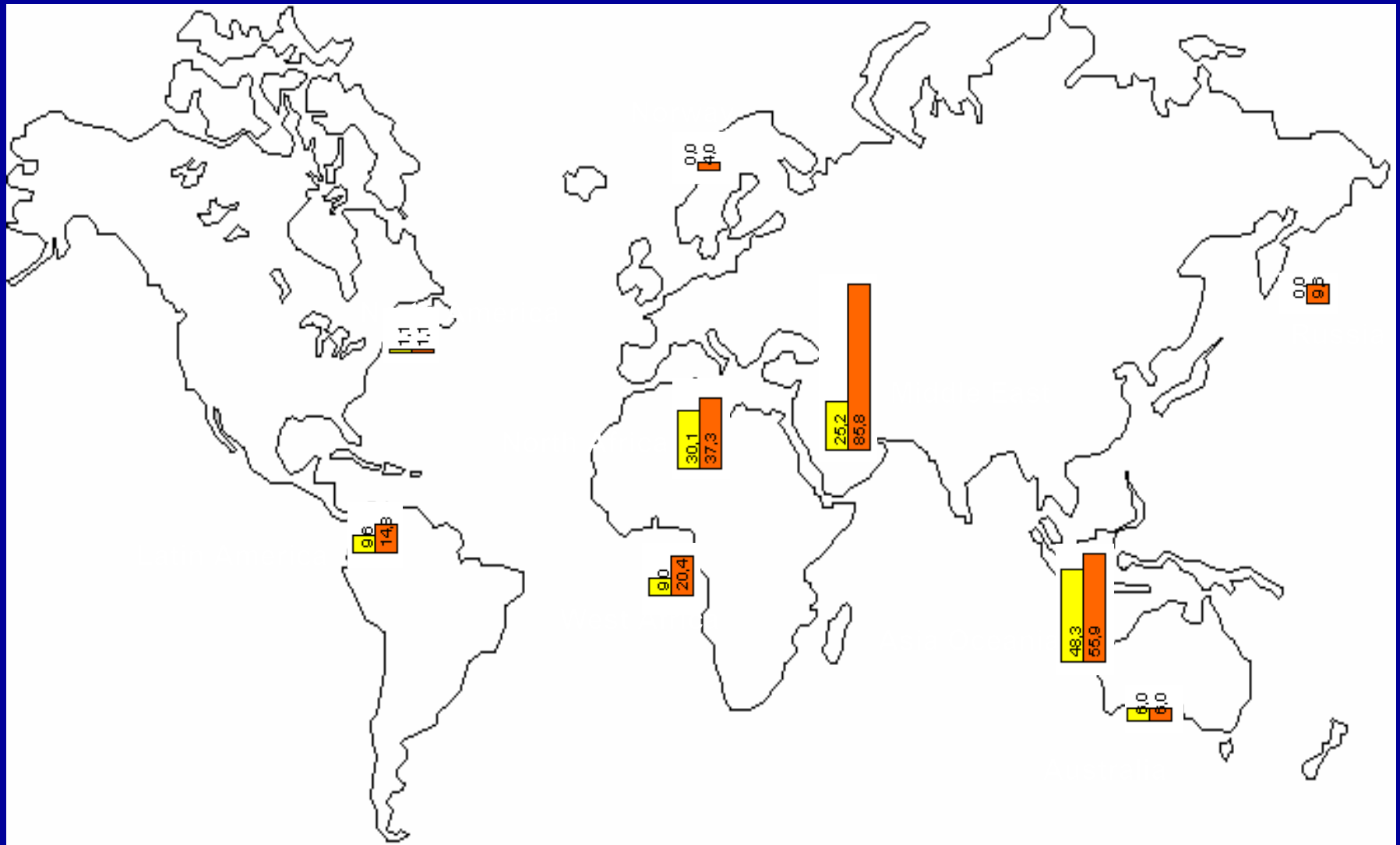
# Atlantic Basin Gas Markets: LNG is the new “Hot Date”

Historical & Projected U.S. LNG Imports



# Sufficient Supply of LNG?

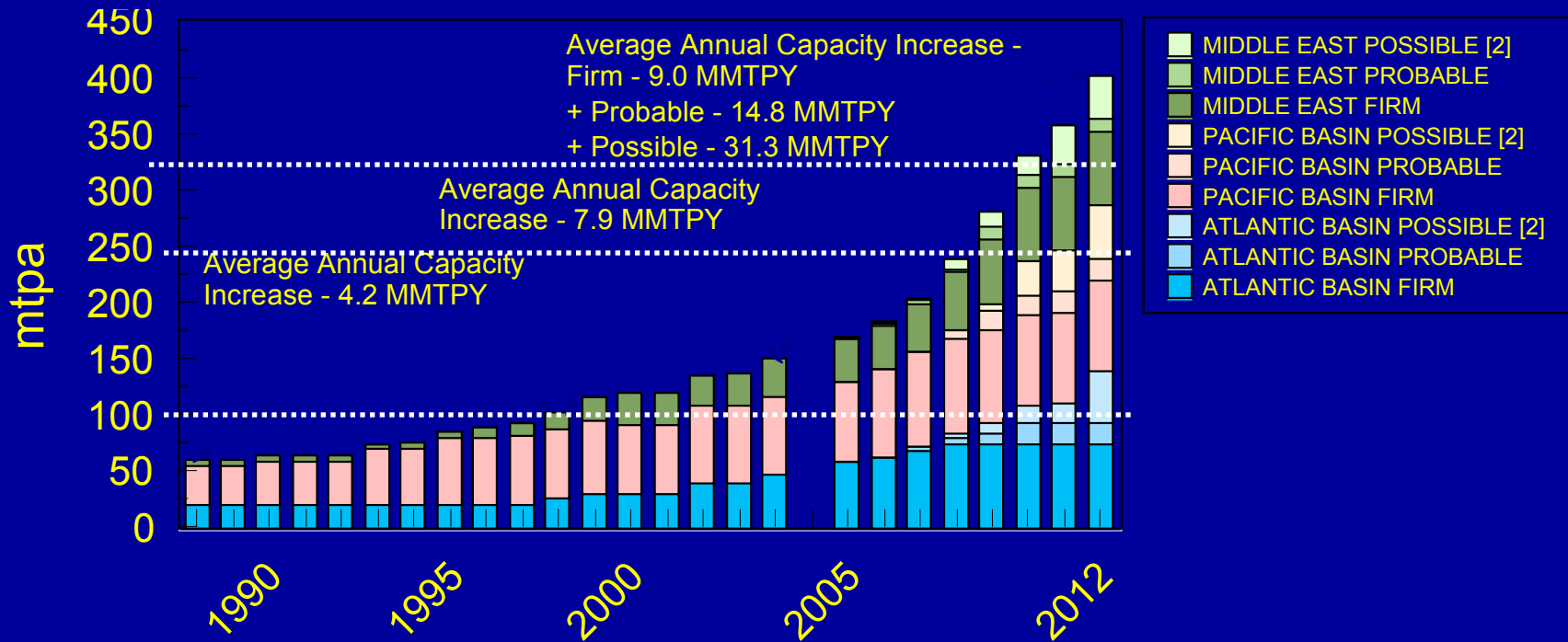
Liquefaction Capacities Worldwide (2005 vs. 2010, in mtpa)



