
Long-Term Contracts and Asset Specificity Revisited – An Empirical Analysis of Producer-Importer Relations in the Natural Gas Industry

Anne Neumann and Christian von Hirschhausen

**Dresden University of Technology, Energy Economics and Public Sector Management (EE²),
and German Institute of Economic Research (DIW Berlin)**

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EE²



DIW Berlin

German Institute
for Economic Research

Background: EE² / DIW Program

“The Globalization of Natural Gas Markets” (2004-2008)

- Jointly between Dresden University of Technology, Chair of Energy Economics and Public Sector Management (EE²), and DIW Berlin
- Research and advice to policy makers and the corporate sector, three modules:

Computational model of the European (and trans-Atlantic) natural gas market

- Competition/oligopoly, effect on prices and quantities
- Infrastructure bottlenecks (pipelines, LNG-terminals)
- Role of Russia ...

Institutional economic modeling on governance structures and contracts

- Nexus between regulation and contracts
- Changing role of long-term contracts
- Vertical integration along the LNG value added chain

Econometric analysis of energy price developments

- Relation between North American, European, Asian gas and oil prices
- Cointegration and/or convergence of trans-Atlantic natural gas prices?



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<http://globalgas.ee2.biz>

Agenda

1. The Issue

2. Structural Changes in the Natural Gas Industry

3. Data

4. Model Specification and Results

5. Conclusions

6. Further Issues

Long-term Contracts – Competition – Supply Security

DG COMP (2007) Sector Inquiry:

- Vertical foreclosure: long-term gas supply contracts can have adverse effects on competition, e.g. exclude entrants
- „However, legitimate needs to underpin large investments with certain long-term contracts, must be taken into account. “

LTC are changing in the globalizing natural gas markets

- Shorter contract duration („from 25 to 15 years“)
- More flexible price-indexation

Related literature

- Joskow (1987) on contract duration and asset-specificity in American coal industry
- Masten / Crocker (1985) and Crocker / Masten (1988); Mulherin (1986), Hubbard / Weiner, 1986, Doane / Spulber (1994)
- Increasing use of spot transactions in LNG industry (Hartley / Brito, 2006)
- Long-term vs. short-term contracts (Neuhoff and Hirschhausen, 2005)

This paper in a nutshell:

- Decreasing contract duration comes along with sector liberalization and less asset specificity in the investments
- Other things being equal, LTCs are (still) when large-scale, asset-specific investment decisions are at stake.

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2. Structural Changes in the Natural Gas Industry

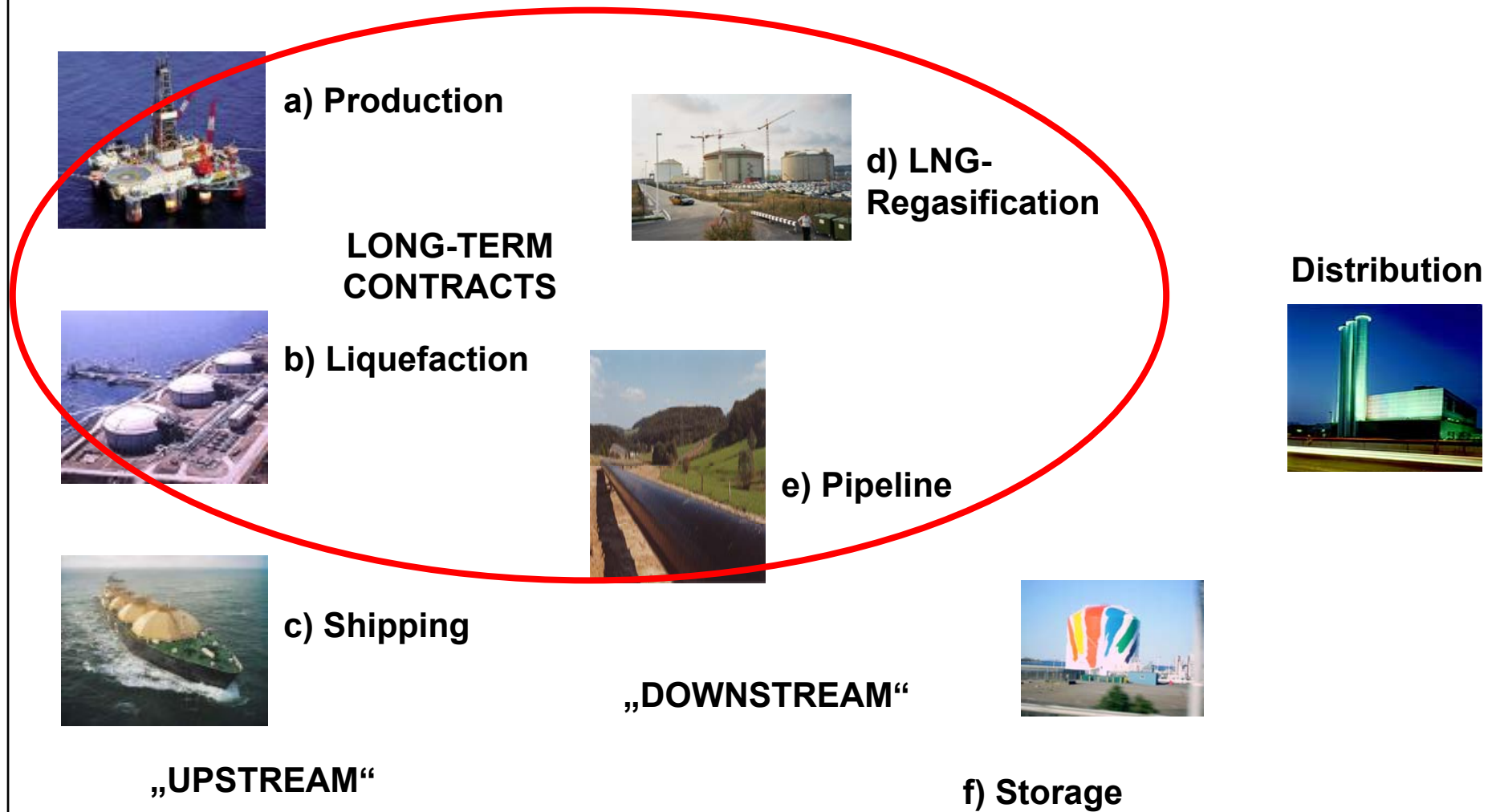
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Value-added Chain in Natural Gas Markets



2. Structural Changes in the International Natural Gas Industry

- Cost reduction in the LNG value-added chain

- Economies of scale in liquefaction
- Lower costs for shipping
- Economies of scale in regas

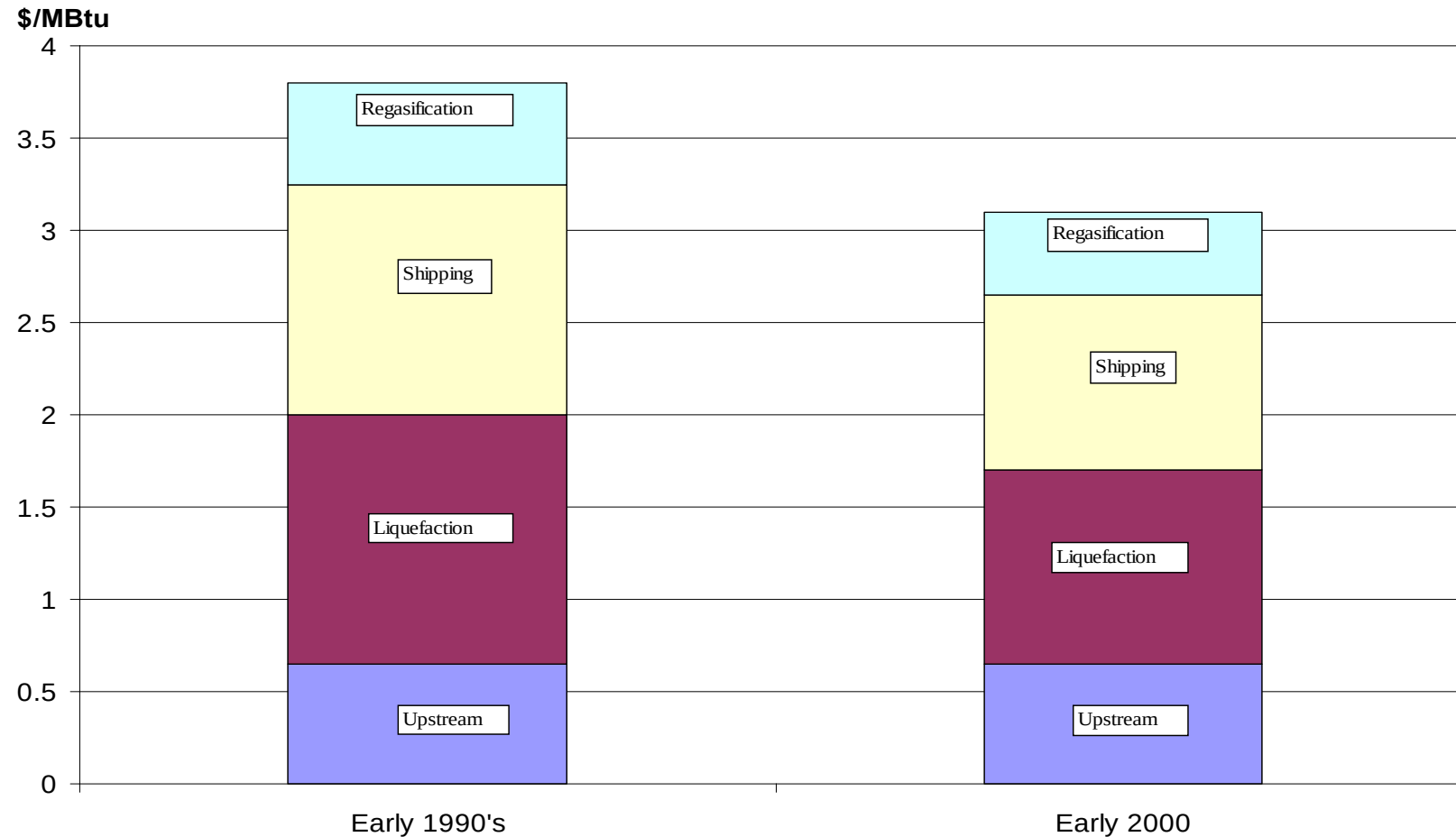
- Diminishing asset specificity of investments

