

Evolution of Commercial LNG

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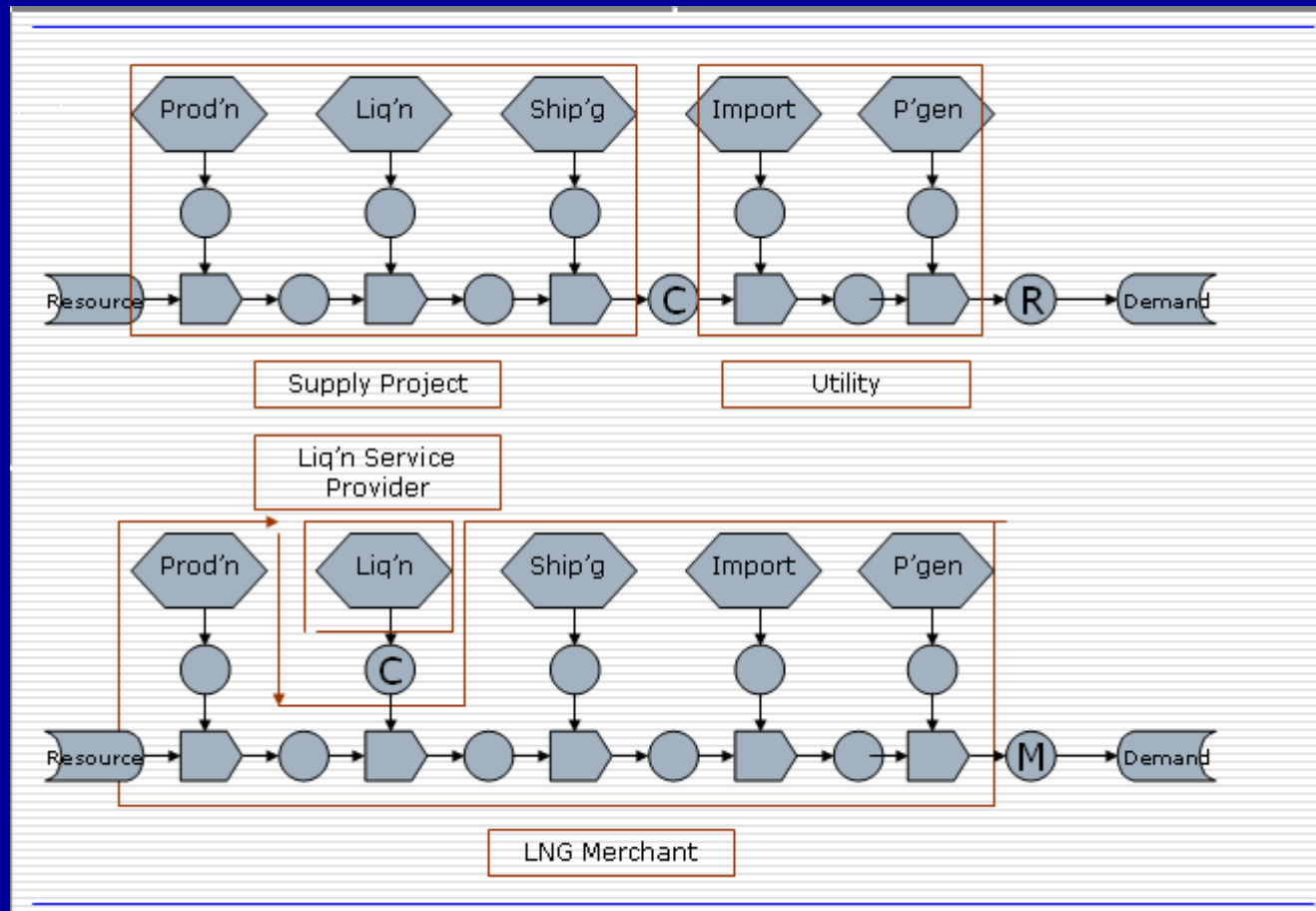
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Principles of business and commercial organization

Coasian efficiencies

- **Locus of transactions (Type I, "The Nature of the Firm")**
 - Internal to integrated enterprise
 - Long-term contracts
 - "Spot" market
- **Span of ownership and structure of partnering (Type II, "The Problem of Social Cost")**
 - To implement integrated internalization
 - Project roles
 - (tech advisor, marketing, etc.) maximize total project value if assigned to partner who can optimize execution and risk mitigation costs
 - Needs compensation within project - transfer pricing, fee income, sovereign participation (resource taxation, participation, funding and carried interests)
 - Funding implications - "project finance" often for sovereign risk discipline, and carrying sovereign participation, costly because of asymmetric information and moral hazard (Type I)

