Commercial LNG: Structure and Implications

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Road map

- Atlantic Basin LNG development
- LNG business and commercial structure development
- Implications for structure and policy

Atlantic Basin LNG development

Three forces are leading to growth in gas and LNG

- ***Demand*** **in electricity generation**
  - **Gas Value: preferred fuel in baseload electricity generation (below $4 - 5/MBtu)**
- ***LNG costs*** **through the chain have halved**
  - **Contractor and process competition**
  - **Simpler design and management**
  - **Scale (from 3 to 5 going to 8 Mt/y)**
  - **Shipyard competition (Korea, Spain, and China coming)**

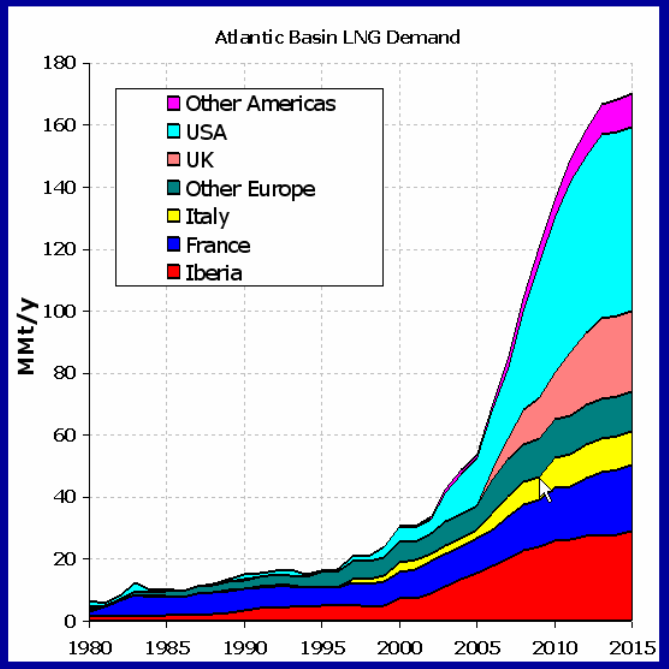
  LNG can economically reach inland markets at $3.00 – 3.50/MBtu
- ***Markets***
  - **Competitized gas markets in North America and Europe (esp. Iberia)**
  - **"Commercialization" of LNG business structure and markets**
- ***LNG can compete with coal for baseload generation***

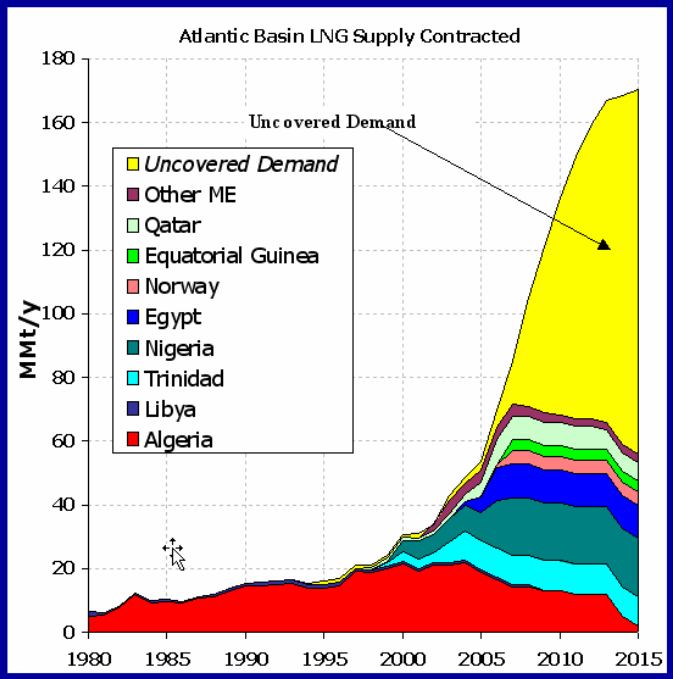
Atlantic Basin trade can triple over the next decade

- Iberian growth has led the way
- France and Italy follow with infrastructure expansion
- Big imports to UK as domestic production falls
- US import capacity is big question
- New supply projects proliferate

Growth is "rate-constrained" -- limits on capacity expansion, esp. in imports

Plenty of supply resources and demand potential at "cost'