Source: Holz & Hirschhausen, 2006

■ mtpa in 2005 ■ mtpa in 2010

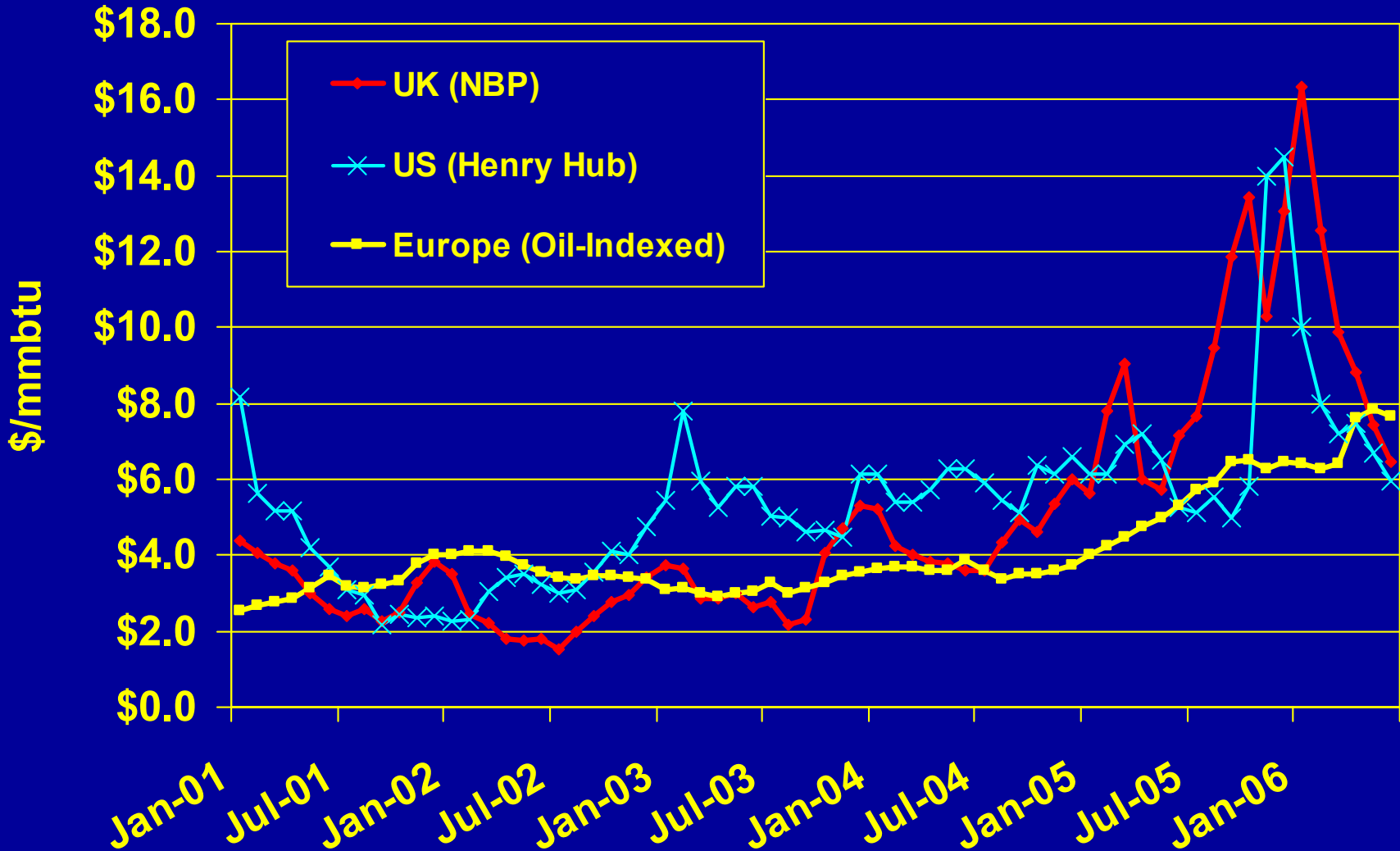
# Global LNG Supplies



Source: James Jensen

# **Part 2: Revolution in LNG Trade**

# U.S. & U.K. spot, European Contract Prices

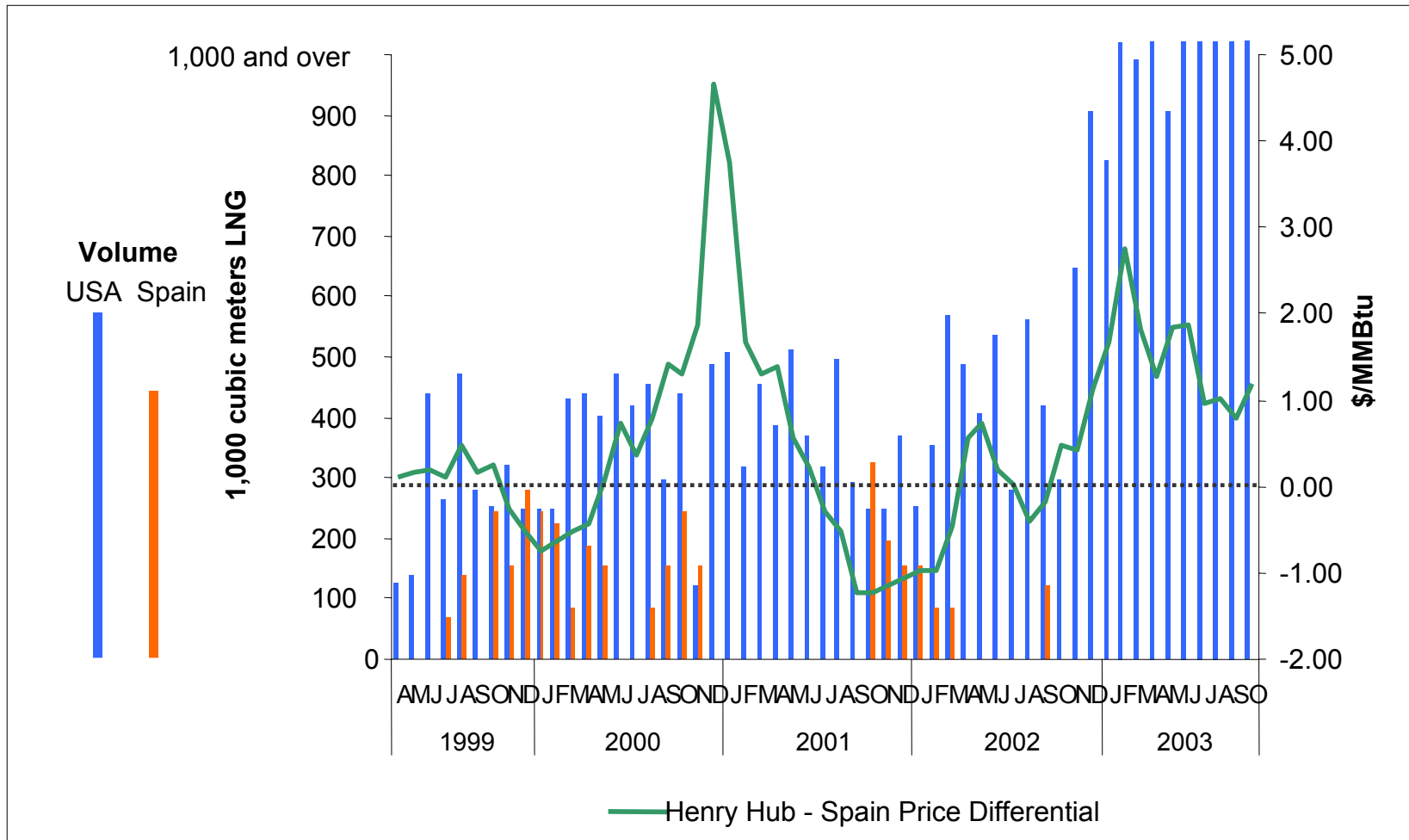


Source: Heren, Bloomberg

# “Old World” of LNG Trade

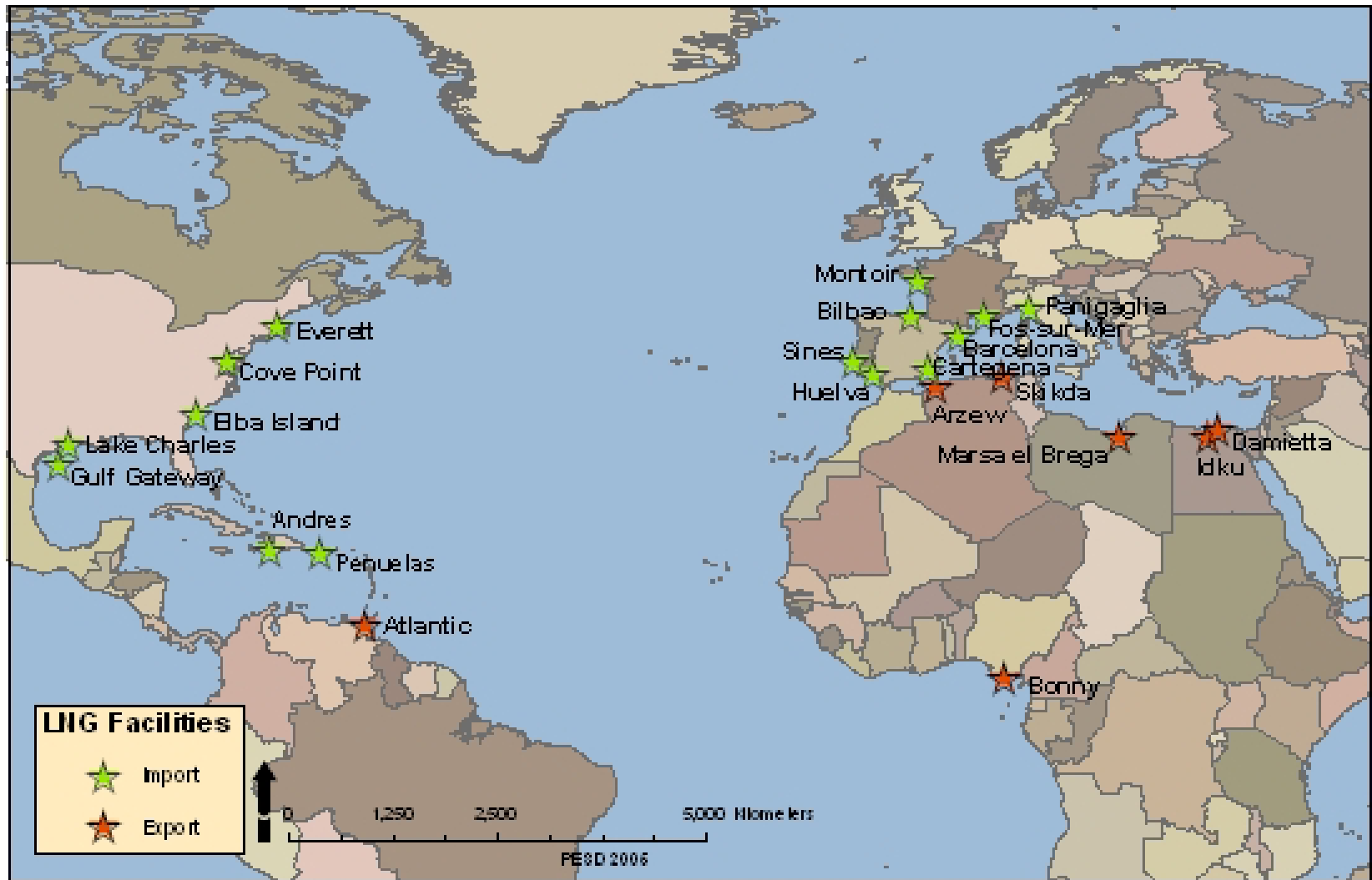
- Few importers, dominated by fixed point-to-point shipments
- Rigid, oil-linked pricing structures (continue to dominate in Japan and continental Europe)
- Muted price incentives to divert cargoes
- But growing LNG trade and deliveries to competitive markets creates incentive for flexibility in LNG cargo movements

# Breaking the Mould: Trinidad's ATLANTIC LNG Cargoes Follow US-Spain Price Differential



Gas Strategies Consulting Ltd.