Business/commercial structures - where we are going



Road map

- Business/commercial structures and market infrastructure co-evolve
- Energy chains - oil, gas, electricity
- LNG business/commercial evolution
- LNG business/commercial structure
- Predictions and policy problems

Business and commercial structures are endogenous

- Business structure – who owns/controls assets and how (participation, taxation, venture revenue sharing)
- Commercial structure – the institutions and conditions of exchange between businesses (regulated rates, contracts, markets)
- What is “left” to the “market” depends on the capabilities of the market
- The span and character of business control depends on market opportunities
- **Codetermined by:**
 - the physical, economic, and technical characteristics of the activity
 - physical infrastructure – capability for multiply-connected exchange to support multilateral competition
 - amongst sellers for buyers
 - amongst buyers for sellers

Business/commercial structures co-evolve with market transportation infrastructure (creative destruction)

Early days, demand reaches out for supply

assure technical coherence of the chain

assure utilization and payment (credit) - integrated structures or bilateral commitment

As transportation becomes multiply connected

bilateral commitment becomes less necessary to assure credit, as market revenue can be anticipated and competition disciplines bilateral monopoly opportunism

arbitrage opportunities become physically possible

As enduse markets competitize

pressure for cost efficiency grows

opportunities for technical scale efficiency grow

advantage for market scope for business for arbitrage logistic management grows

cost of bilateral quantity commitment for buyer grows (cant be laid off)

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 or commercial 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 435, 636, Europe TPA
 - Electricity FTRs - market for transmission "congestion"

For all energies:

- local markets start by exploiting local resources
 - then reach out with bilaterally dedicated transportation
 - only “unbundle” when physically multiply connected
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- Local and intranational monopolies are regulated or busted up
 - Long-term chains start either with integrated companies (petroleum), or
 - Long-term contracts to establish pricing and offtake and preclude post-commitment opportunism
 - The motivation is to assure a “bankable revenue stream” absent a market to integrate cost and value in multiparty trading
 - Lesson: a market in an energy commodity requires an unbundled market in commodity transportation

Business/commercial evolution -- Oil

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- Oil inland transportation and storage is relatively cheap, so intracontinental (Standard, No America) and intercontinental transportation systems arise early (Royal Dutch & Shell T&T in Russia, Indonesia)
- In majors, oil pipelines and shipping were integrated and dedicated to refineries
- **Market power**
 - In downstream is always a concern.
 - In upstream US, gov't, TRC Connelly Hot Oil Act, Quota 1955
 - In int'l mkts, Achnacarry "As Is" limited market competition, "Red Line" agreement limited competition for resource access
- First break in integrated majors' control was Suez crisis of 1956, brought the Greek shipowners into transit, and began to make FOB crude market possible.
- However most majors were long crude (except Texaco, BP?, TOTAL?) - didn't give up control of crude until early 1980s (posted prices higher than market) brought the pain of "Saudi advantage" to Aramco partners
- Unbundled when 3rd party shipping matured

Business/commercial evolution - USA

- **Natural gas**
 - Municipal manufactured gas were local through 19th and early 20th century
 - P/Ls in US were regulated and dedicated, wellhead price regulation 1954 (NGA 1935, Phillips Decision 1954)
 - Big expansion after WWII
 - Separation of interstate (cost-based pricing) and intrastate markets forced restructuring (NGPA, 1978)
 - Open access (Order 435, 1985) and unbundling of merchant and transportation functions (Order 636, 1992)
- **Electricity**
 - PURPA and QFs
 - EPAAct92 -
 - Millenium Order and RTOs
 - PJM FTRs - market for congestion
- ***Evolution is evolution of infrastructure access - governance and commercial structures***

Europe and Asia – gas and electricity

- **EU directives**
 - focus on retail choice
 - Unbundling
 - Iberia
 - Not Central Europe
 - Effective access with negotiated tariffs -- ?
 - Limited actual trading in continental Europe (J. Stern)
- **Asia**
 - Japan
 - No TPA access through proprietary LNG import terminals,
 - Competition for large customers between gas and electric possible
 - IPPs require siting , not much competition