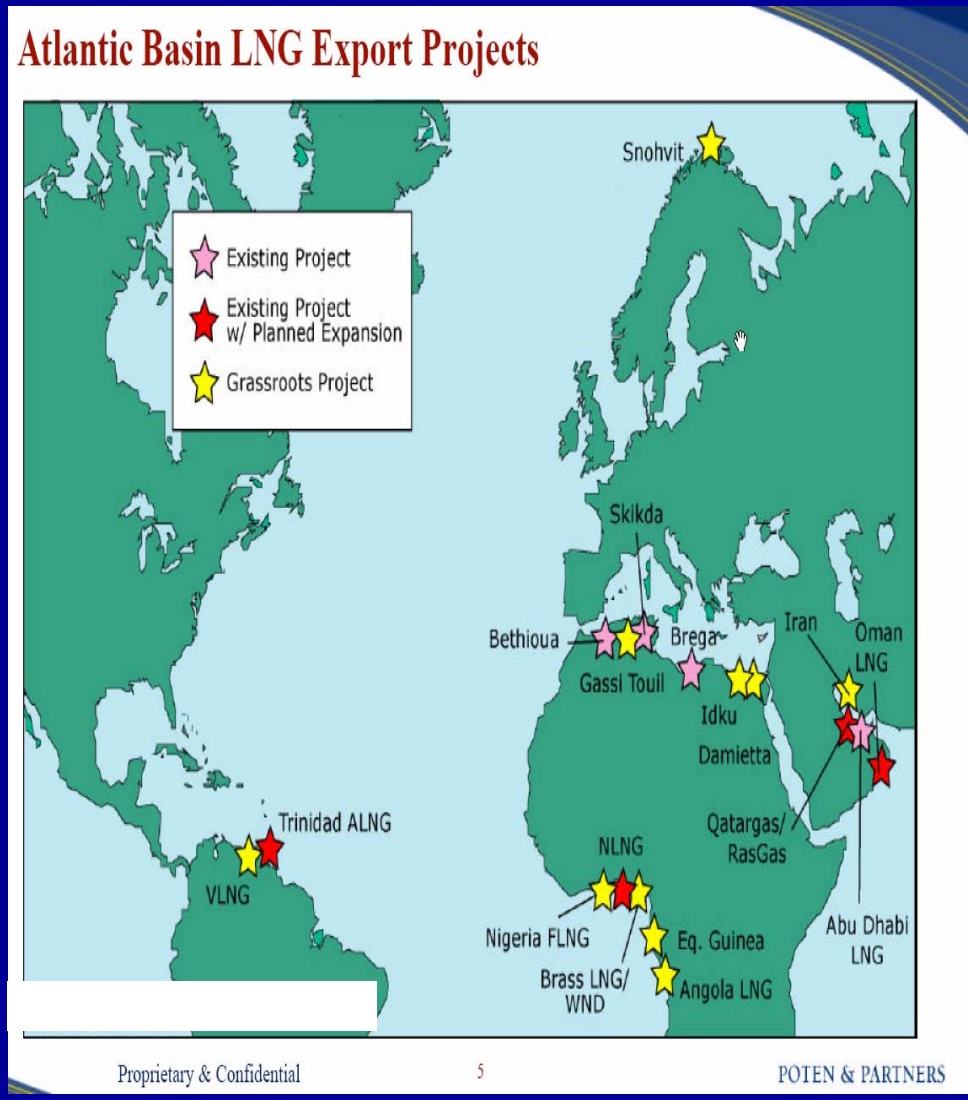


Source: Poten & Partners #20030

Source: Poten & Partners

Expanded and new LNG export projects

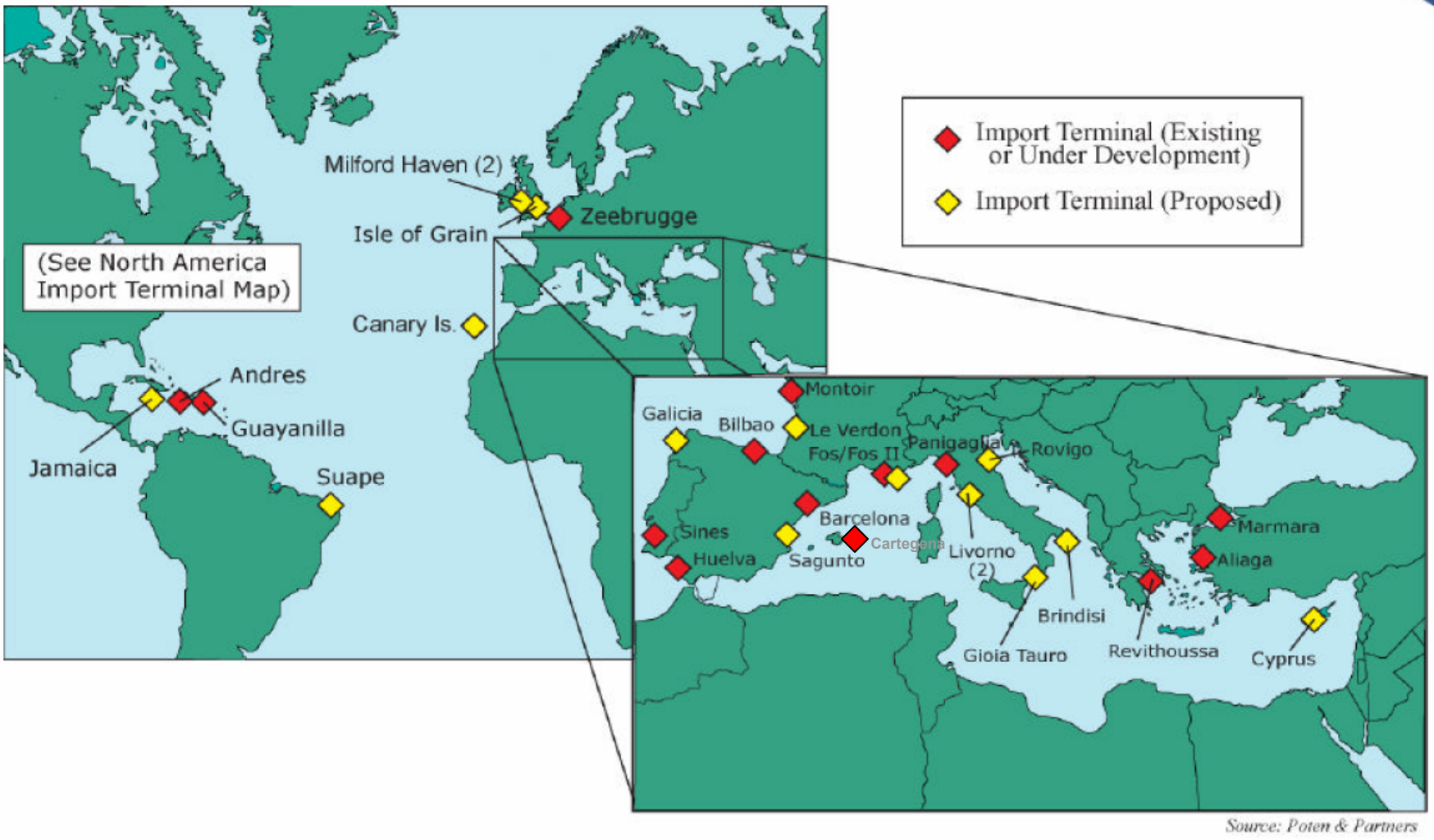
- Of 8 existing export projects, 4 are expanding (Qatar, Oman, Nigeria, and Trinidad)
- New projects in Norway and Egypt (2) are being built
- New projects are being developed in Algeria, Nigeria (3), Angola, Eq. Guinea, Iran (several), and Venezuela



