

Natural Gas and LNG Issues

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*Note: David Nissen is consultant for Poten & Partners, Inc.
from which material in this presentation is drawn*

Road map

- North American Natural Gas prospects
- Atlantic Basin LNG development
- North American LNG import terminal prospects

North American gas -- what's the issue?

- Gas bubble 1980-2000
 - created by
 - Reserve overhang from regulatory 20 yr. dedication requirement
 - Stranded costly gas from NGPA categories
 - Decreased demand
- Then
 - Strong growth from gas-fired CC electricity capacity
 - Tight capacity
 - Gas price spikes
- Revised outlook
 - Less productive drilling
 - Lower R/P ratios
 - Resource base revisions

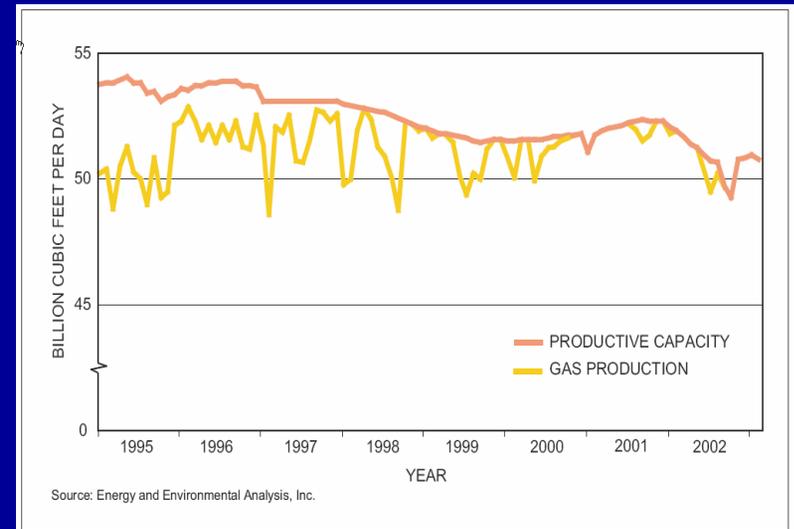


Figure 12. Lower-48 Dry Gas Production vs. Dry Gas Productive Capacity

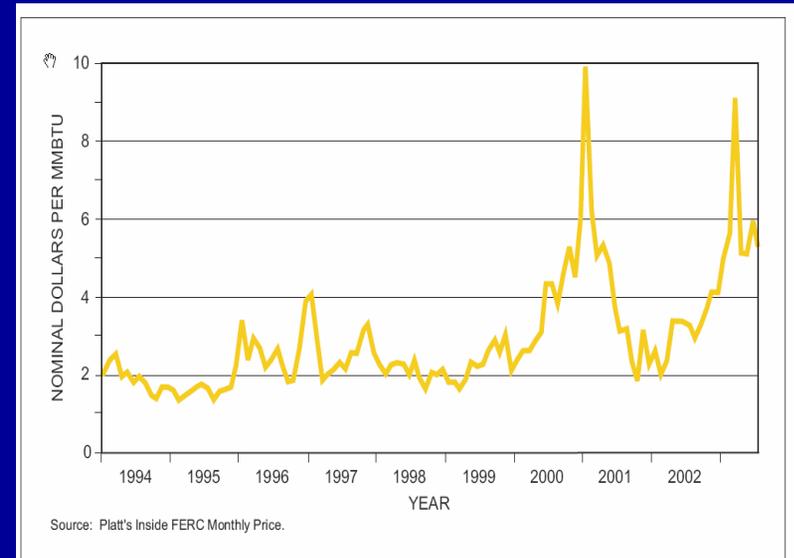


Figure 45. Henry Hub Monthly Index Prices

NPC US/Canada supply

- US about flat
- Canada in decline after 2010
- Need
- Artic gas - + 2 Tcf
- LNG - + 4 Tcf/y
(11 Bcf/d or 80 Mt/y)