Sovereign context – “national champions” are regarded very differently

• US

- Petroleum companies – inherent monopolists
 - Breakup of Standard Oil
 - Conflict between State and Interior over anti-trust re participation in Aramco
- Utilities regulation
 - Regional breakup – PUHCA
 - No economic profit! -- cost-plus regulation, totally destroying cost-saving incentives
 - No SMD

• Europe

- Petroleum companies – national champions
 - UK – golden share in Anglo-Persian
 - France – Elf!!
- Utilities regulation
 - When UK electricity unbundled,
 - E.ON buys Ruhrgas to compete with French
 - RPI+X regulation

• Asia

- Japan – utilities retain import control
- Korea – privatization stalled (partly of gas pricing to electricity)
- Taiwan -- competitive move away from Taipower and CPC failed.

Sovereign attitude -- contracting

- **USA**

- Contract structure
 - Detailed
 - Highly legal
 - Willing to shut down in face of dispute
 - Enhances risk and ex ante rigidity

- **Key example**

- El Paso (Cove Point and Elba Island) stopped - two facilities and about 10 ships laid up
- Lake Charles - bankrupt, stopped (SONATRACH has 22% of Trunkline)
- Everett - no trade through mid-1980s

- **Japan**

- Contracts are often short, incomplete, expectation is for renegotiation
- Reopeners (except Indonesia)

- **Key example**

- contract oil prices were "posted prices", from which markets diverged in mid-1980s
- LNG kept moving, contested revenues were banked, differences ultimately worked out in extended cargoes

LNG business and commercial evolution

LNG technical and economic characteristics

Characteristic	Implication
Transportation technology - moves remote, low-value natural gas to high-value markets.	<p>Can't grow incrementally in local markets</p> <p>Export locations remote, limited local use, production dedicated to trade</p> <p>Early relevant markets isolated. Significant buyer commitment of facilities, service areas. Requires full capacity, rigid offtake indexed pricing</p>
Efficient scale is large relative to relevant market size (early)	<p>Undiversified commitment. Slow buildup.</p> <p>Offtake commitment is onerous, potential mismatch between supply commitment and market demand.</p>
Early buyers were domestic network utilities (integrated electricity and gas companies in Japan, gas monopoly transmission merchants in Korea, Taiwan, Europe, USA)	<p>Supply ventures couldn't integrate downstream, needed robust contract between supply project and buyer. Indexed pricing and rigid offtake requires societal endorsement.</p>
Transportation costly (shipping and storage) (half or more of value-added), and optimized	<p>Technically illiquid, but shipping can be flexible later</p> <p>Early project structure: Shipping dedicated to trades, production/loading scheduling embedded in project design, planned annually. Limited seasonal flexibility.</p>

Updated: 2/21/2006

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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

LNG Early stages of the business - until about 1992

- **Asia and Europe - creditworthy buyers are integrated utilities (J) or monopoly gas transmission merchants (K,T,Europe)**
- **Seller commits production, liquefaction/export, shipping (usually)**
- **Buyer commits facilities, utility service obligation**
- **Incentive-compatible oil-indexed pricing**
 - buyers take volume mismatch risk
 - sellers take value mismatch risk
 - requires social (gov't, regulators, customers) commitment to
- **Capacity (esp. shipping) optimized, no "spare" , no "market"**
- **Comfortable business**
 - market power permits seller/buyer collusion vs enduser (can see this in industrial terms) (note Electric Utilities always killed inland transportation in Japan)
- **This kind of deal collapsed in early-1980s in the US-Algeria trades**

"Project-utility 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**
 - Early commitment amplifies mismatch risk
 - Rigid delivery -- can't manage volume mismatch through merchant activity
- **Costly to sellers**
 - "destination restrictions" limit arbitrage

Drivers of the "phase change"

- Autonomous market revenues replace bilateral commitment as "bankable demand"
- For buyers, costly early commitment and lack of merchant mitigation opportunities creates market for uncommitted capacity
- Old monopoly franchise offtakers can't commit to pricing given competitive inland markets, not needed (out of market price commitments never survive the politics)
- Still requires offtake access, demand aggregation, inland transportation, sales, trade credit (Note: It is one thing to sell into Henry Hub, and quite another to sell into Florida.)
- Monopolies resist competitization with varying degrees of success (Central Europe, Asia)

How does it fragment and competitize?