Source: Poten & Partners

CEMTPP

A flood of new import terminal projects in periphery -- Southern Europe and UK



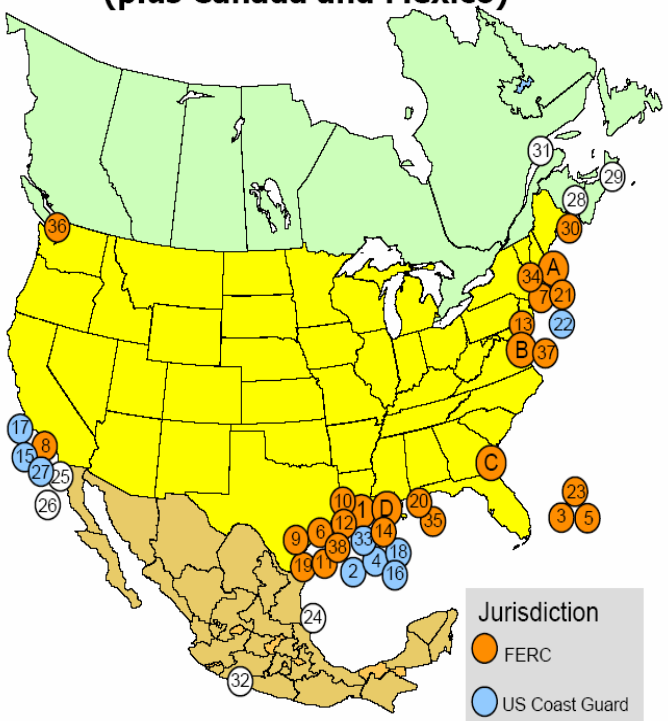
Source: Poten & Partners

Flood of import terminal *proposals* in No. America

- Existing terminals - 26 Mt/y or 1.3 Tcf/y
- Approved terminals - 44 Mt/y or 2.2 Tcf/y
- Aided by FERC decision and Deepwater Port Act renouncing "open access"
- Projects in Gulf of Mexico are faring better than those on the coasts

FERC

Existing and Proposed Lower-48 LNG Terminals
(plus Canada and Mexico)



April 2004

Office of Energy Projects

Existing Terminals with Approved Expansions
A. **Everett, MA :** 1.035 Bcfd (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 :** 1.2 Bcfd (Southern Union – Trunkline LNG)

Approved Terminals
1. **Hackberry, LA :** 1.5 Bcfd, (Sempra Energy)
2. **Port Pelican:** 1.6 Bcfd, (Chevron Texaco)
3. **Bahamas :** 0.84 Bcfd, (AES Ocean Express)*
4. **Gulf of Mexico:** 0.5 Bcfd, (Excelerate Energy LLC)
5. **Bahamas :** 0.83 Bcfd, (Calypso Tractebel)*

Proposed Terminals and Expansions – FERC
6. **Freeport, TX :** 1.5 Bcfd, (Cheniere / Freeport LNG Dev.)
7. **Fall River, MA :** 0.8 Bcfd, (Weaver's Cove Energy)
8. **Long Beach, CA :** 0.7 Bcfd, (SES/Mitsubishi)
9. **Corpus Christi, TX :** 2.6 Bcfd, (Cheniere LNG Partners)
10. **Sabine, LA :** 2.6 Bcfd (Cheniere LNG)
11. **Corpus Christi, TX :** 1.0 Bcfd (Vista Del Sol/ExxonMobil)
12. **Sabine, TX :** 1.0 Bcfd (Golden Pass/ExxonMobil)
13. **Logan Township, NJ :** 1.2 Bcfd (Crown Landing LNG – BP)
14. **Lake Charles, LA:** 0.6 Bcfd (Southern Union – Trunkline LNG)

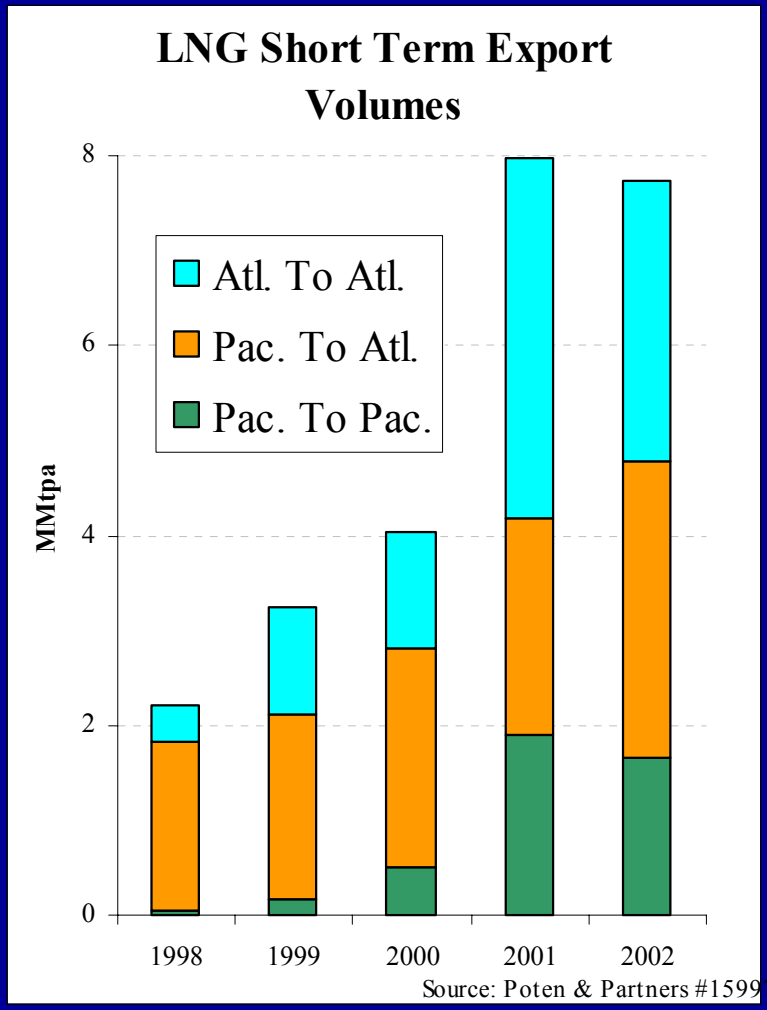
Proposed Terminals – Coast Guard
15. **California Offshore:** 1.5 Bcfd, (Cabrillo Port – BHP Billiton)
16. **Louisiana Offshore :** 1.0 Bcfd (Gulf Landing – Shell)
17. **So. California Offshore :** 0.5 Bcfd, (Crystal Energy)
18. **Louisiana Offshore :** 1.0 Bcfd (McMoRan Exp.)