# Many New Atlantic Basin Players



# Part 3: Simulating Future LNG Cargo Flows and Price Formation

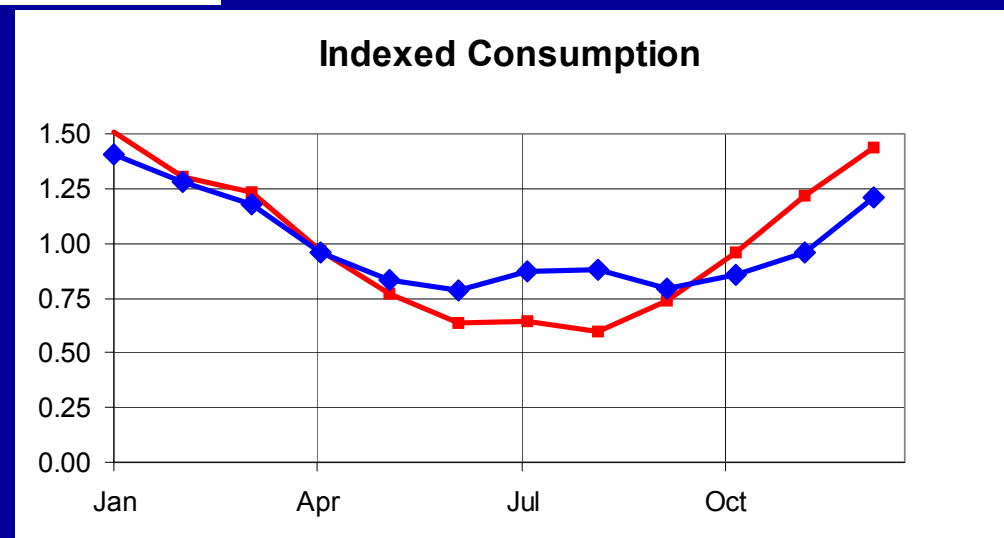
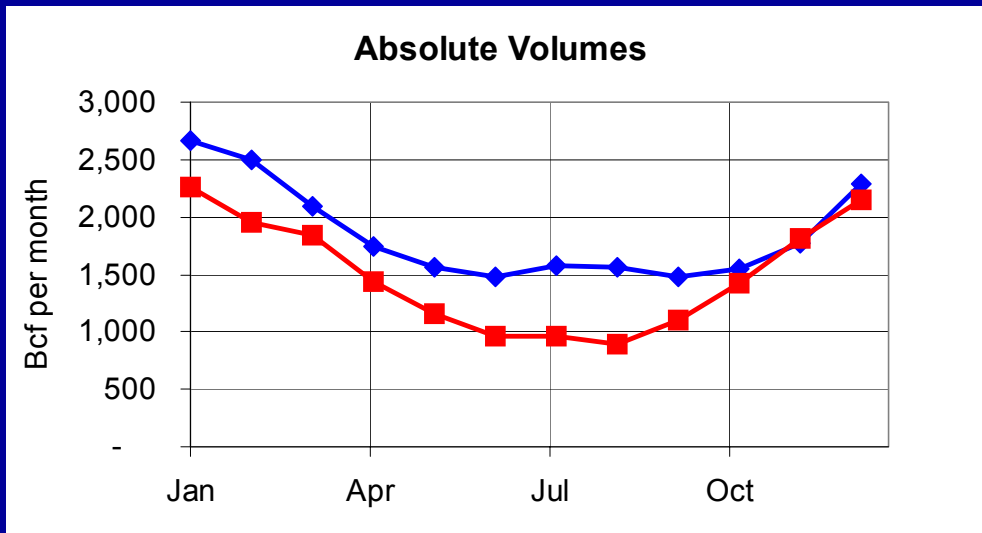
- a) Seasonality → Expected cargo routing, price spreads
  
- b) Unpredictable variability → physical arbitrage & contract optimization

# Factors Shaping Future Atlantic Basin Market

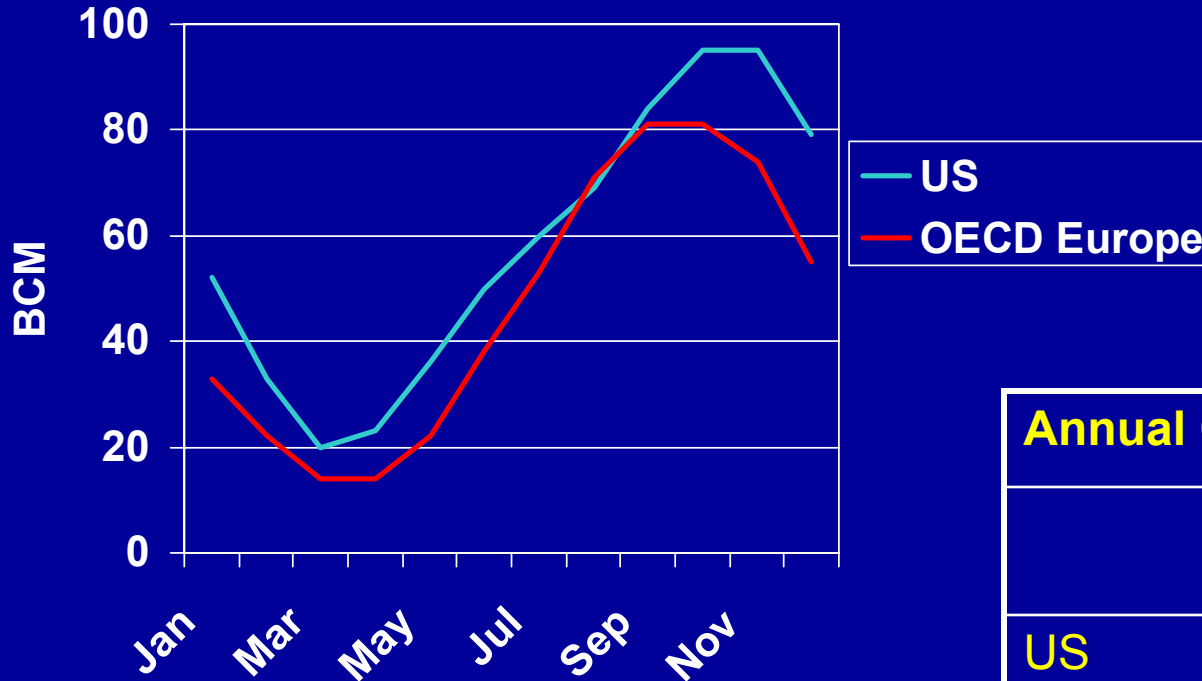
- Seasonal & unpredictable variability in gas demand in importing country markets
- Pipeline supply— fixed and operating costs
- Gas storage costs for each market
- Capital and operating costs for each part of LNG supply chain (liquefaction, shipping, regasification)