- **Basic principle**
 - competition requires uncommitted capacity through the chain
- **Spare capacity -- production**
 - comes from "wedge volumes", conservative design and debottlenecking
 - Early commercial terms - "supercargoes" to same buyers, with same pricing and discretionary volumes (after 1986 price renegotiation)
 - Asian projects began to commit with partial sales on spec for spot trading (
- **Spare capacity -- shipping**
 - 17 ships were laid up between 1981 and 1999
 - now merchants are buying uncommitted shipping
- **Spare capacity - import**
 - at existing facilities, expansion is easy up to about 12-14 Mt/y (2 Bcf/d) (230 60kt cargoes/y)
 - new facilities require merchant incentives - Hackberry
- **Commercial terms**
 - destination clauses attacked by EU

Business structure implications - I

- Partnering for sovereign stability and financing becomes less important as market revenues and commercial opportunities discipline host gov'ts
- Shipping control becomes strategic and conflicted
 - Korea starts controlling shipping to place Korean ships, now uses shipping control to manage seasonality (5 to 1 winter summer swing in citygas demand)
 - Japan - utilities including TEPCO buying ships
 - Malaysia (1st and last FOB contract to Korea)
 - Nigeria (Shell) - never sold FOB to USA
 - Australia-China FOB?

Business structure implications -- II

- Arbitrage exploitation requires span of control over multiple chains (sources, shipping, import access)
- Disappearance of monopoly utility buyer means supply chain must reintegrate downstream into terminals and buyers
 - buy access - BP, BG, Tractabel
 - build access - BG (Brindisi), ExMob (Millford Haven, Texas)
- "Projects" can't do this, so re-emergence of majors as LNG merchants
 - Gas producers/traders (IOCs), rather than LNG projects, become the LNG sellers
- **Competitive construction**
 - competitive FEEDs at Atlantic LNG brought Bechtel-Phillips back in
 - now in Indonesia (Tangguh)
 - Asia - still don't have real markets, but request for supply tenders by India (Petronet) and then China buyers changed everything
- **Massive scale increase**
 - ExMob to 7+Mt/y trains, 230+ kcm ships

Old business structures

- **Full sale before commitment**
 - Assures funding coverage
 - Limits opportunistic marketing
 - Big burden on buyer, who must anticipate demand 5-10 years in future
 - Note: when Japan opens inland gas market to competition between gas and electricity companies, neither can project demand as effectively.
- **Partnering for ex ante demand formation**
 - Seller-buyer conflicts built into supply project business structure
- **Partnering for host participation**
 - Split upstream/downstream ownership to accommodate different ownership
 - Different transfer prices compromised unitary incentives
 - In all cases E. of Suez where relevant, national oil companies had at least 60% of the downstream

New “unbundled” business structures

- **Merchant-** business structure that owns assets for transformation/transportation, and is paid on the gross commodity margin
- **Trader** -- asset-free market maker (downstream gas marketing)
- **Service provider** – sells services long-term (long-term ship charter, liquefaction tolling), or short-term (spot charters)
- **Goals**
 - Abolish commodity transfer pricing to unitize incentives
 - Enable merchant to span multiple supply-transportation-import-marketing streams, (get the project out of the merchant business)
 - Reintegrate downstream
- **Three models:**
 - Liquefaction project as service provider – Trinidad, Egypt
 - Supply merchant – ExMob/QP
 - Buyer moves upstream – GdF, Union Fenosa, Tractabel ?

Commercial structure evolution

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*

Tech illiquidity implications

- **An asset is “strategic” if it controls “real optionality”**
 - Shipping becomes strategic and creates FOB/exship tension between buyer and seller
 - Example - Korea after 1st sale (Exship, Indonesia in uncommitted ships) insisted on FOB purchase to employ own ship, now enables optionality to cover seasonal needs
- **One prediction**
 - Must have a strategic asset position to gain negotiating access to the rest of the chain.
 - Spot trading discussion is between principals - logistic arrangements and rent-sharing
 - With shipping glut, shipping-based merchants will fail (in fact, large shipping company has tried and failed to become merchant trader)