- Formerly: field-specific contracts
- Nowadays: infrastructure developed, less hold-up risk, more general country-focused contracts
- More players on both sides (producers, traders, importers)

- Development of spot markets and shorter-term trading

➔ Lower asset-specificity and other structural change implies less efforts required to overcome the hold-up problem

Cost Reduction in the LNG Chain

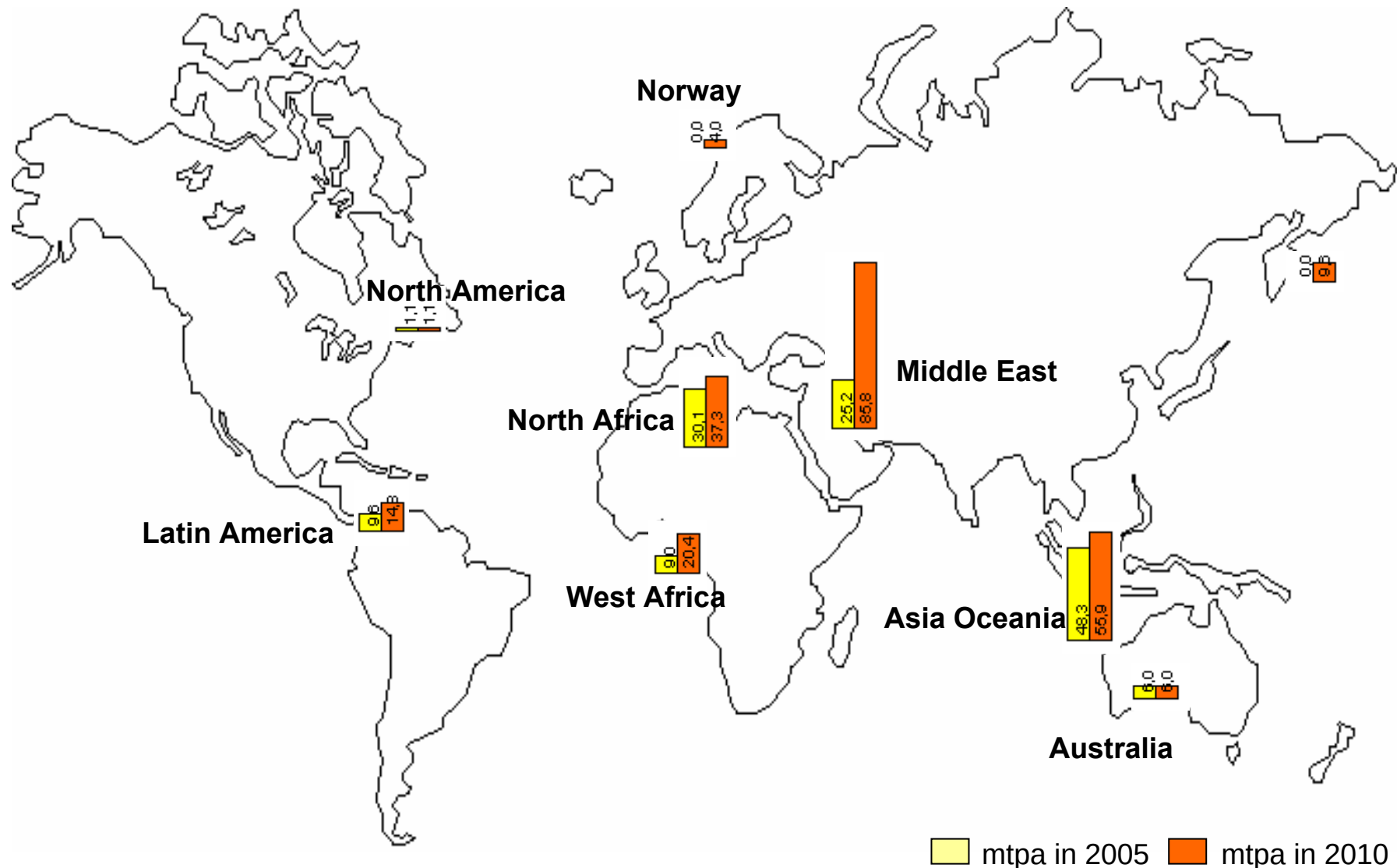


Decreasing capital intensity and decreasing asset-specificity

Source: Jensen (2004), IEA (2004), EIA (2003)

Increasing LNG-Exports and No. of Exporters

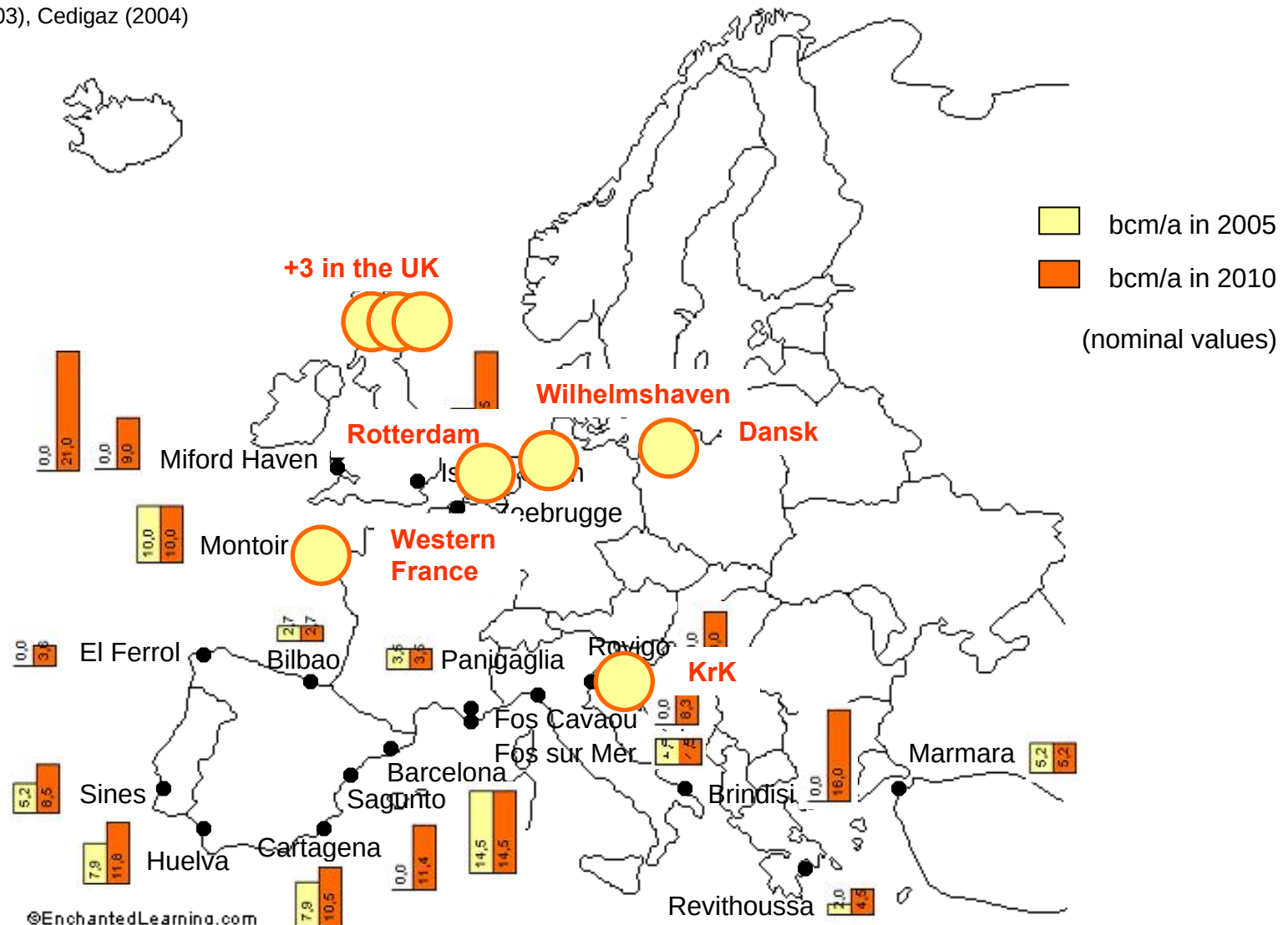
Liquefaction Capacities Worldwide (2005 vs. 2010)