Planned Terminals and Expansions
19. **Brownsville, TX:** n/a, (Cheniere LNG Partners)
20. **Mobile Bay, AL:** 1.0 Bcfd, (ExxonMobil)
21. **Somerset, MA :** 0.65 Bcfd (Somerset LNG)
22. **Belmar, NJ Offshore :** n/a (Excelerate Energy)
23. **Bahamas :** 0.5 Bcfd, (Seafarer - El Paso/FPL)
24. **Altamira, Tamulipas :** 1.12 Bcfd, (Shell)
25. **Baja California, MX :** 1.0 Bcfd, (Sempra & Shell)
26. **Baja California - Offshore :** 1.4 Bcfd, (Chevron Texaco)
27. **California - Offshore :** 0.5 Bcfd, (Chevron Texaco)
28. **St. John, NB :** 0.5 Bcfd, (Canaport – Irving Oil)
29. **Point Tupper, NS** 1.0 Bcf/d (Bear Head LNG - Access Northeast Energy)
30. **Searsport, ME :** n/a
31. **St. Lawrence, QC :** n/a (TCPL and/or Gaz Met)
32. **Lázaro Cárdenas, MX :** 0.5 Bcfd (Tractebel)
33. **Gulf of Mexico :** 1.0 Bcfd (ExxonMobil)
34. **Providence, RI :** 0.5 Bcfd (Keyspan & BG LNG)
35. **Mobile Bay, AL:** 1.0 Bcfd (Cheniere LNG Partners)
36. **Cherry Point, WA:** 0.5 Bcfd (Cherry Point Energy LLC)
37. **Cove Point, MD :** 0.8 Bcfd (Dominion)
38. **Corpus Christi, TX :** 1.0 Bcfd (Occidental Energy Ventures)

* *US pipeline approved; LNG terminal pending in Bahamas*

Growing short-term supplies

- New export projects always have some spare capacity, but in the 1980s and ’90s, this moved within the long-term contract structure
- 1998-2002 – arms-length short-tem trading from 2 to 8 MMtpa (7% of total trade)
- ME (Pacific) supply largely to Atlantic
- Growing Atlantic short-term supply, from new projects in Nigeria and Trinidad
- Atlantic- Atlantic trades continue growth in 2003



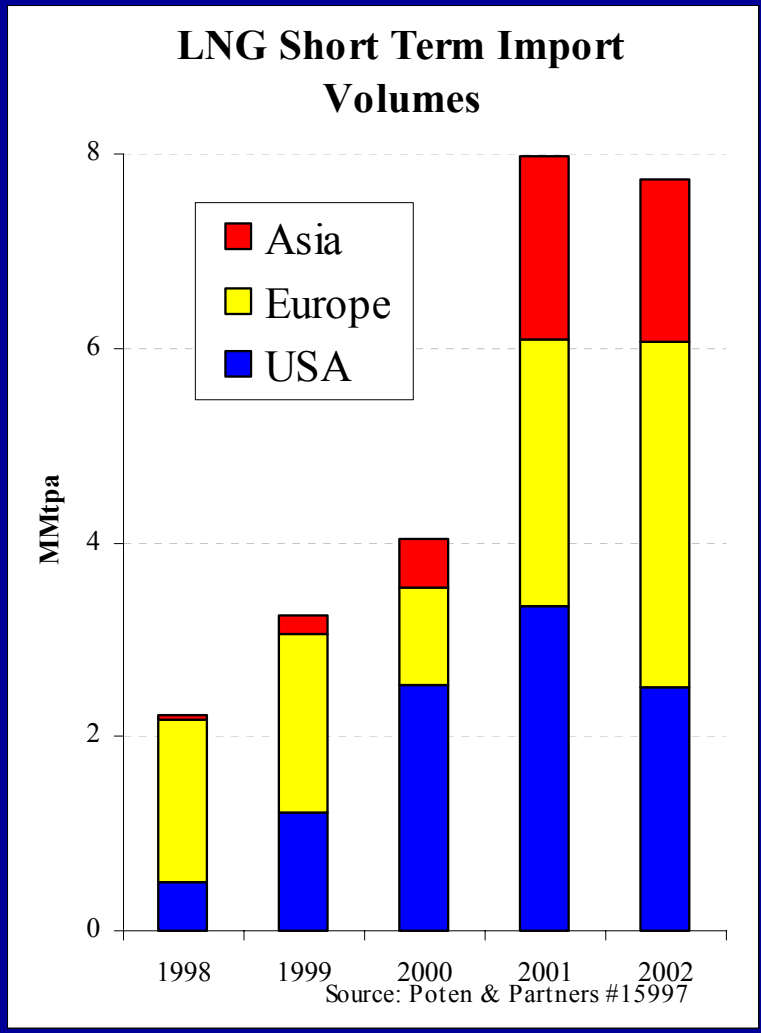
Source: Poten & Partners

Growing short-term markets

- Growing US liquidity offers markets for global spare supply capacity
- Shift to Europe in 2002 reflects opportunistic exploitation of oil-based gas prices
- Asia import - Korea reflecting winter shortfall and stalled long-term contracting (nuclear shut in in Japan in 2003)