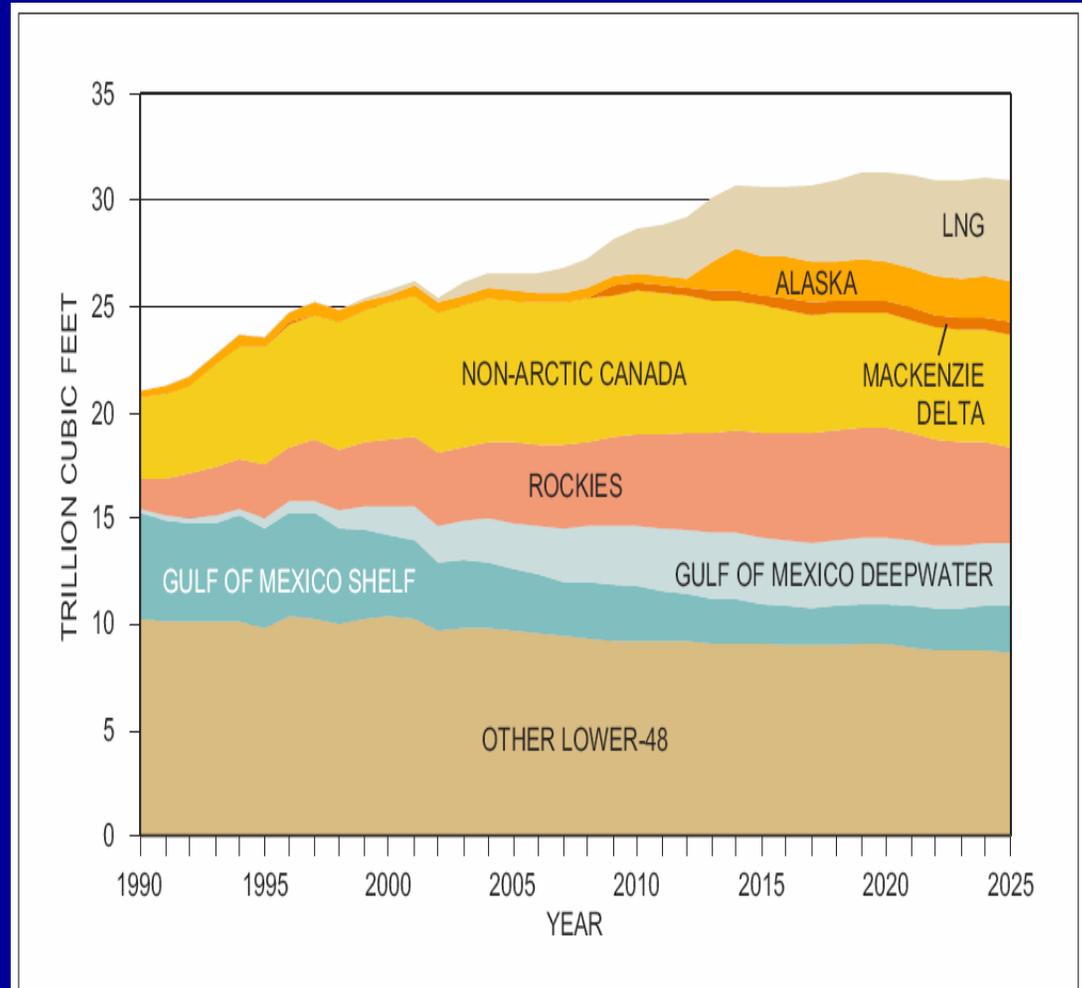


Figure 51. U.S. and Canadian Natural Gas Supply – Balanced Future Scenario

Gas production changes

- In spite of higher rig counts and connections ---
- Lower resource recovery per well – especially in Canada