**Part 3a:  
Expected Seasonal LNG Flows and  
Regional Price Spreads**

# Historical Data: Seasonal Consumption US vs. OECD Europe, 2001-2004

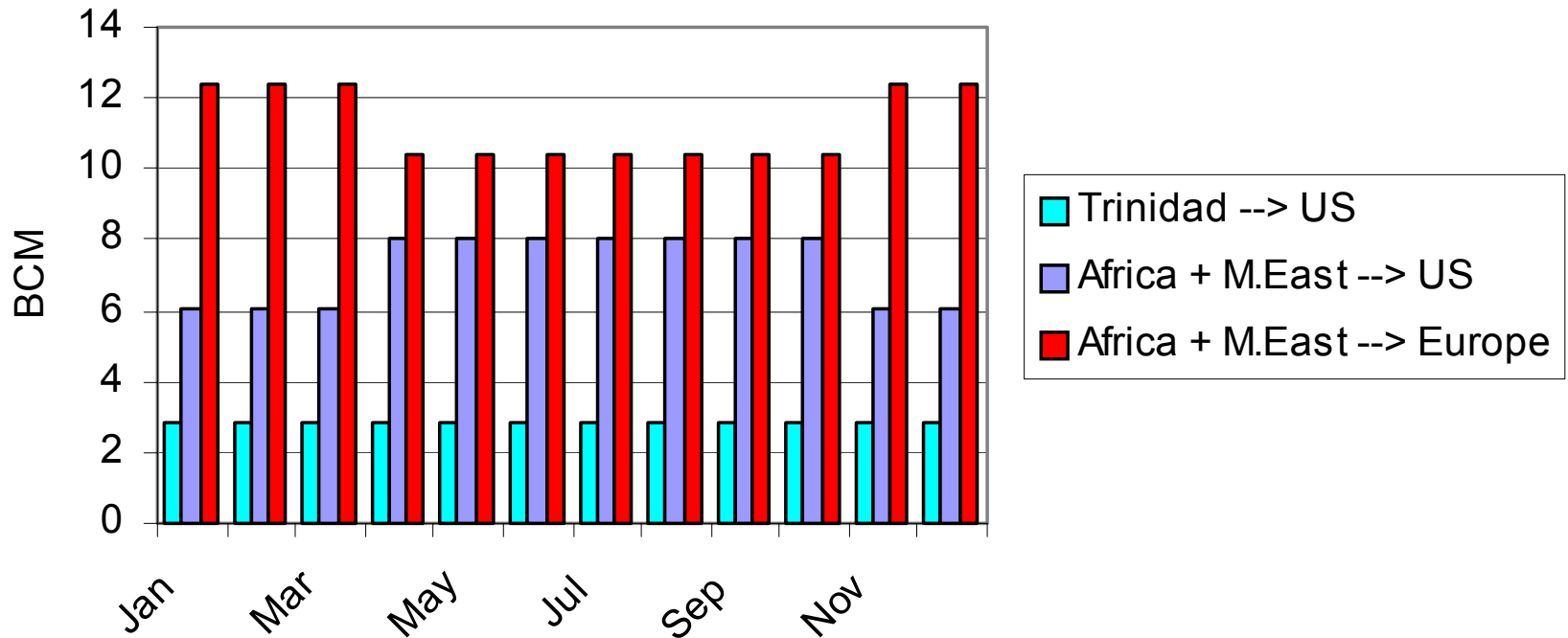


# Model Results: Seasonal Gas Storage Costs and Utilization

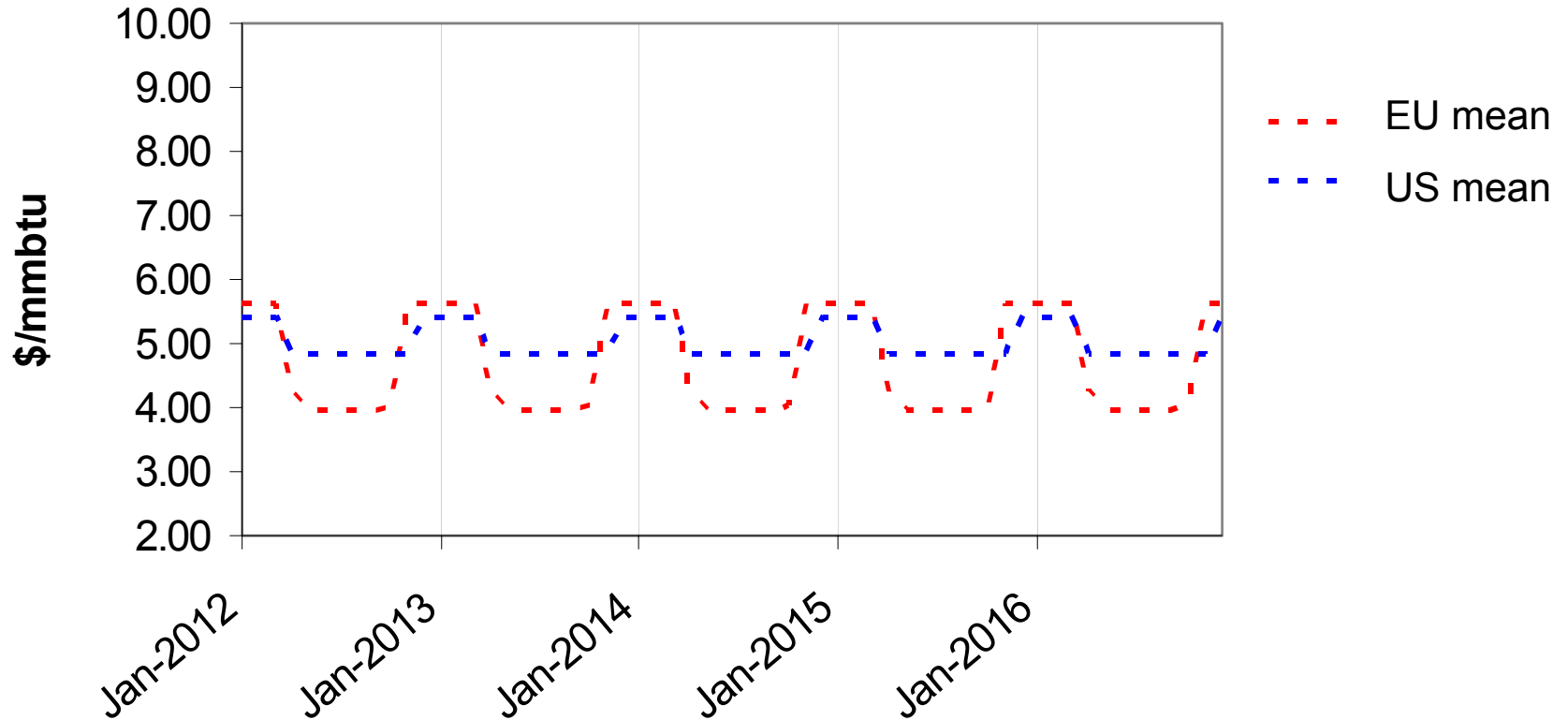


Annual Gas Storage Costs		
	\$/mcf	\$/10 <sup>3</sup> m <sup>3</sup>
US	0.58	20.50
OECD Europe	1.66	59.00