Increasing LNG-Imports and No. of Importers: Europe ...

LNG Import Capacities 2005 vs. 2010

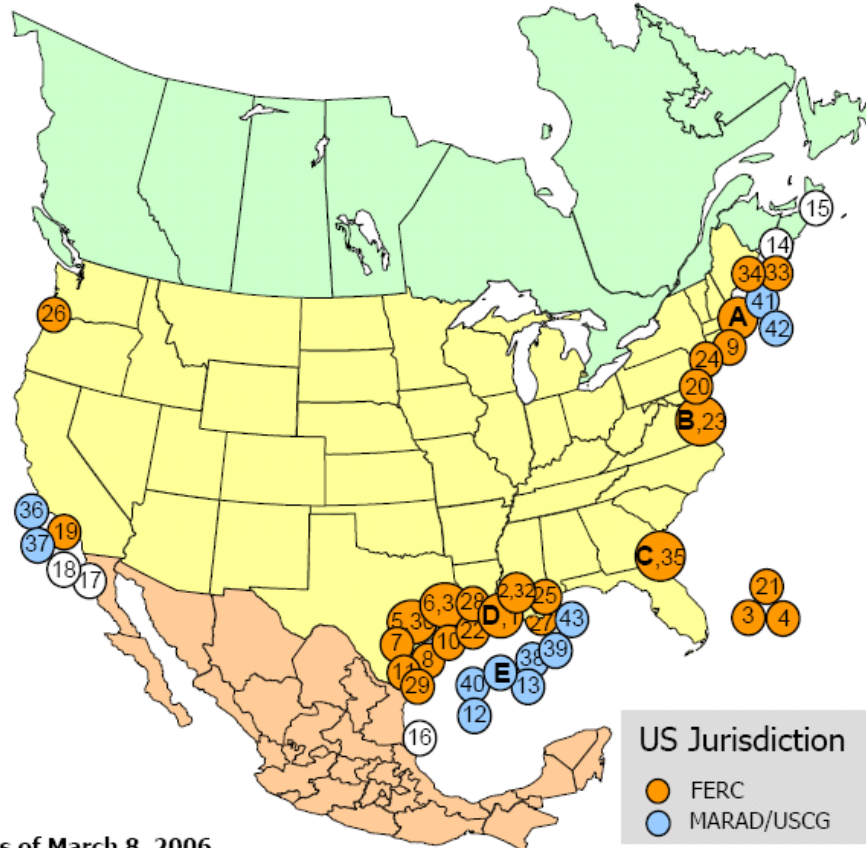
Sources: IEA (2003), Cedigaz (2004)



... and in North America

FERC

Existing and Proposed North American LNG Terminals



As of March 8, 2006

* US pipeline approved; LNG terminal pending in Bahamas

CONSTRUCTED

- A. Everett, MA : 1.035 Bcfd (SUEZ/Tractebel - DOMAC)
- B. Cove Point, MD : 1.0 Bcfd (Dominion - Cove Point LNG)
- C. Elba Island, GA : 1.2 Bcfd (El Paso - Southern LNG)
- D. Lake Charles, LA : 1.5 Bcfd (Southern Union - Trunkline LNG)
- E. Gulf of Mexico: 0.5 Bcfd (Gulf Gateway Energy Bridge - Excelerate Energy)

APPROVED BY FERC

- 1. Lake Charles, LA: 0.6 Bcfd (Southern Union - Trunkline LNG)
- 2. Hackberry, LA : 1.5 Bcfd (Cameron LNG - Sempra Energy)
- 3. Bahamas : 0.84 Bcfd (AES Ocean Express)*
- 4. Bahamas : 0.83 Bcfd (Calypso Tractebel)*
- 5. Freeport, TX : 1.5 Bcfd (Cheniere/Freeport LNG Dev.)
- 6. Sabine, LA : 2.6 Bcfd (Cheniere LNG)
- 7. Corpus Christi, TX: 2.6 Bcfd (Cheniere LNG)
- 8. Corpus Christi, TX : 1.0 Bcfd (Vista Del Sol - ExxonMobil)
- 9. Fall River, MA : 0.8 Bcfd (Weaver's Cove Energy/Hess LNG)
- 10. Sabine, TX : 1.0 Bcfd (Golden Pass - ExxonMobil)
- 11. Corpus Christi, TX: 1.0 Bcfd (Ingleside Energy - Occidental Energy Ventures)

APPROVED BY MARAD/COAST GUARD

- 12. Port Pelican: 1.6 Bcfd (Chevron Texaco)
- 13. Louisiana Offshore : 1.0 Bcfd (Gulf Landing - Shell)

CANADIAN APPROVED TERMINALS

- 14. St. John, NB : 1.0 Bcfd (Canaport - Irving Oil)
- 15. Point Tupper, NS 1.0 Bcfd (Bear Head LNG - Anadarko)

MEXICAN APPROVED TERMINALS

- 16. Altamira, Tamulipas : 0.7 Bcfd, (Shell/Total/Mitsui)
- 17. Baja California, MX : 1.0 Bcfd, (Energy Costa Azul - Sempra)
- 18. Baja California - Offshore : 1.4 Bcfd, (Chevron Texaco)

PROPOSED TO FERC

- 19. Long Beach, CA : 0.7 Bcfd, (Mitsubishi/ConocoPhillips - Sound Energy Solutions)
- 20. Logan Township, NJ : 1.2 Bcfd (Crown Landing LNG - BP)
- 21. Bahamas : 0.5 Bcfd, (Seafarer - El Paso/FPL)
- 22. Port Arthur, TX: 1.5 Bcfd (Sempra)
- 23. Cove Point, MD : 0.8 Bcfd (Dominion)
- 24. LI Sound, NY: 1.0 Bcfd (Broadwater Energy - TransCanada/Shell)
- 25. Pascagoula, MS: 1.0 Bcfd (Gulf LNG Energy LLC)
- 26. Bradwood, OR: 1.0 Bcfd (Northern Star LNG - Northern Star Natural Gas LLC)
- 27. Pascagoula, MS: 1.3 Bcfd (Casotte Landing - ChevronTexaco)
- 28. Cameron, LA: 3.3 Bcfd (Creole Trail LNG - Cheniere LNG)
- 29. Port Lavaca, TX: 1.0 Bcfd (Calhoun LNG - Gulf Coast LNG Partners)
- 30. Freeport, TX: 2.5 Bcfd (Cheniere/Freeport LNG Dev. - Expansion)
- 31. Sabine, LA: 1.4 Bcfd (Cheniere LNG - Expansion)
- 32. Hackberry, LA : 1.15 Bcfd (Cameron LNG - Sempra Energy - Expansion)
- 33. Pleasant Point, ME : 0.5 Bcfd (Quoddy Bay, LLC)
- 34. Robbinston, ME: 0.5 Bcfd (Downeast LNG - Kestrel Energy)
- 35. Elba Island, GA: 0.9 Bcfd (El Paso - Southern LNG)

PROPOSED TO MARAD/COAST GUARD

- 36. California Offshore: 1.5 Bcfd (Cabrillo Port - BHP Billiton)
- 37. So. California Offshore : 0.5 Bcfd, (Crystal Energy)
- 38. Louisiana Offshore : 1.0 Bcfd (Main Pass McMoran Exp.)
- 39. Gulf of Mexico: 1.0 Bcfd (Compass Port - ConocoPhillips)
- 40. Gulf of Mexico: 1.5 Bcfd (Beacon Port Clean Energy Terminal - ConocoPhillips)
- 41. Offshore Boston, MA: 0.4 Bcfd (Neptune LNG - Tractebel)
- 42. Offshore Boston, MA: 0.8 Bcfd (Northeast Gateway - Excelerate Energy)
- 43. Gulf of Mexico: 1.4 Bcfd (Bienville Offshore Energy Terminal - TORP Technology)