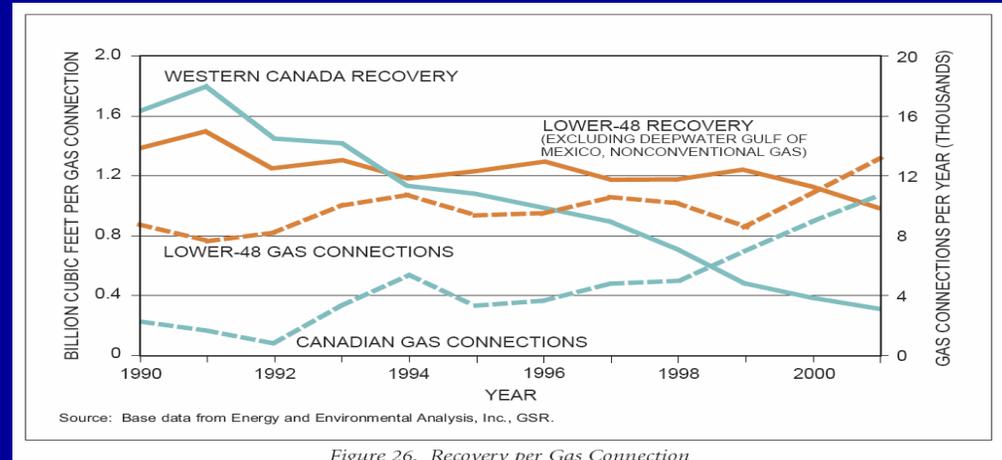
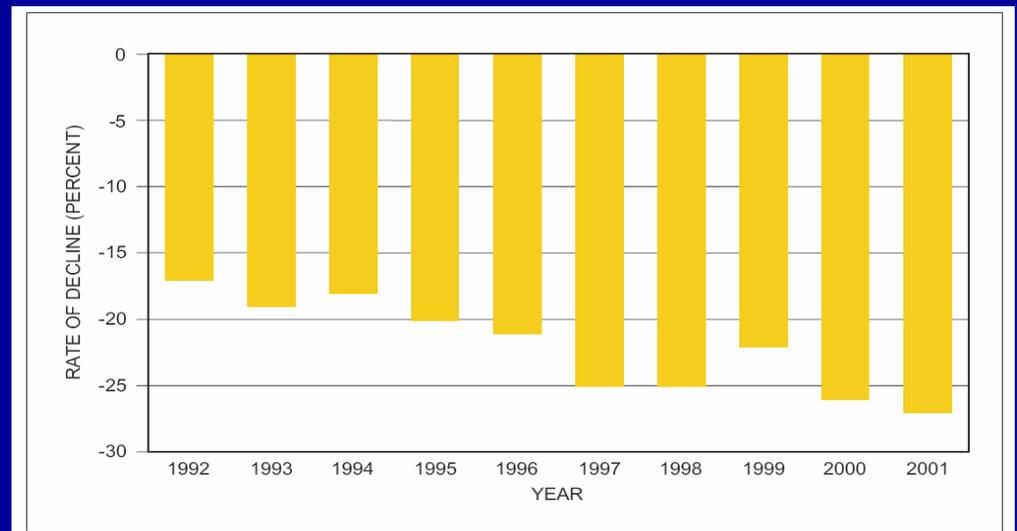