Commercial flexibility

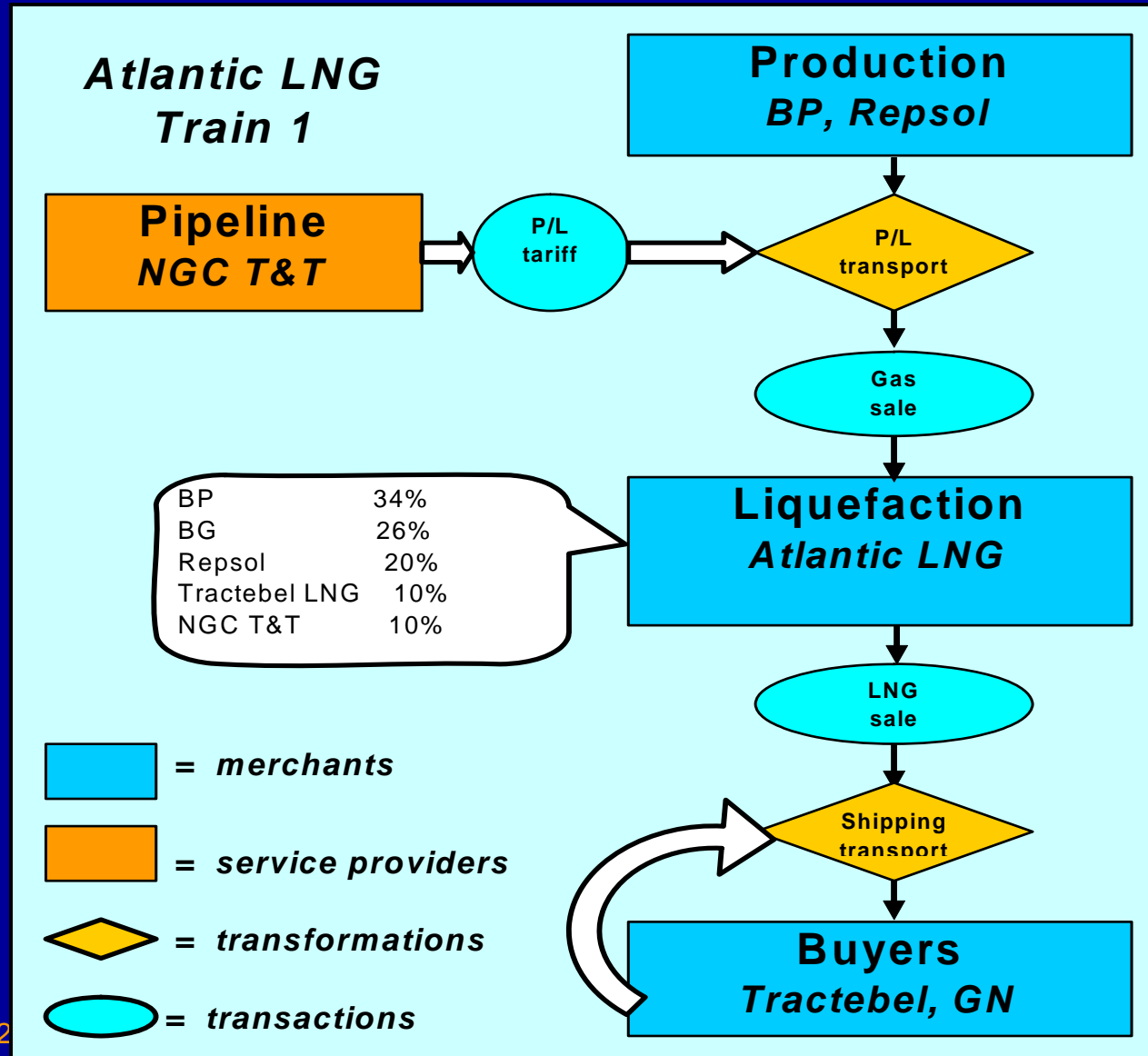
- **Commitment with partial sales**
 - Starting with Ras Gas 1999
 - Malaysia III, Sakhalin
 - Not needed in Atlantic with big markets
- **BP sale to Dominican Republic (0.7 – 1.0 Mt/y) not sourced (“branded LNG”)**
- **Sempra suppliers Sakhalin, Indonesia, Australia -- Flexible destinations – West Coast USA/East Asia**
- **Yemen – East (Korea winter)/West (Atlantic summer) sales**
- **ExMob/QP – Main destination Wales, but capacity at Zeebrugge**
- **New long-term contract terms**
 - share flexibility rents between seller and buyer