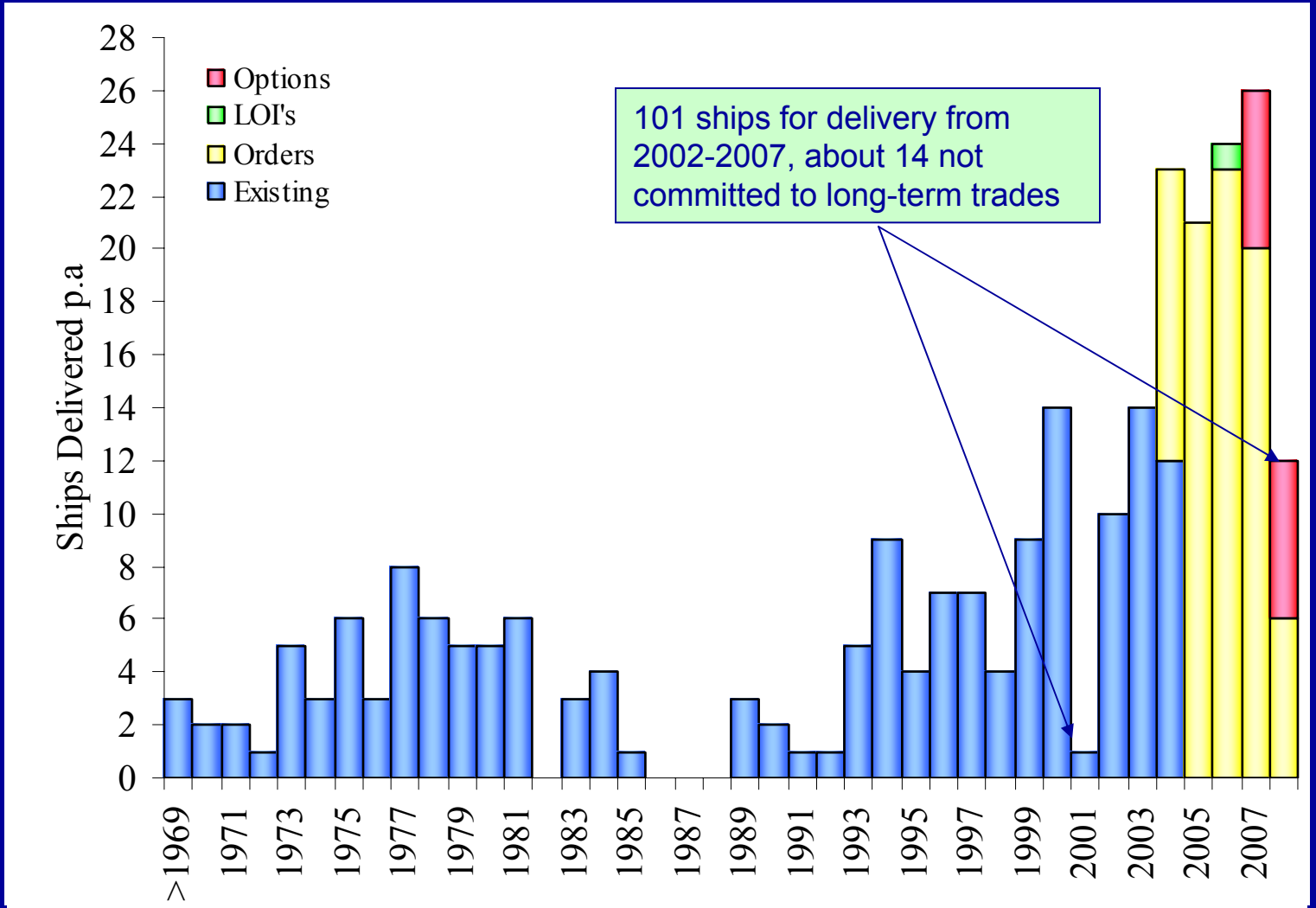
LNG is the only physical arbitrage between continental gas and electricity markets

Market liquidity and "destination optionality" are key



Source: Poten & Partners

Commercial trading requires "uncommitted capacity" through the chain -- ships are being bought for merchant trading



As of 5 July 2004

Source: Poten & Partners, Inc

LNG business and commercial structure development

Business and commercial structures are endogenous

- Determined by the underlying physical, economic, and institutional . (adapted from Coase, 1937)
- As these conditions change, the structures change to economize.
- Business structure – who owns assets and how (participation, taxation, venture revenue sharing)
- Commercial structure – the institutions and conditions of exchange between businesses (regulated rates, contracts, markets)
- Merchant – trader that adds value with asset services

Energy business and commercial structures

- Are capital-intensive – 70% value-added by capital services
- Require a facilities "chain"
  for production, transportation, distribution, and enduse
- Early in development – "chains" are bilateral ("asset specificity")
  and require an integrated business structure
  to preclude opportunistic threats/ "defection"
- Integrated monopoly companies requiring regulation or
  businesses connected by long-term contracts
- "Commercial" exchange becomes feasible when the scope of the market admits reliable "generalized exchange"
- A competitive commercial market for an energy commodity requires a competitive commercial market for transportation services
  - Oil tankers and FOB Gulf crude – after Suez crisis of 1956
  - Gas P/Ls -- USA Order 436, Europe TPA
  - Electricity FTRs – market for transmission "congestion"

LNG economic fundamentals

- Economic function of LNG -- to move natural gas from low cost/value resource to distant, high value market
  - Gas & LNG production ~$2G will have low alternative value locally
  - "Distant" market => international trade => no "utility" or "tax-based" revenue for export project
  - Has to start "Big" – no local autonomous growth
  - Costly and technically challenging: early viable trades offered little "rent cushion"
  - Early demand projects owned by monopoly utility – import terminal and service facilities ~2$ -- separate business in an isolated market
  - Whole chain of $5G (including shipping ~$1G) must be created and financed simultaneously, dedicated 4+ years in advance of startup

"Project business model" structure

- **Business structure**
  - ***Export project*** **(JV of IOCS, NOC, & maybe buyers) is the LNG seller**
  - **Buyers are *monopoly franchised utilities* -- integrated utilities (Japan) or merchant gas transportation companies (Korea, Taiwan, Europe)**
  - **Trades and facility/shipping services are *bilaterally committed***
- **Commercial structure**
  - **Facilities and shipping -- optimized and dedicated**
  - ***Quantity risk – buyer*** **assumes w/ high take-or-pay commitment**
  - ***Price risk – seller*** **– Oil- indexed pricing (because no gas market) needs endorsement by buyers' regulatory and political structure**
  - **Neither side has incentive to defect w/ energy market value movements**