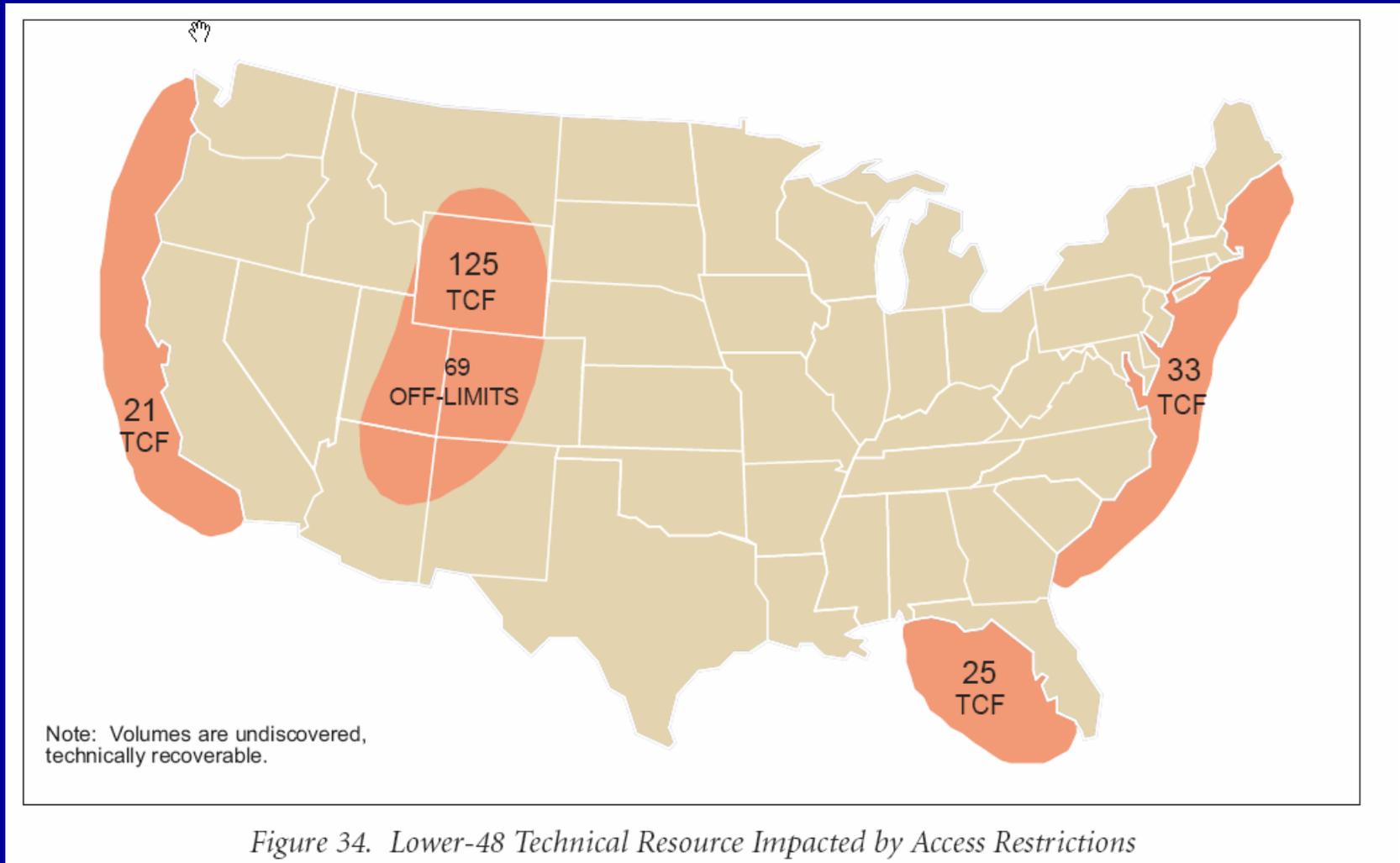