LNG business and commercial structures

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 total destination flexibility, but rigid 100% offtake
- **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

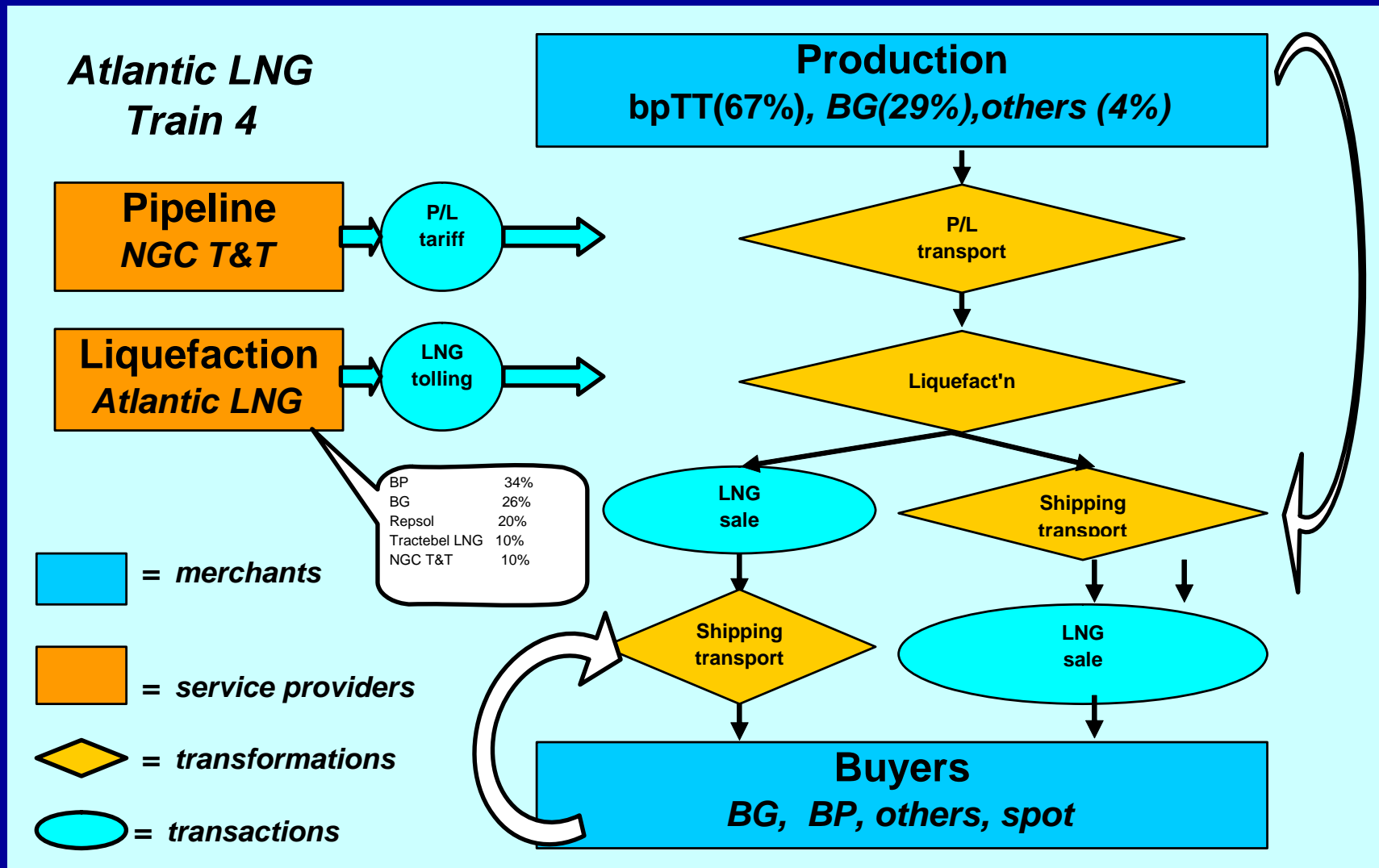
Atlantic LNG Train 1 - LNG project as merchant