# Model Results: Monthly LNG Flows

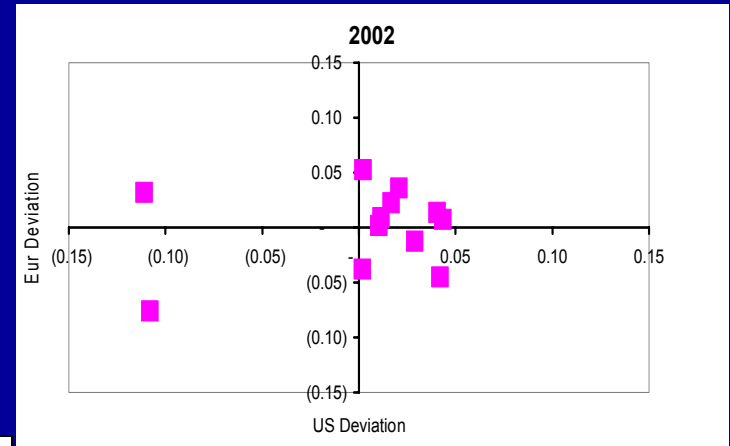
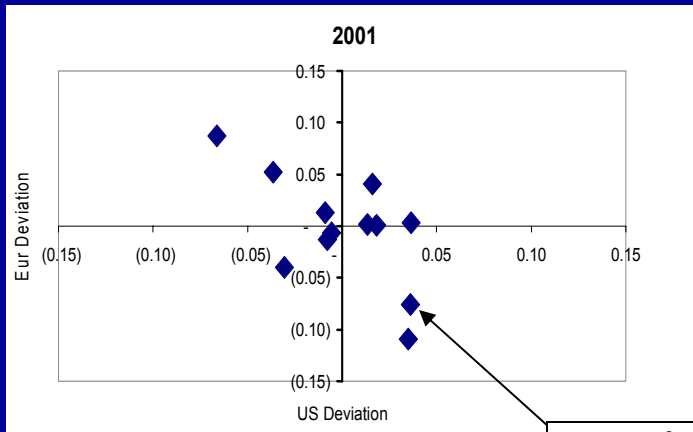


# Model Results: U.S. & “Europe” Expected Price Levels

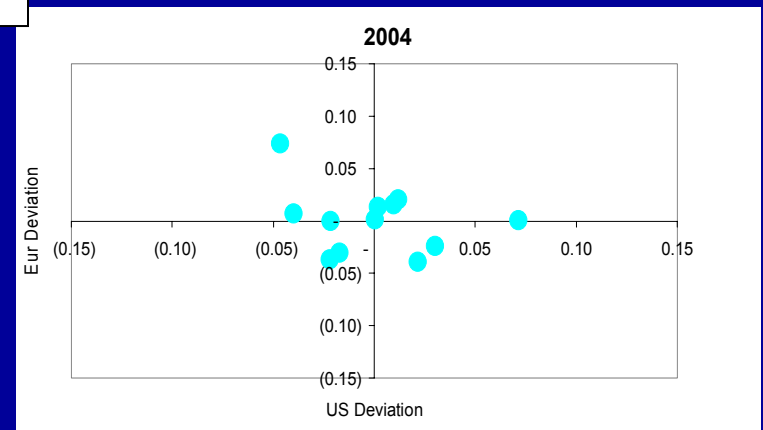
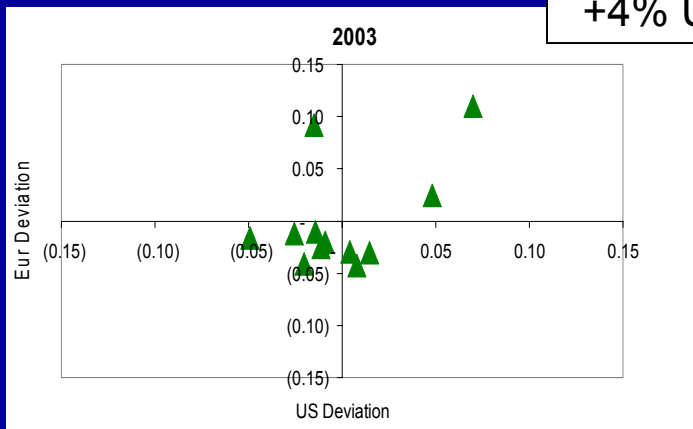


**Part 3b:  
Unpredictable  
Monthly and Annual Variability  
in Gas Demand**

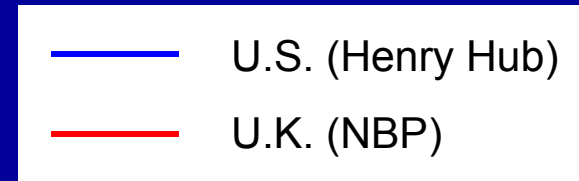
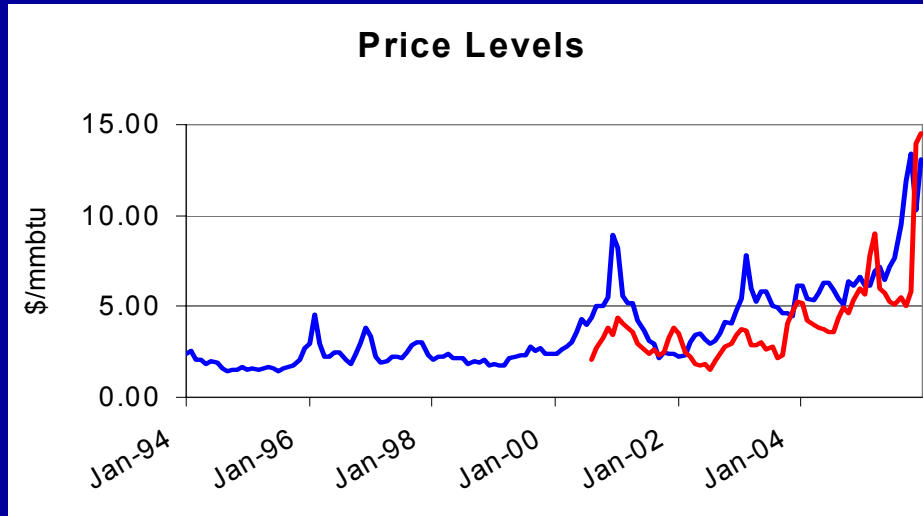
# Historical Demand Variability: Monthly Consumption Deviations from 4-Yr Avg. US vs. OECD Europe



Jan. 2001  
+4% US, -7% EU



# Historical Data: Prices, Volatility & Correlation



## 1994 to 1999

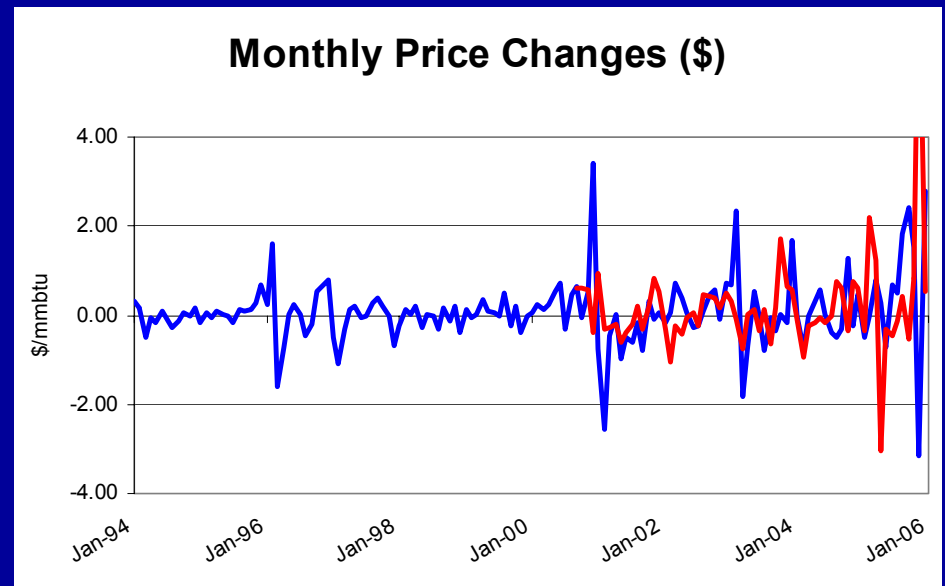
HH monthly volatility ( $\sigma$ ) = \$0.4