Figure 26. Recovery per Gas Connection

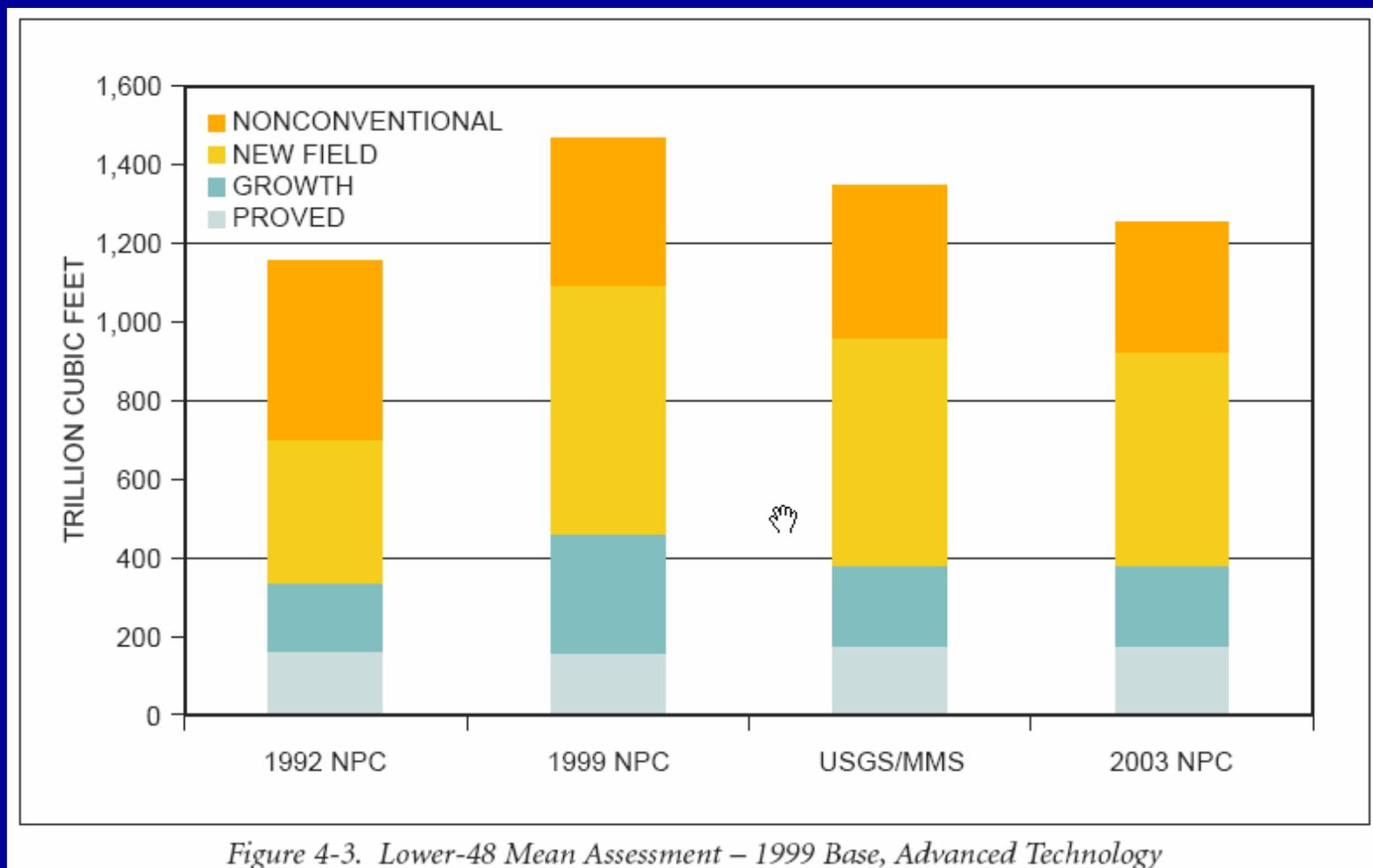
- Higher decline rates (better reservoir productivity) implies more replacement requirement



Restricted access to 150 Tcf of resources, 5 years demand, important but not decisive