Project business model properties

- Purpose
  - Supply project: to assure credit-worthy revenue stream
  - Demand project: to assure reliable non-opportunistic supply
- Limits flexibility to preclude "defection"
- Costly to buyers
  - Rigid delivery -- can't manage volume mismatch through merchant activity
- Costly to sellers
  - "destination restrictions" limit arbitrage

Commercial LNG

Sale and purchase of LNG using existing facilities on contemporaneous commercial terms

- **Drivers of commercial LNG**
  - **Lower LNG costs reduce funding coverage and permit project commitment without full capacity sold**
  - **Competitive inland gas markets reduce export project offtake risk if shipping and import capacity is available**
  - **Expanded LNG market scope increases "liquidity of exchange" for uncommitted production, shipping import capacity**
- **Requires uncommitted capacity and commercial access "through the chain" –**
  - For LNG supply
  - For LNG shipping
  - For LNG import/regas
  - For demand aggregation and inland access
- **"Optionality" is embedded in shipping, which becomes strategic**

LNG is still "technically illiquid'

- Storage and shipping are much more costly than for crude (an LNG carrier costs 2x VLCC and holds about 1/3 the energy)
- Ship positioning and production/storage scheduling are idiosyncratic
- Short-term sales will be negotiated between principals who control capacity through the chain
- *Long-term contracts for most LNG sales*
  - *to assure capacity access through chain,*
  - *local market illiquidity even when pricing is market based*

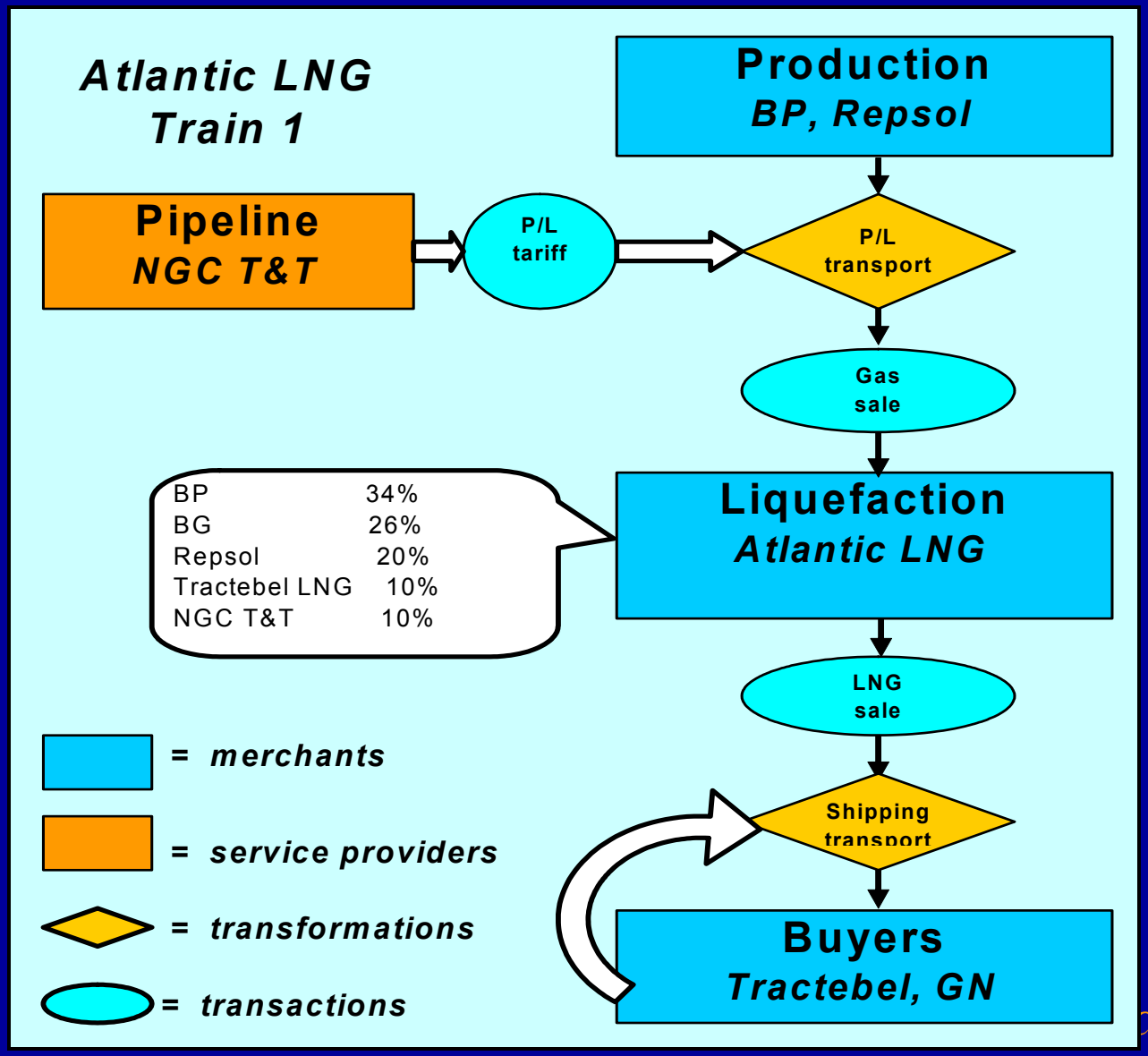
Key business structure problems

- How to organize LNG supply projects to accommodate flexible sales?
- Who owns/controls the facilities to provide flexible capacity through the chain – shipping and import terminal capacity?
- Answers
  - New supply project structures have evolved from LNG sellers to become "tolling" facilities
  - Gas producers/traders, rather than LNG projects, become the LNG sellers
  - "Merchant" LNG traders, with asset/facility positions through the chain, have developed from both ends of the chain