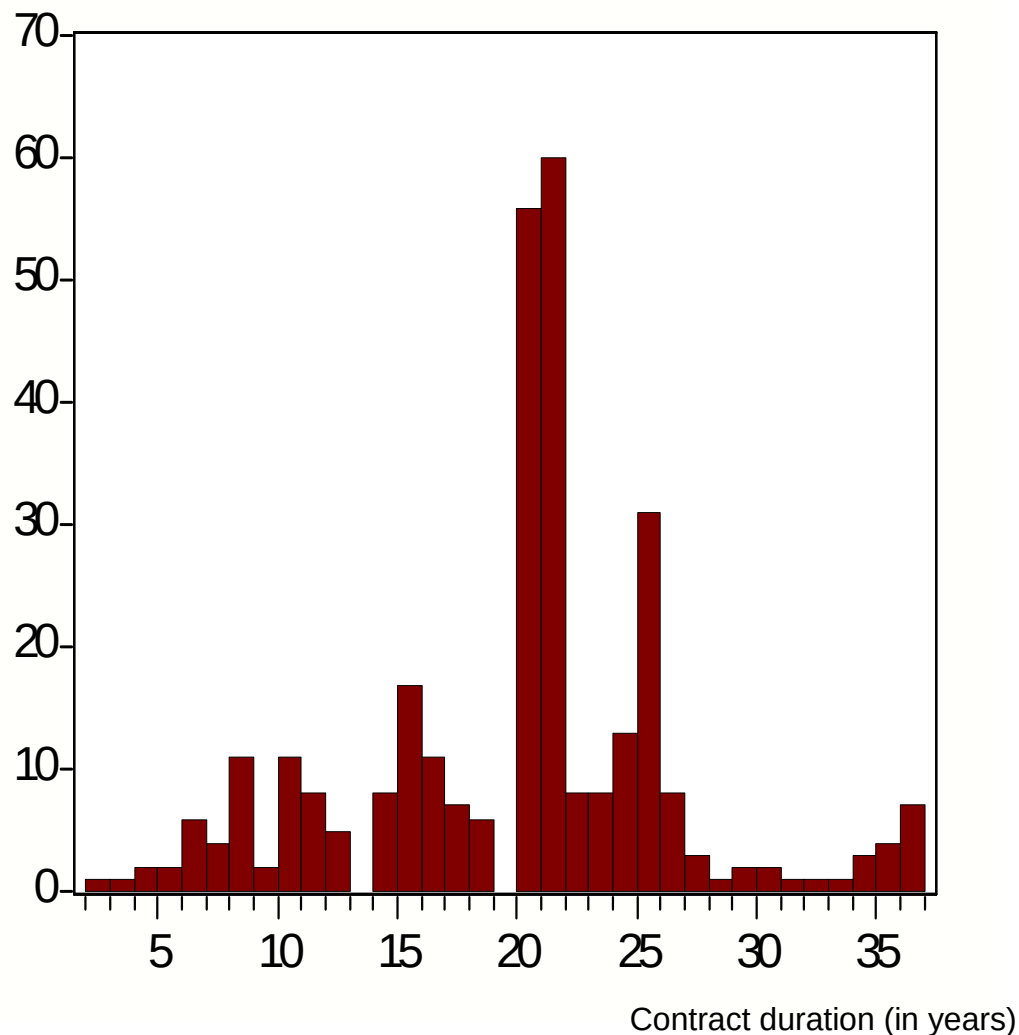
Office of Energy Projects

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Data: Upstream LTCs World-Wide (pipeline and LNG)

Number of contracts



Descriptive Statistics

Observations	311
Mean	19.53
Max.	39
Min.	2
Std. Dev.	6.71

Structural Variables

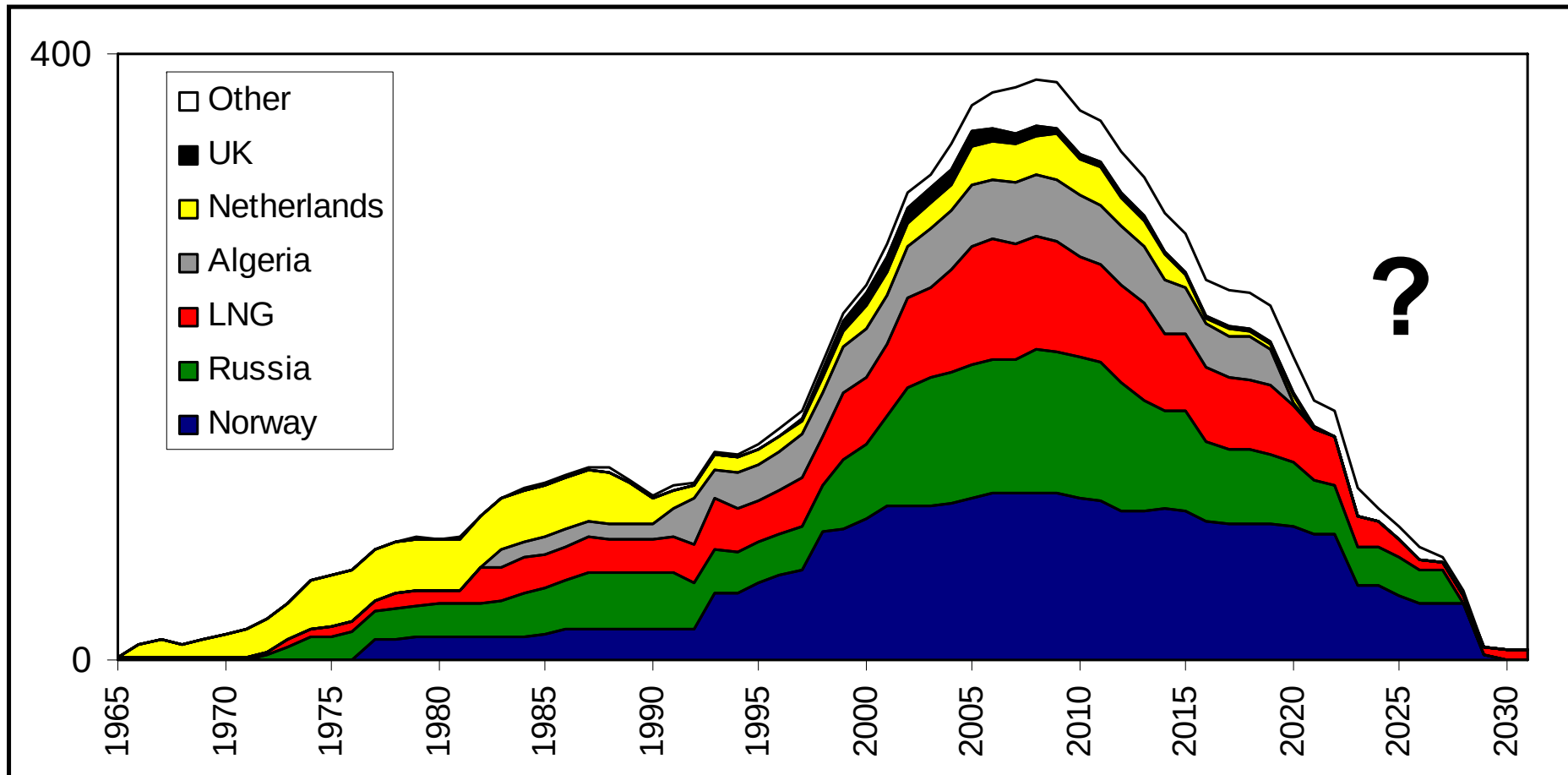
Non-European	146
C_US_UK	31
1999-2006	113
Reneg	32
Project specific	149
LNG	189
Entrant	76

Data Description

	Observations	311			
Variable	Description	Mean	Min.	Max.	Std. Dev.
CD	Contract duration (years)	19.53	2	36	6.71
TVol	Total contracted volume (bcm)	50.62	0.32	360	62.64
Project	Contract signed to dedicated project	D=1: 149 observations			
Entrant	Contract signed by new market player (import)	D=1: 76 observations			
D99-2006	Contract signed 1999-2006	D=1: 113 observations			
Reneg.	Extended / Renegotiated contract	D=1: 32 observations			
C_Europe	Deliveries for European market	D=1: 165 observations			
C_Asia	Deliveries for Asian market	D=1: 122 observations			
C_USA_UK	Deliveries for US or UK market	D=1: 31 observations			
P_Oceania	Production in Oceania	D=1: 85 observations			
P_Africa	Production in Africa	D=1: 50 observations			
P_Eurasia	Production in Eurasia (Russia)	D=1: 36 observations			
P_Europe	Production in Europe	D=1: 79 observations			
P_ME	Production in Middle East	D=1: 47 observations			

E.g. European Natural Gas Supply from LTCs

European gas imports contracted volume (in bcm)



E.g. France

26 contracts signed between 1964 and 2006

- covering a total of **1.5** tcf/a of natural gas,
- securing supplies up to **2028** from **11** different exporting countries, and of which
 - **12** are LNG,
 - **5** signed by new market participants (EdF, Total, Rhodia),
 - **4** are extensions of „old“ contracts,
 - **18.5** years average contract duration (min: 2 years; max: 36 years).