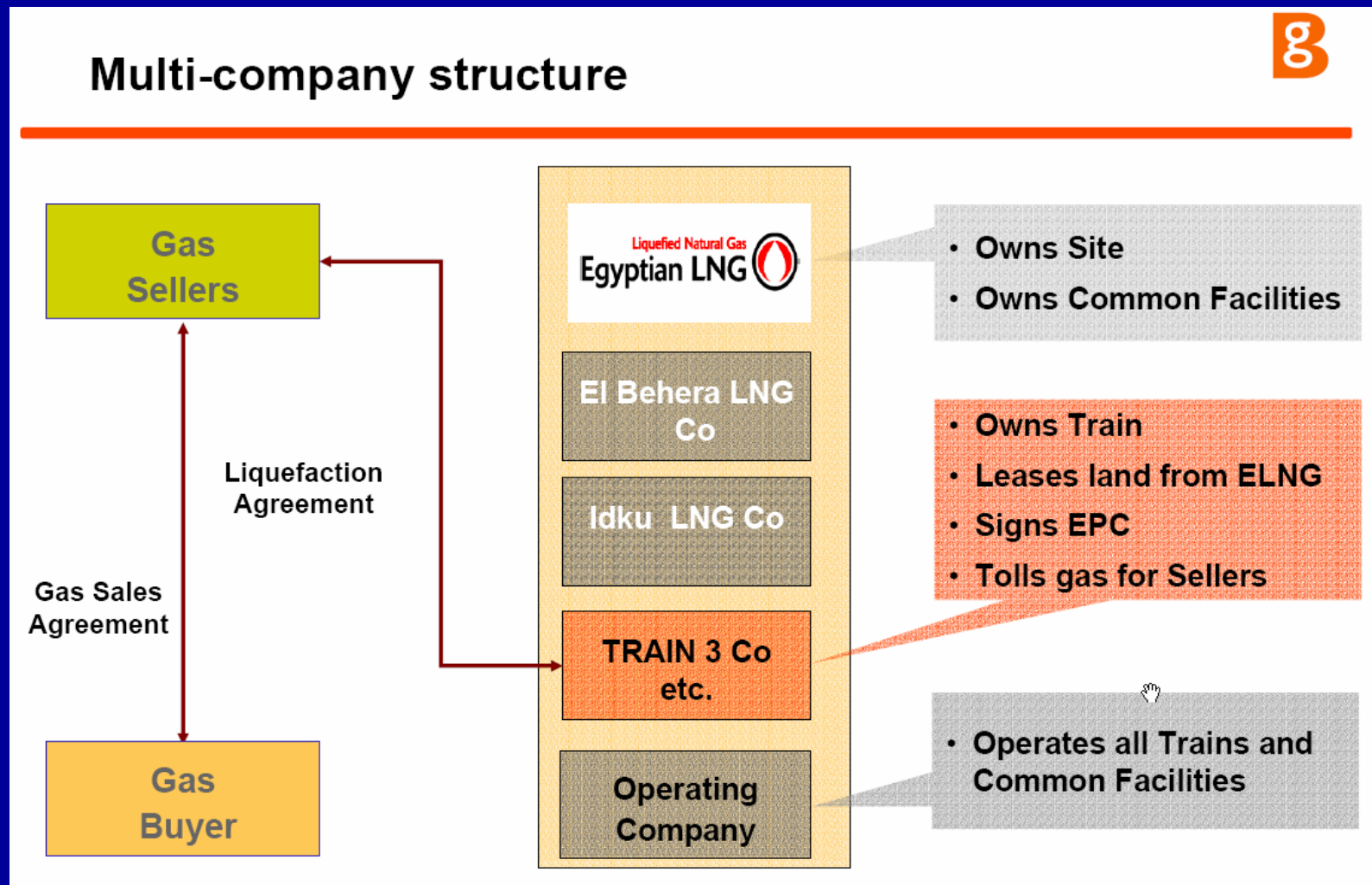
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Atlantic LNG Train 4 - gas producer as merchant



Egyptian LNG (Idku) - the ultimate tolling structure



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

<i>Merchant</i>	<i>Export positions</i>	<i>Shipping</i>	<i>Import positions</i>
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.)