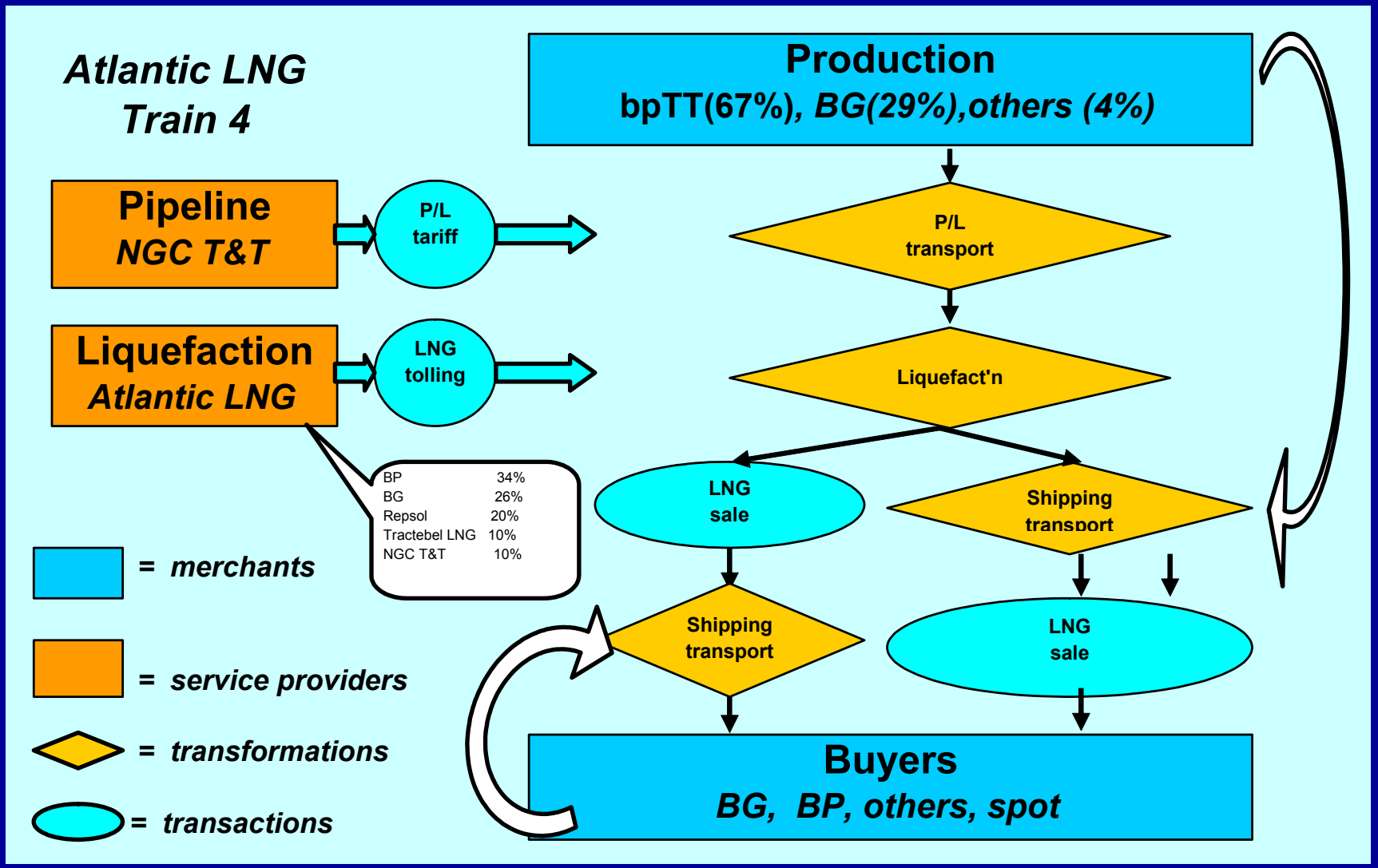
Atlantic LNG leads the way – buyer flexibility

- Train 1
  - 1-train project
  - LNG project is “merchant”
  - Competitive Front End Engineering Design chooses new contractor/process in Bechtel/Phillips
  - Buyers (Enagas / Gas Natural and Cabot LNG / Tractebel LNG) are shippers with flexibility
- Trains 2/3 and 4
  - Move to “tolling” structure
  - Gas producers are merchants and sometimes shippers
  - Buyers (Gas Natural and Tractebel LNG) are shippers with flexibility