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4.1 Specification

$$(1) \text{CD}_i = c_i + \beta_1 \text{TVol}_i + \beta_2 \text{Project} + \beta_3 \text{Entrant} + \beta_4 \text{Reneg} + \beta_5 \text{P_Africa} + \beta_6 \text{P_Eurasia} + \beta_7 \text{P_Europe} + \beta_8 \text{P_ME} + \beta_9 \text{P_Oceania} + \beta_{10} \text{D99_06} * \text{C_Europe} + \beta_{11} \text{C_US_UK} + \varepsilon_i$$

$$(2) \log \text{CD}_i = c_i + \beta_1 \log \text{TVol}_i + \dots$$

CD – contract duration (years)

TVol – total contracted volume (in bcm)

PROJECT – contract concluded in greenfield infrastructure project

TRAD – traditional player vs. incumbent

Reneg – extended/renegotiated contract

P Region – production of natural gas in contract

C Region – consumption of natural gas in contract

D99 06 – time dummy for contracts signed since 1999

Specification	(1)	(2)
C	20.54*** (0.0000)	2.61*** (0.0000)
TVOL	0.04*** (0.0000)	0.16*** (0.0000)
PROJECT	3.09*** (0.0000)	0.16*** (0.0002)
ENTRANTS	-3.09*** (0.0001)	-0.19*** (0.0004)
RENEG.	-4.36*** (0.0000)	-0.29*** (0.0000)
P_Africa	-2.39* (0.0525)	-0.15* (0.0526)
P_Eurasia	-3.86*** (0.0014)	-0.25*** (0.0007)
P_Europe	-2.85** (0.0303)	-0.25*** (0.0016)
P_ME	-2.93** (0.0178)	-0.21** (0.0107)
P_Oceania	-3.15*** (0.0067)	-0.15** (0.0430)
D99_06*C_EU	-1.50** (0.0416)	-0.12** (0.0170)
C_USA_UK	-2.42* (0.0502)	-0.12 (0.1218)
R ²	0.326	0.387
Adj. R ²	0.301	0.365

→ Positive relation between asset-specificity and contract duration

→ Entrants choose shorter contract duration

→ Contracts since 1998 are becoming shorter (c.p.)

Reported are estimated coefficients and p-values.

***, **, * indicate significance at 1%, 5%, and 10% levels

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5. Conclusion

General trend: market developments seem to enhance shorter term trading; shorter contract duration

Contracts dedicated to infrastructure investment exhibit significantly longer durations → importance of LTC to secure efficient investments

→ No real conflict between competition and security of supply

→ Adequate regulation required

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6. Further Issues: U.S. and Europe compared

- LNG: investment without TPA exemption?
- Pipelines: no pipe-to-pipe competition in Europe
- Storage: „crisis – what crisis?

6.1 LNG Regas Terminals in the U.S.

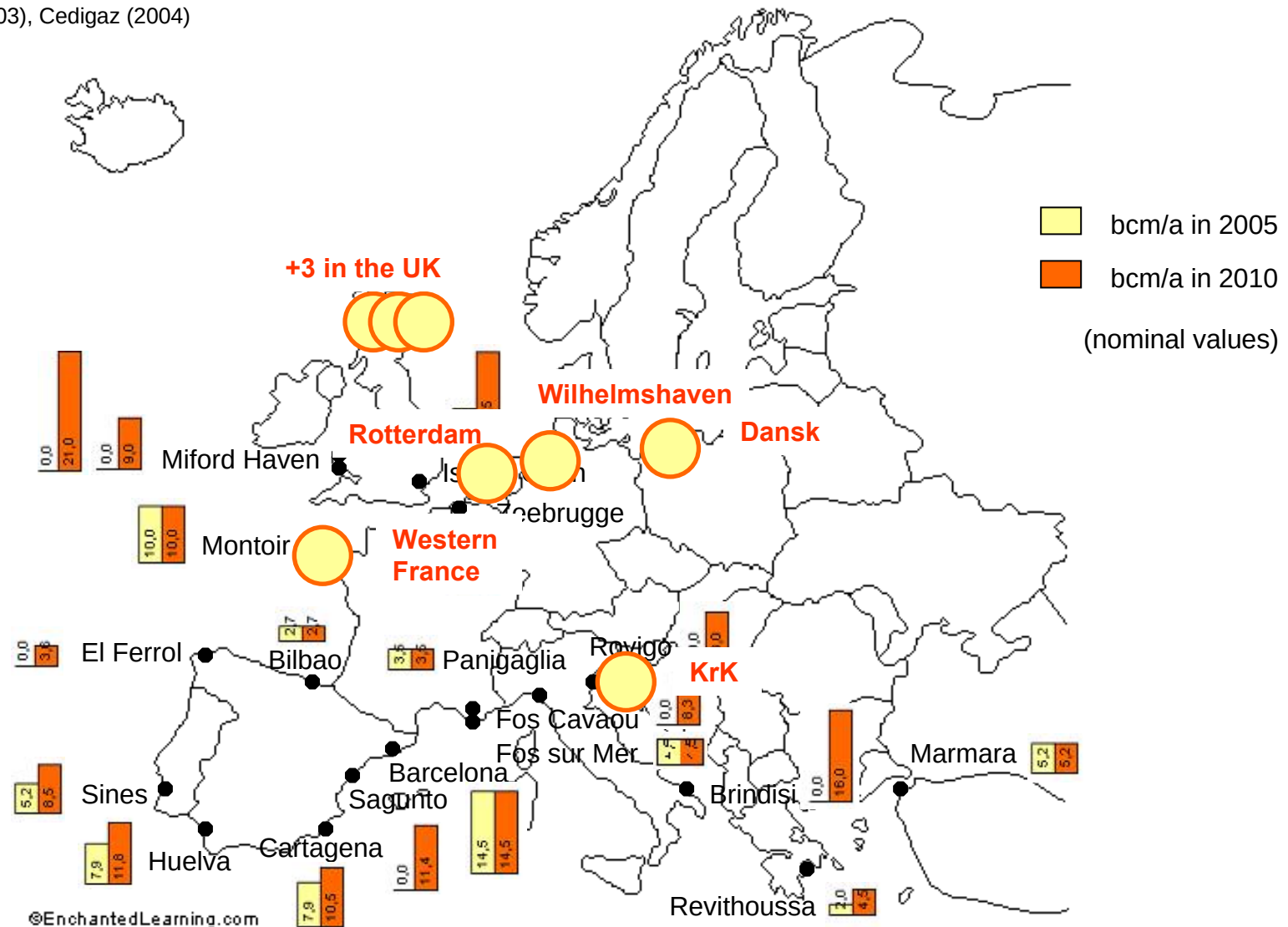
Significant investment in “merchant” terminals, e.g. Chenière (Freeport, TX)