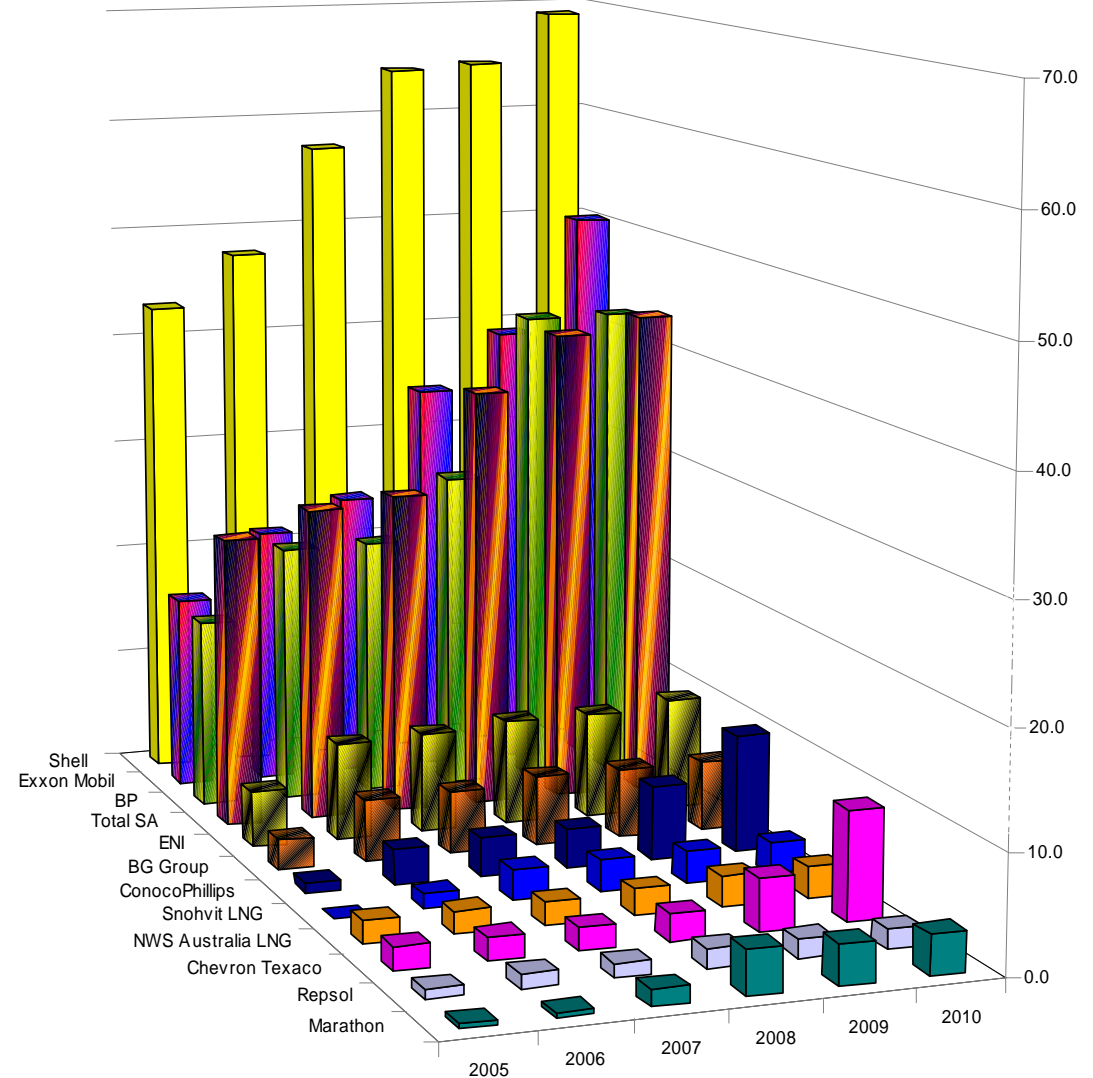
... and buyers integrate upstream

<i>Merchant</i>	<i>Export positions</i>	<i>Shipping</i>	<i>Import positions</i>
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.)

Gas Input & Marketing Output

A chart estimating ownership of gas input and marketing rights associated with LNG production

*Tonnes may include production sharing contract volumes, which are to the account of the national oil company



Source John S Herold estimates

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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
- Much more resistance to competitization in established Central Europe markets

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)
 - LNG is much more "secure"
- **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 and arbitrage rent sharing
 - Terms of access to import capacity
 - Market power of emerging “national champions”
- **Asia**
 - flexibility between E. Asia and W. No. America
 - flexibility between East and West-bound trades from ME
 - netback pricing parity from No America West Coast? (not enough liquidity in Calif. market for a while)