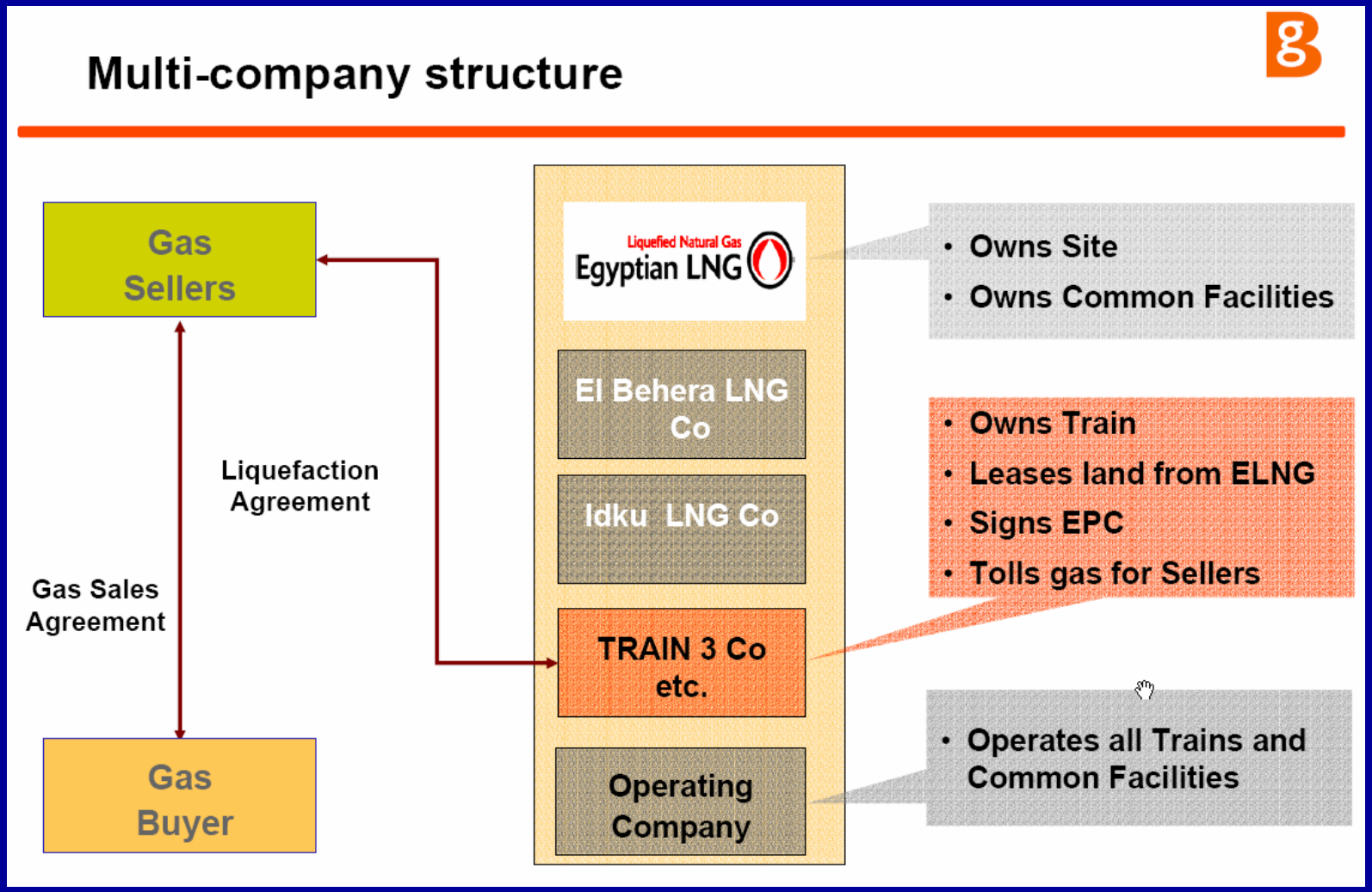
Atlantic LNG Train 1 – LNG project as merchant



Atlantic LNG Train 4 – gas producer as merchant



Egyptian LNG - the ultimate tolling structure



Merchants emerge from both ends of the chain -- gas producers integrate downstream

Merchant	*Export positions*	*Shipping*	*Import positions*
BG	Trinidad (Atlantic LNG), Egyptian LNG, Iran (prop.)	Yes	Lake Charles, LA Brindisi, Italy (prop.)
BP	Trinidad (Atlantic LNG), Angola LNG (prop.), Abu Dhabi, Indonesia, Iran (prop.),	Yes	Bilbao, Spain, Cove Point, MD
ExxonMobil	Qatar, West Niger Delta LNG (prop.), Angola LNG (prop.), Indonesia	Yes	UK, France, and Gulf of Mexico (all prop.)
Shell	Nigeria LNG, Venezuela (prop.), Oman LNG, also Brunei, Australia NWS, Malaysia, Sakhalin	Yes	Cove Point, MD, Elba Island, GA, Altamira, Mexico (prop.)
SONATRACH	Algeria	Yes	El Ferrol, Spain (prop.)

… and buyers integrate upstream

Merchant	*Export positions*	*Shipping*	*Import positions*
GdF	Snohvit, Egyptian LNG	Yes	France (2)
Repsol/YPF	Trinidad (Atlantic LNG)	Yes	Bilbao, Spain, Altamira and Lazaro Cardenas, Mexico (prop.)
Tractebel	Trinidad (Atlantic LNG)	Yes	Zeebrugge, Bel., Everett, MA, Bahamas-FL (prop.)
Union Fenosa/ENI	SEGAS LNG (Egypt), and purchase from Oman LNG		Sagunto El Ferrol, Spain (prop.)

Spanish gas marketing

- Enagas divested gas supply contracts to Gas Natural and became a terminal and P/L service provider
- GN auctioned 25% of Algerian supply
- Proliferation of gas marketers. In 2003, LNG imports (cargoes):
  - Iberdrola (49) – Algeria, Nigeria, Qatar
  - BP (16) –Algeria, Qatar, Trinidad, Australia, Abu Dhabi
  - Cepsa (Total)(42) – Algeria
  - Shell/GN (25) – Algeria, Nigeria, Qatar, Oman
  - Union Fenosa (2004+)- Oman, Qatar, Nigeria, Egypt
  - Endesa (2004) – Nigeria, Qatar

Implications for structure and policy

Implications for commercial structure

- Long-term contracts will structure the bulk of trade
- Long-term contracts will permit and share arbitrage
- Liquid markets support some “spot” trading
- True long-term “swaps” are rare
  – 2 sellers, 2 buyers, 2 shippers

Arbitrage will be significantly accommodated within long-term contract structures, but merchant business is shifting to producers and consumers who integrate control of flexible capacity through the chain

Market power in "global gas"?

- Not in LNG
  - LNG is too small – 7% of global gas and 37% of traded gas
  - Liquefaction projects and shipping are costly and not easily redeployed
  - Market power thus means "capacity restrictions"
    (Think about Qatar not building capacity to keep the price up)
  - Key players are international oil companies not NOCs
  - Reputation in a bilateral market and a stable investment environment are crucial and fragile (How much new Algerian capacity has been built since 1981)
- P/L -- Gazprom is the threat in Eurasia
  - Monopolizes w> Russian gas
  - Controls Turkmen and Kazakh gas
  - Blocked Turkish transit with Bluestream
  - Pushing into East Asia
- US policy towards Iran upstream participation and transit doesn't help

Policy issues

- North America
  - Import terminal siting
  - Financial markets have lost liquidity (post-"Enron")
  - Demand aggregation still required
- Europe
  - "Destination" clauses
  - Terms of access to import capacity
  - Market power of emerging "national champions"