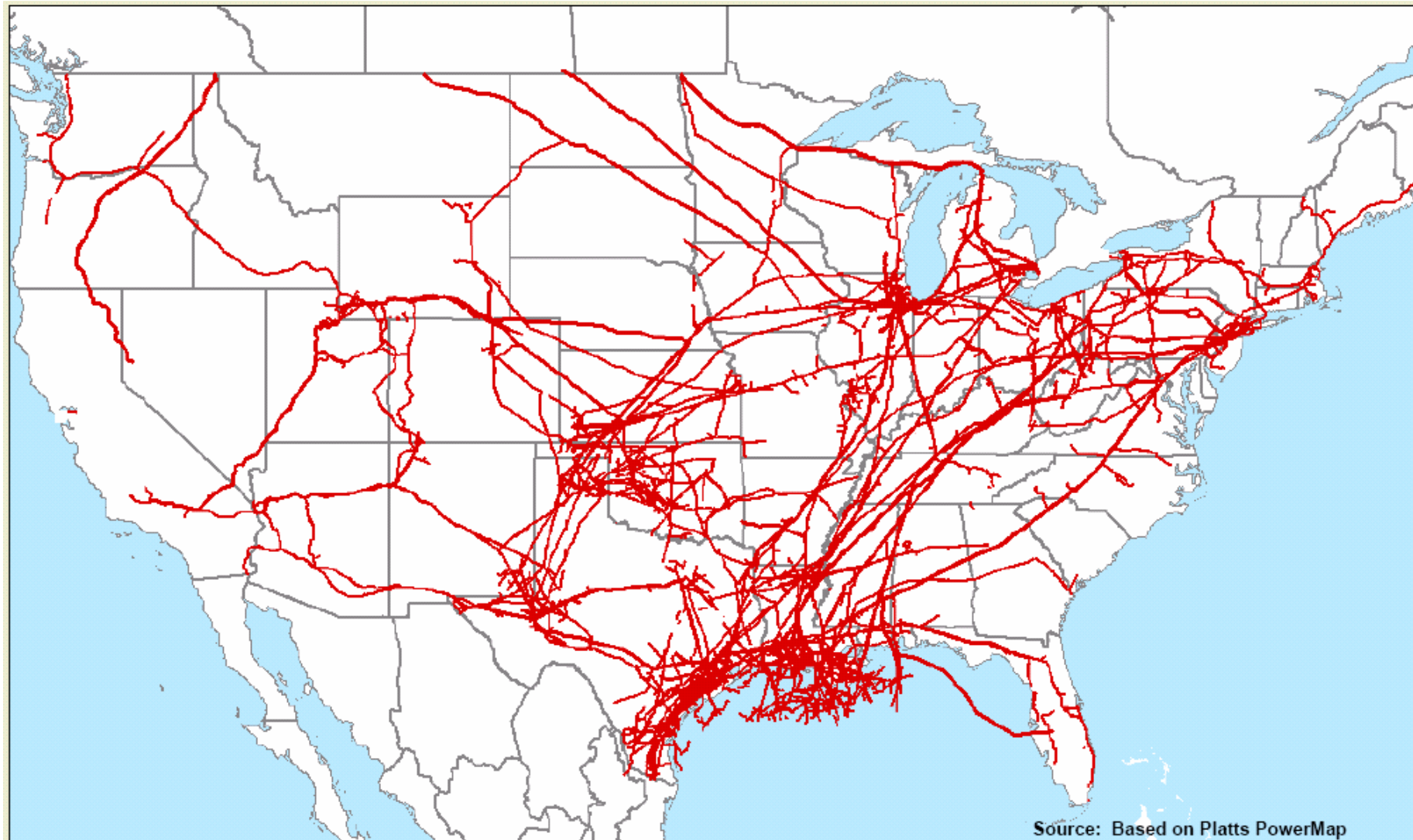
Increasing LNG-Imports and No. of Importers: Europe

LNG Import Capacities 2005 vs. 2010

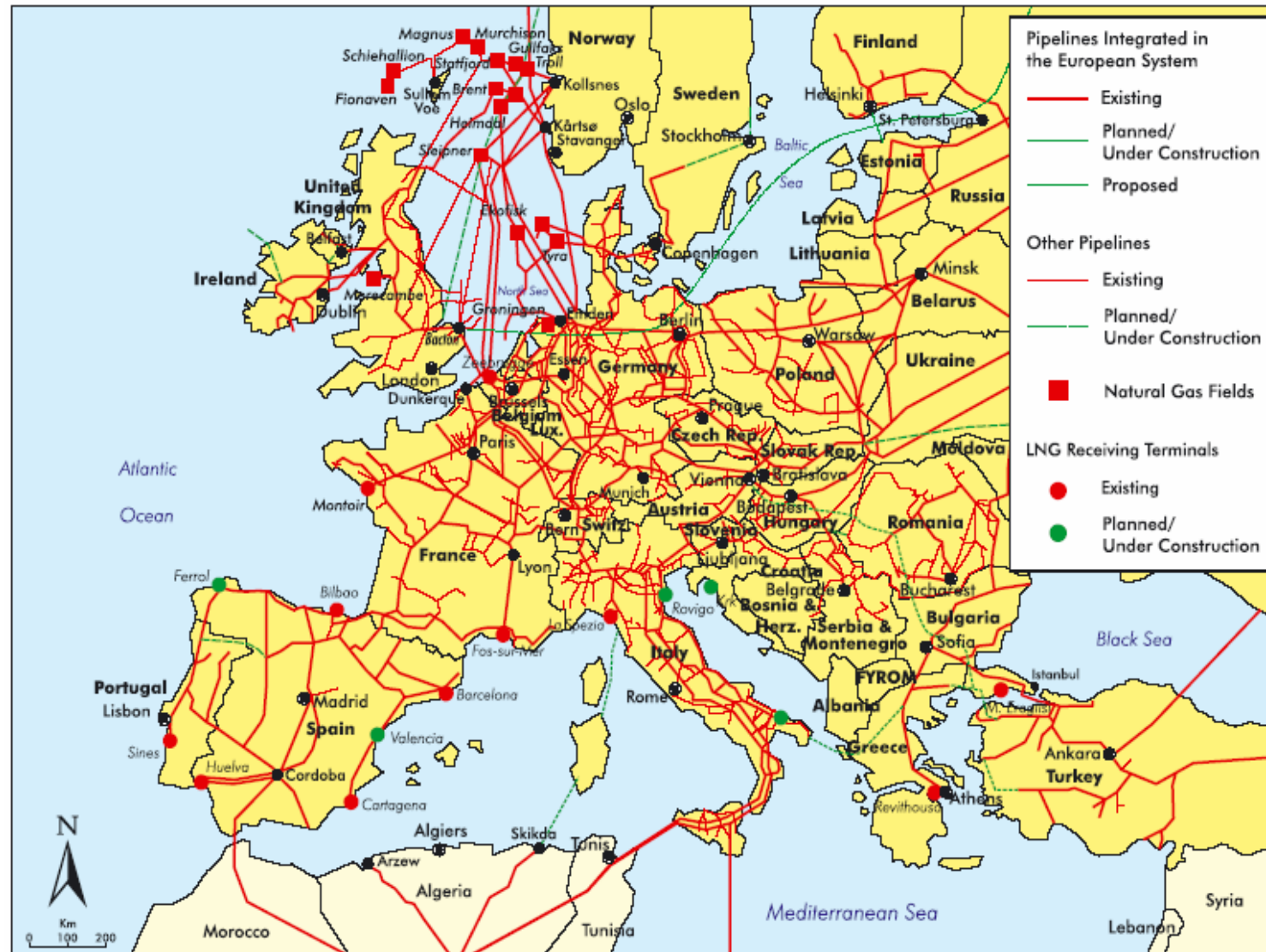
Sources: IEA (2003), Cedigaz (2004)