## 2000-2005

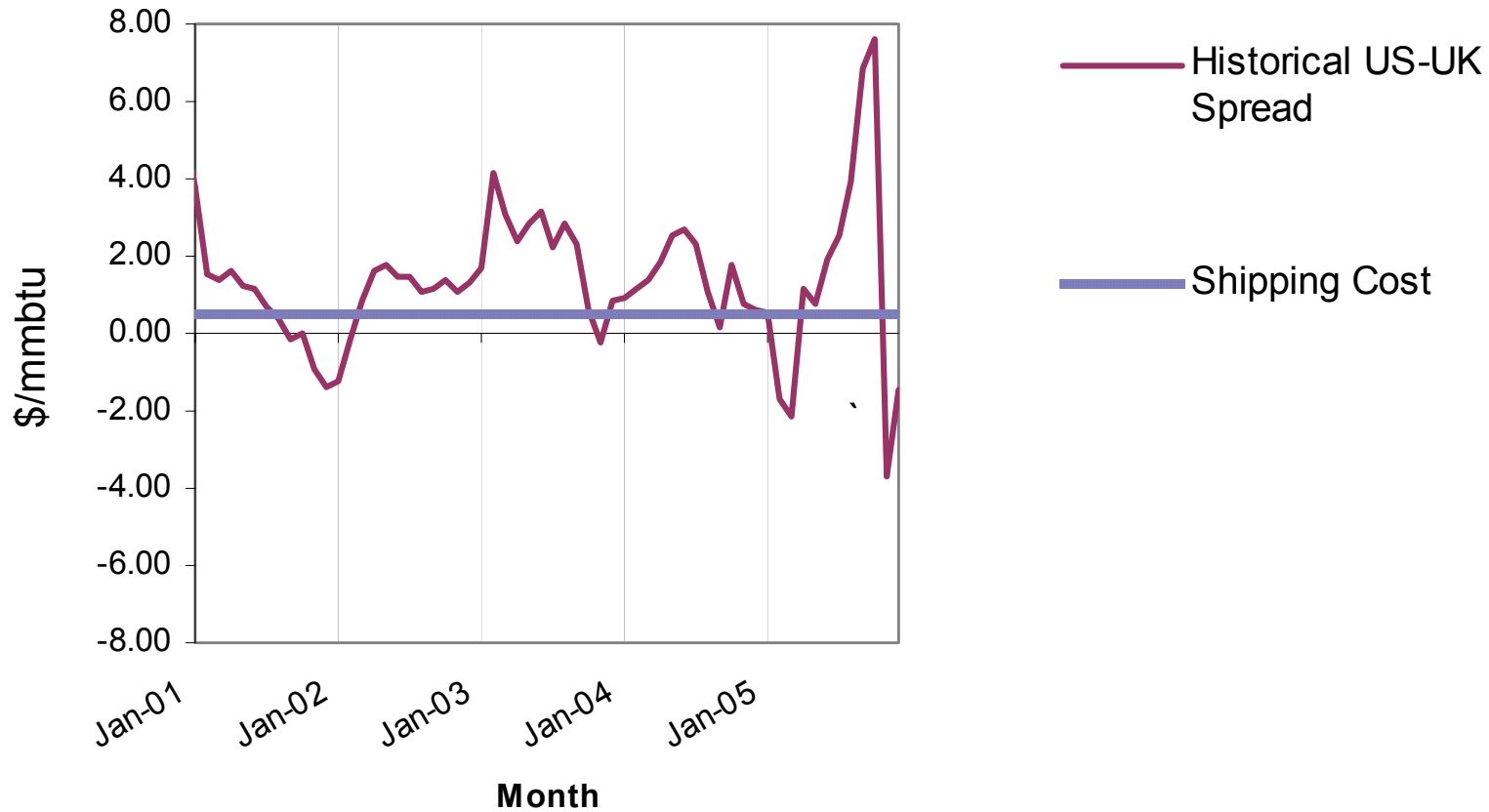
HH monthly volatility ( $\sigma$ ) = \$0.8