6.2 U.S.: Pipeline Competition Regionally Feasible (U.S. Interstate National Pipeline Grid)



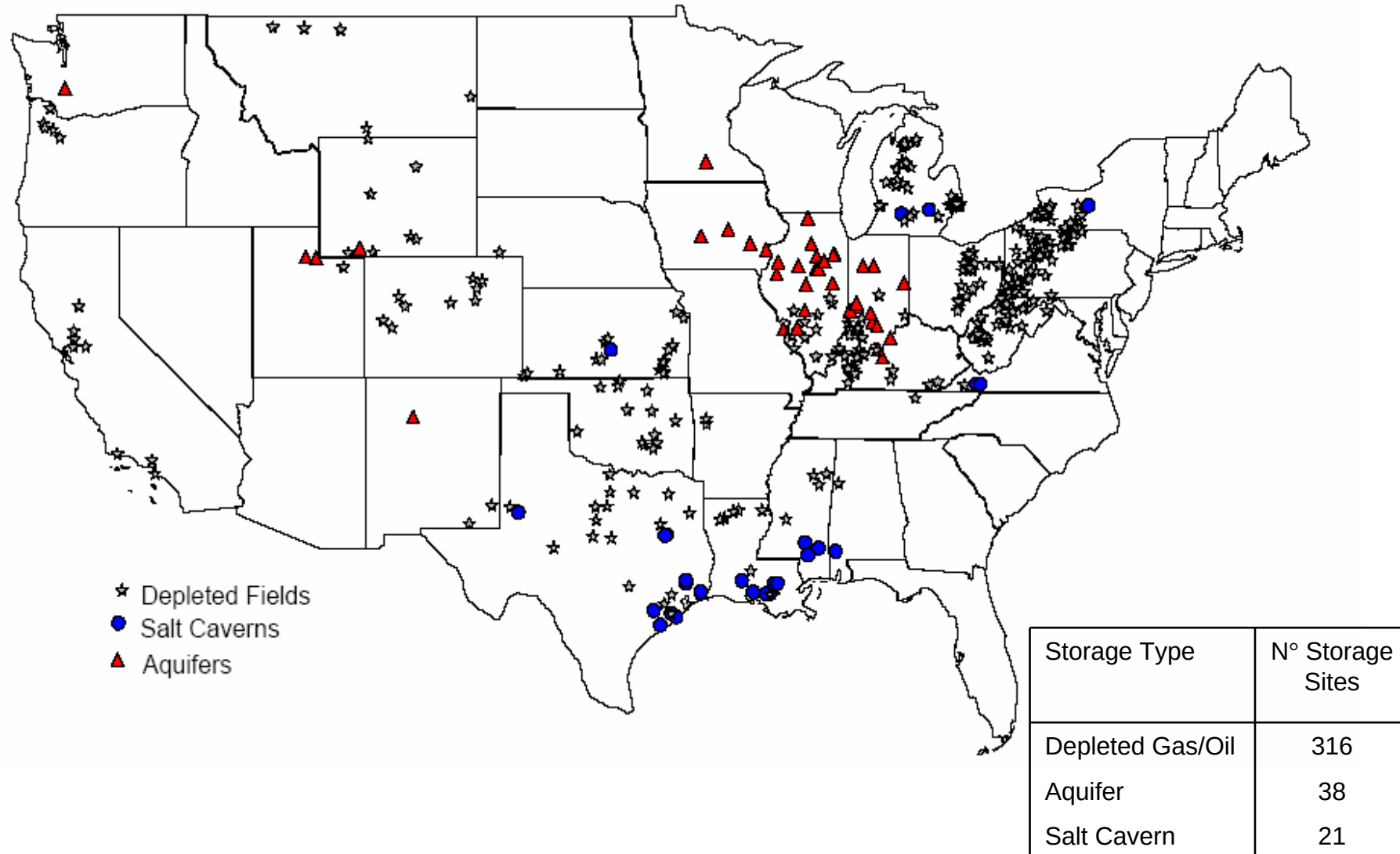
No Fully Workable Pipe-to-Pipe Competition to be Expected in Europe



Source: IEA (2005) Natural Gas Information

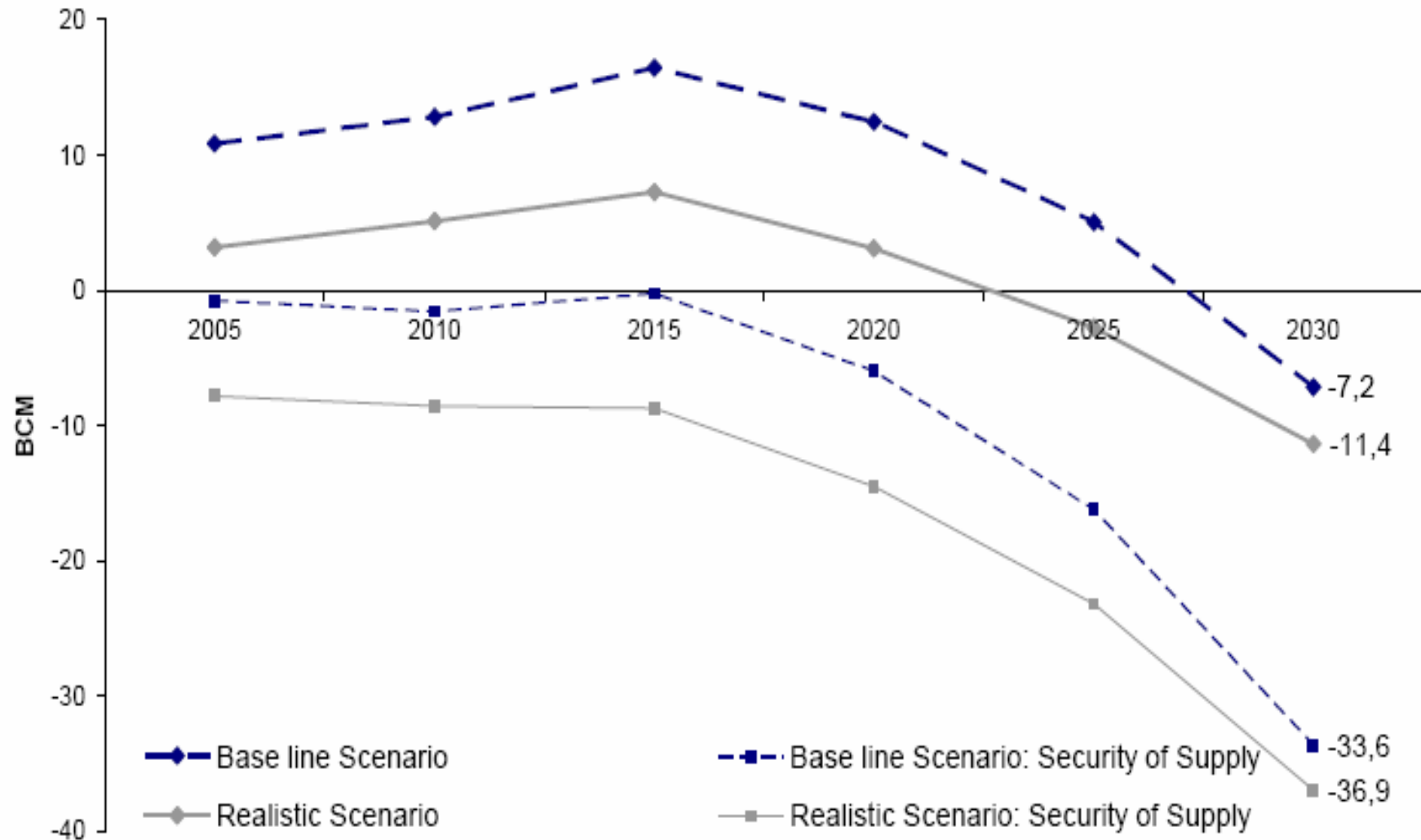
6.3: Storage: Crisis, What Crisis?

U.S. Investment in Storage Readily Forthcoming (regulated and merchant)



Europe: Is There Really a Lack of Investment?

Net Surplus/Deficit of Storage Capacity (in bcm)



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Research Program

“Globalization of Natural Gas Markets”

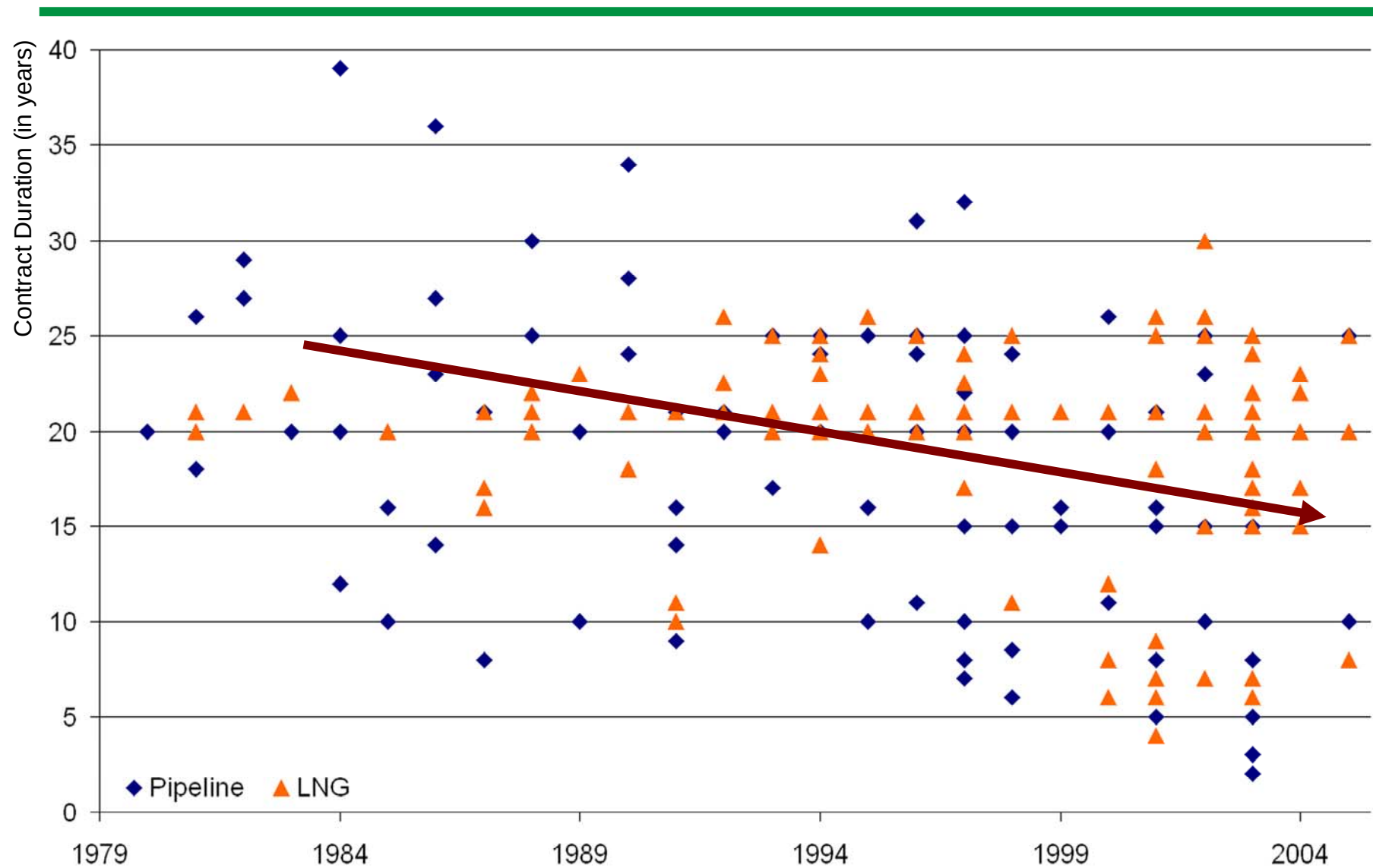


- WP-GG-19 Christian von Hirschhausen: Infrastructure Investments and Resource Adequacy in the Restructured U.S. Natural Gas Market - Is Supply Security at Risk?
- WP-GG-18 Sophia Ruester and Anne Neumann: Tomorrow, Next Year, Next Decade, Never? Perspectives of Liquefied Natural Gas Development in the U.S. (forthcoming)
- WP-GG-17 Sophia Ruester and Anne Neumann: Corporate Strategies along the LNG Value Added Chain - An Empirical Analysis of the Determinants of Vertical Integration
- WP-GG-16 Anne Neumann and Christian von Hirschhausen: Long-Term Contracts and Asset Specificity Revisited - An Empirical Analysis of Producer-Importer Relations on the Natural Gas Industry
- WP-GG-15 Christian von Hirschhausen: Langfristige Erdgasversorgung Europas – LNG vs. russisches Pipelinegas?
- WP-GG-14 Christian von Hirschhausen: Strategies for Energy Security – A Transatlantic Comparison.
- WP-GG-13 Anne Neumann and Christian von Hirschhausen: Long-Term Contracts for Natural Gas - An Empirical Analysis.
- WP-GG-12 Karsten Neuhoff and Christian von Hirschhausen: Long-Term vs. Short-Term Contracts: A European Perspective on Natural Gas.
- WP-GG-11 Anne Neumann and Boriss Siliverstovs: Convergence of European Spot Market Prices for Natural Gas? A Real-Time Analysis of Market Integration using the Kalman Filter.
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- WP-GG-09 Franziska Holz, Christian von Hirschhausen and Claudia Kemfert: A Strategic Model of European Gas Supply (GASMOD).
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- WP-GG-07 Anne Neumann and Christian von Hirschhausen: Less Long-Term Gas to Europe? A Quantitative Analysis of European Long-Term Gas Supply Contracts.
- WP-GG-06 Boriss Siliverstovs, Anne Neumann, Guillaume L'Hégaret, and Christian von Hirschhausen: International Market Integration for Natural Gas? A Cointegration Analysis of Prices in Europe, North America and Japan.
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- WP-GG-02 Anne Neumann: Security of (Gas) Supply: Conceptual Issues, Contractual Arrangements, and the Current EU Situation
- WP-GG-01 The Globalization of Natural Gas Markets - A Research Agenda.

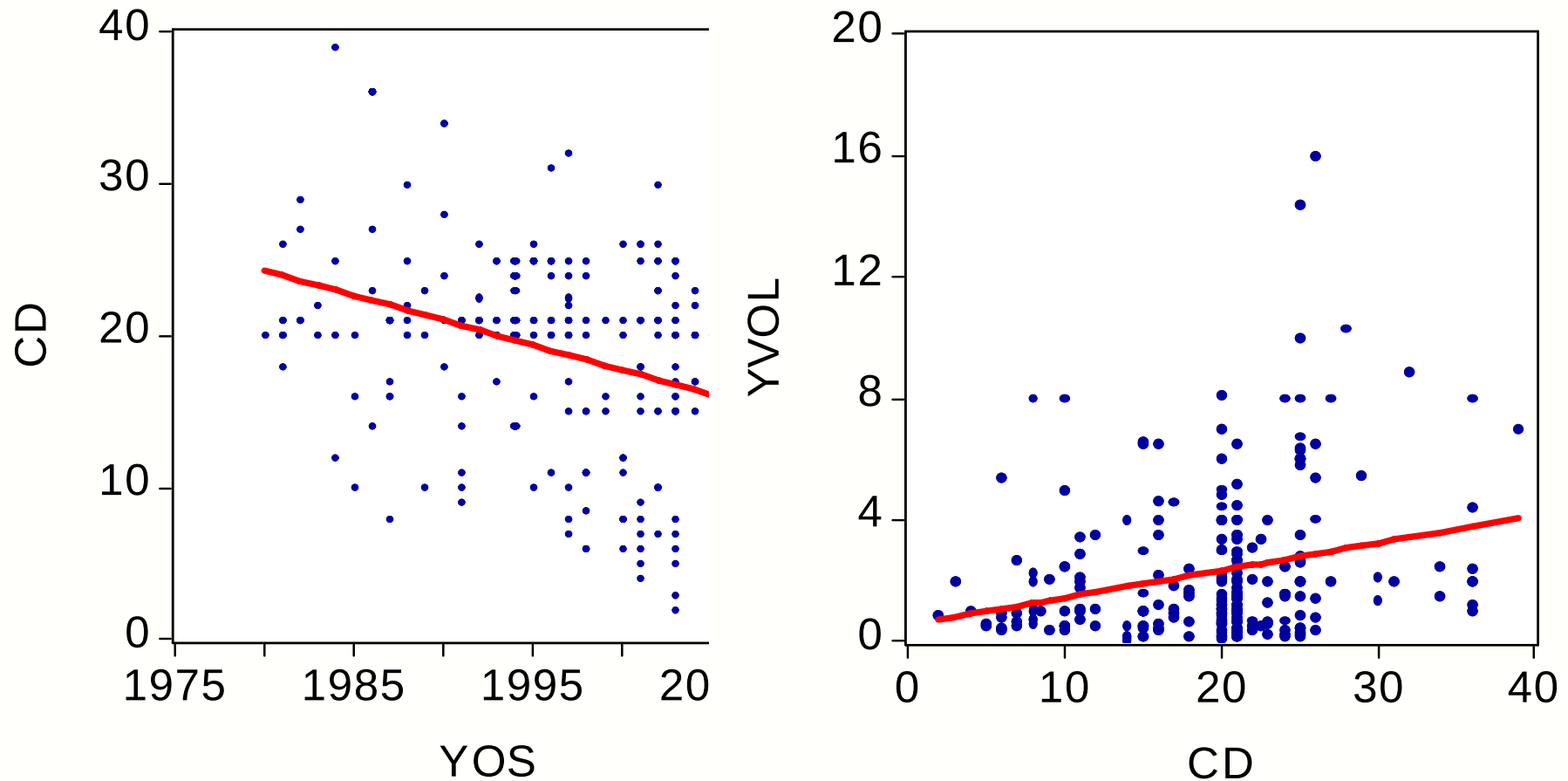
<http://globalgas.ee2.biz>

But also: Contract Length Significantly Reduced

(Source: Neumann and Hirschhausen, 2006)



Sample Visualization



→ Diminishing contract duration over time

→ Positive relation between contract duration and yearly contracted volumes

New North American Gas Storage Requirements

Source: FERC (2004, 15)

Incremental Working Gas Capacity in EEA Base Case			
	2004-2008	2009-2020	Total
Western Canada	30 Bcf	40 Bcf	70 Bcf
Eastern Canada/Michigan	36 Bcf	74 Bcf	110 Bcf
Midwest	–	60 Bcf	60 Bcf
New York	10 Bcf	56 Bcf	66 Bcf
Pennsylvania / West Virginia	33 Bcf	90 Bcf	123 Bcf
Gulf Coast	72 Bcf	5 Bcf	77 Bcf
West Coast	21 Bcf	78 Bcf	99 Bcf
Other	10 Bcf	37 Bcf	47 Bcf
Total	212 Bcf	439 Bcf	651 Bcf

Source: Energy and Environmental Analysis Inc, *At the Crossroads: Crisis or Opportunity for Natural Gas*

... and in Europe: More Storage Necessary in the Future

Net Surplus/Deficit of Storage Capacity in Europe (in bcm)