NBP monthly volatility ( $\sigma$ ) = \$0.7

**...BUT, ONLY 12% CORRELATED**



# Historical Data: Arbitrage Opportunity for Africa/M.East LNG Supplier (monthly average prices: HH – NBP)

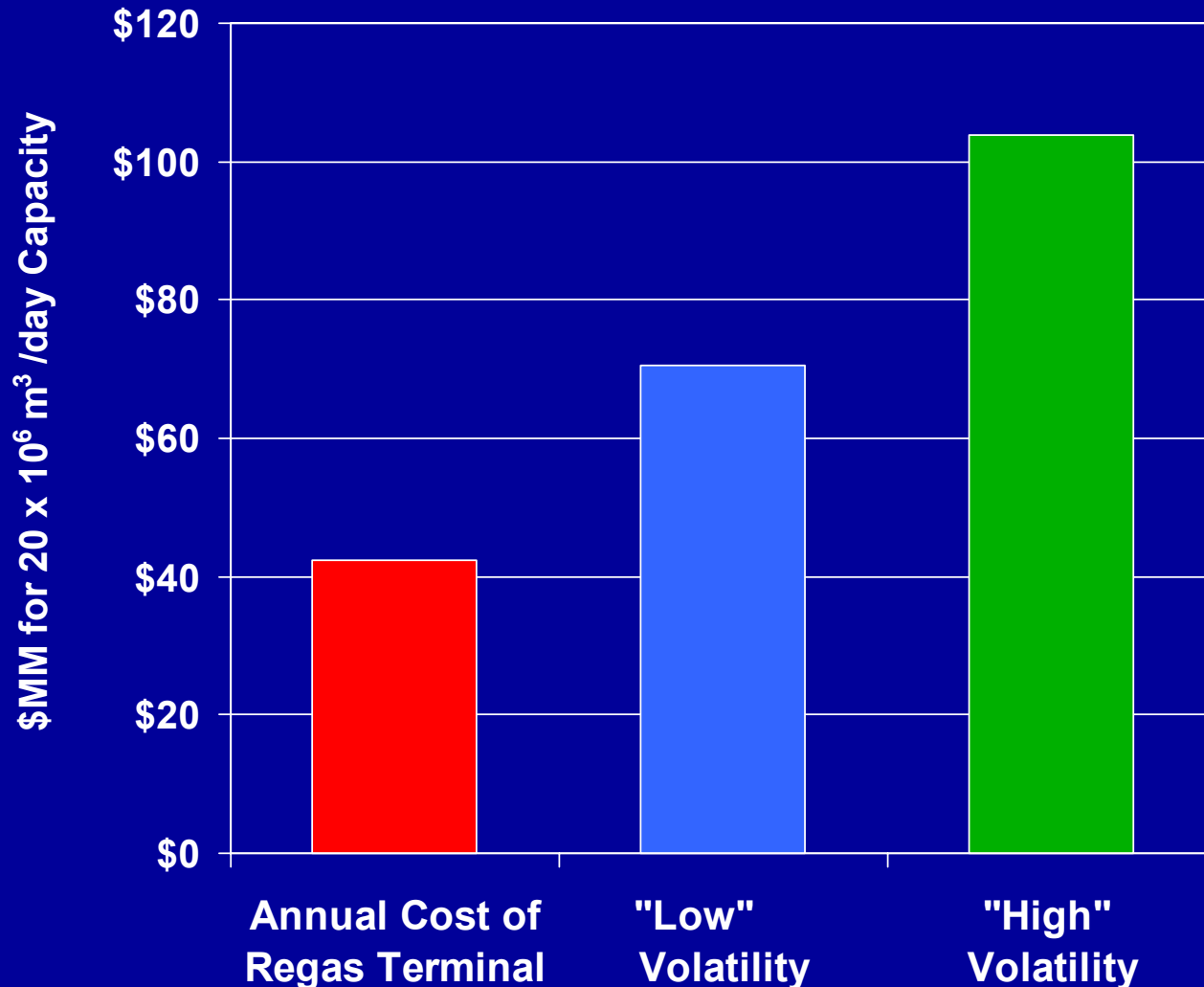


# Model Results: Simulations to Value Cargo Diversion Option

“High” Volatility Case

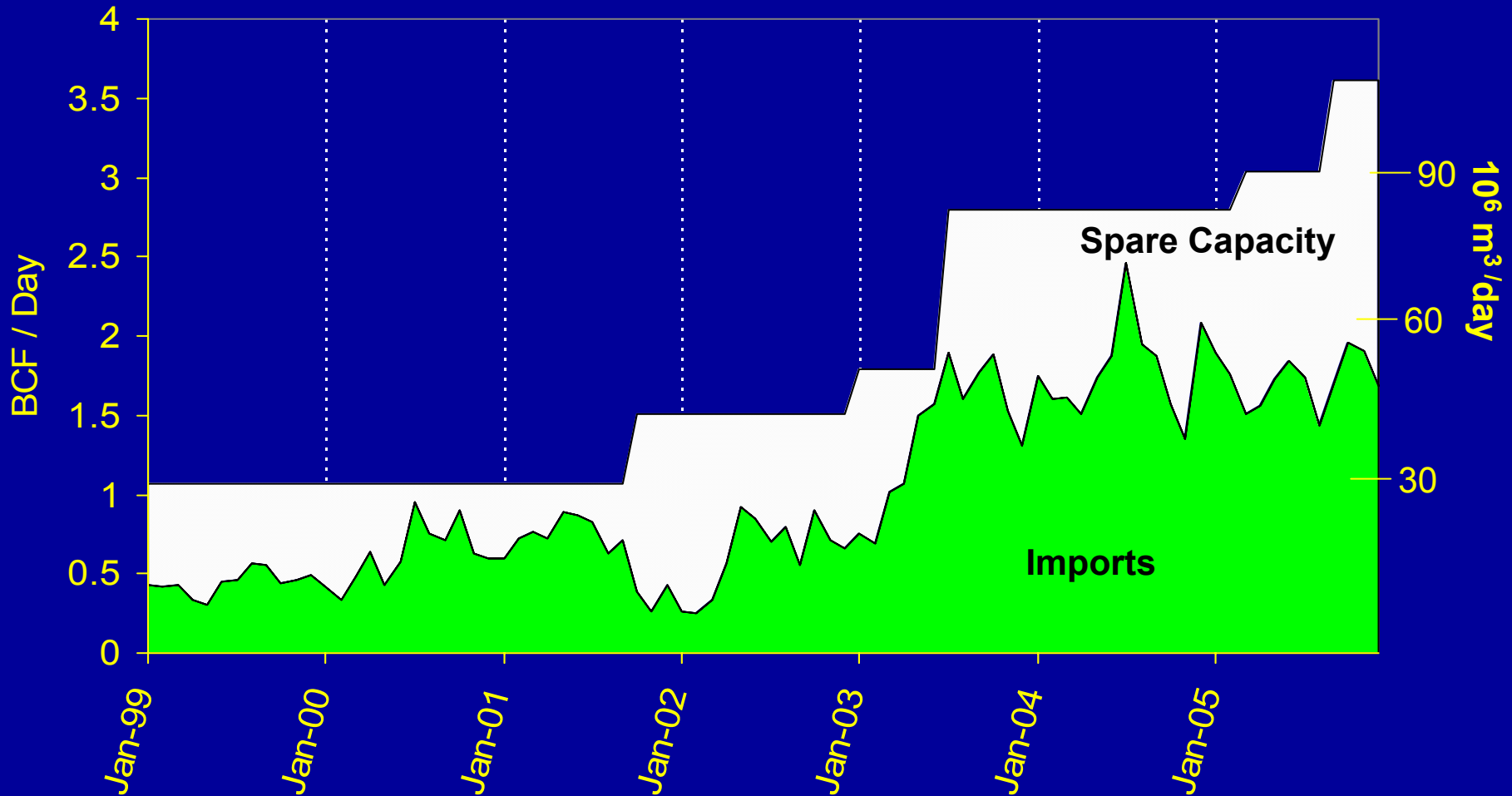


# Model Results: "Option" Value of 20 MM-m<sup>3</sup> Regasification Plant



# Part 4: Implications

# US LNG Import Capacity Utilization (through December 2005)



Source: US EIA

# Implications for Brazil LNG

- U.S. (and U.K.) are fungible markets for LNG imports and cargo diversions
- Cargoes will be available to be diverted from US/UK markets – for the right price
- How does Brazil interact with rest of Atlantic Basin market?
  - Seasonality
  - Unpredictable variability
  - Storage costs

# Summary

- Atlantic Basin market will have strong seasonal & unpredictable variability
- Flexible LNG shipping creates value to meet diverse buyer needs
- Optimal pricing and contract structure will depend on Brazil's needs and interaction with other Atlantic Basin markets