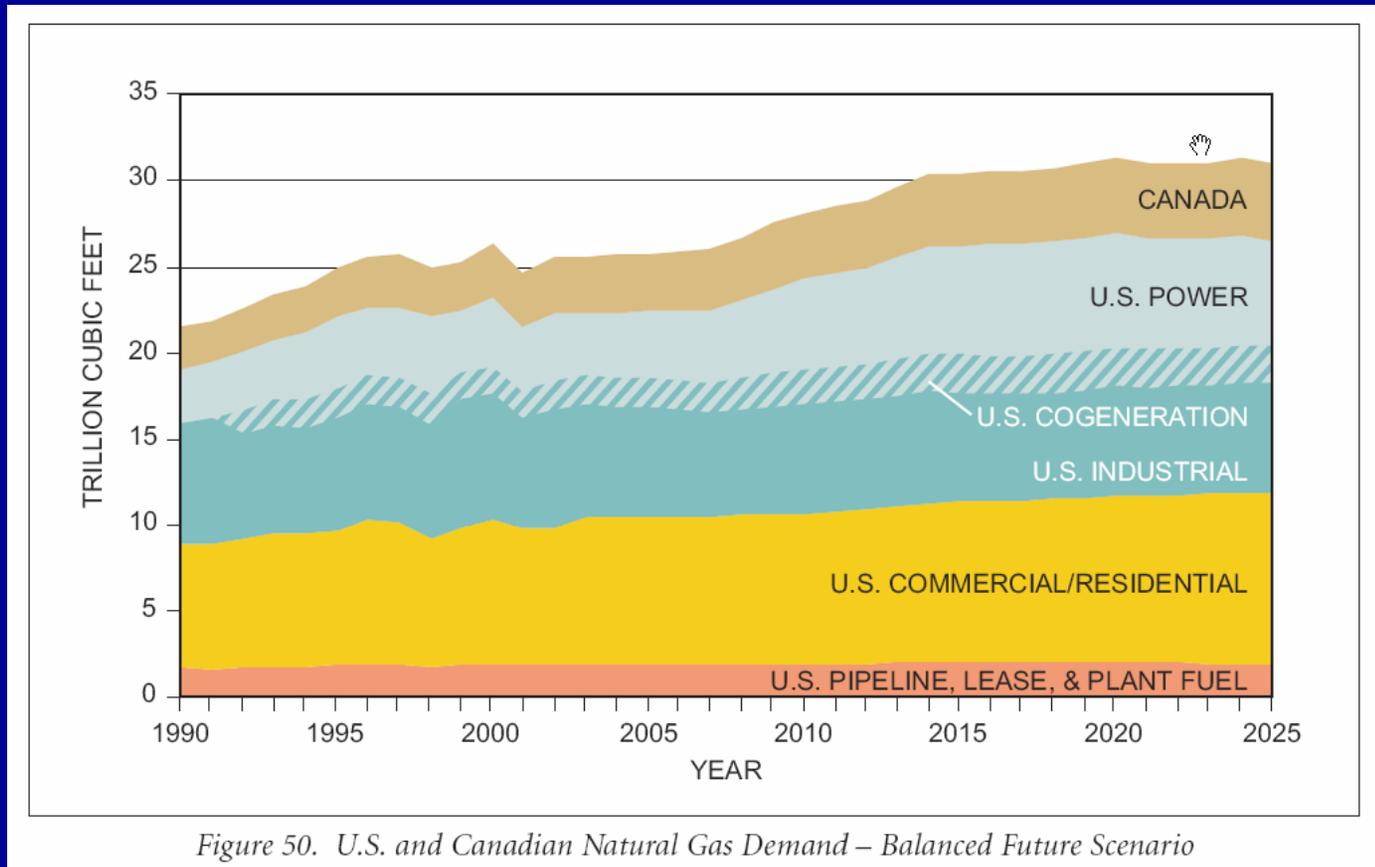


Reserve/resource revisions



US/Canada demand -- Natural Petroleum Council (NPC)

- Sum of Residential, Commercial, Industrial enduser demand is flat
- Big growth in powergen fuel
- Total growth to 2015 = + 5 Tcf



Atlantic Basin LNG development

Three forces are leading to growth in gas and LNG

- *Demand value* in electricity generation:
 - Gas is 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 and China coming)
- *Markets*
 - Demand growth is reaching “farther” for new supply
 - Competitized gas markets in North America and Europe (esp. Iberia)
 - “Commercialization” of the business structure and markets for LNG

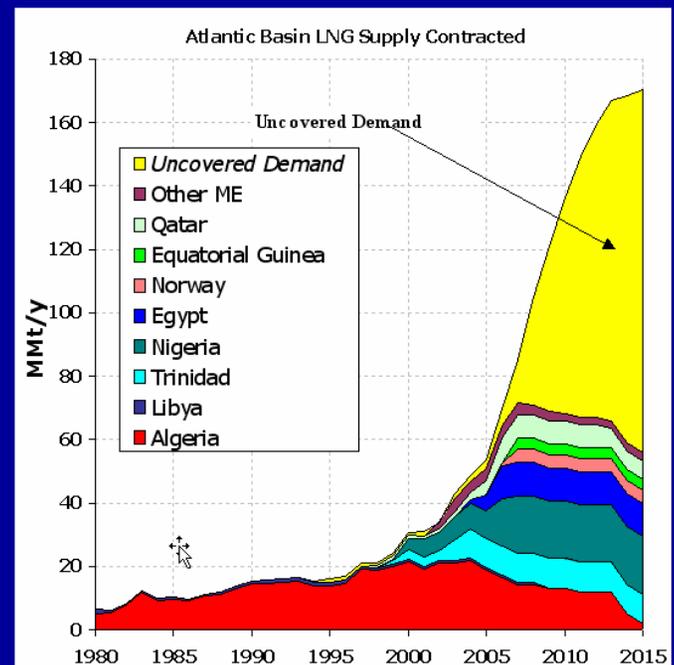
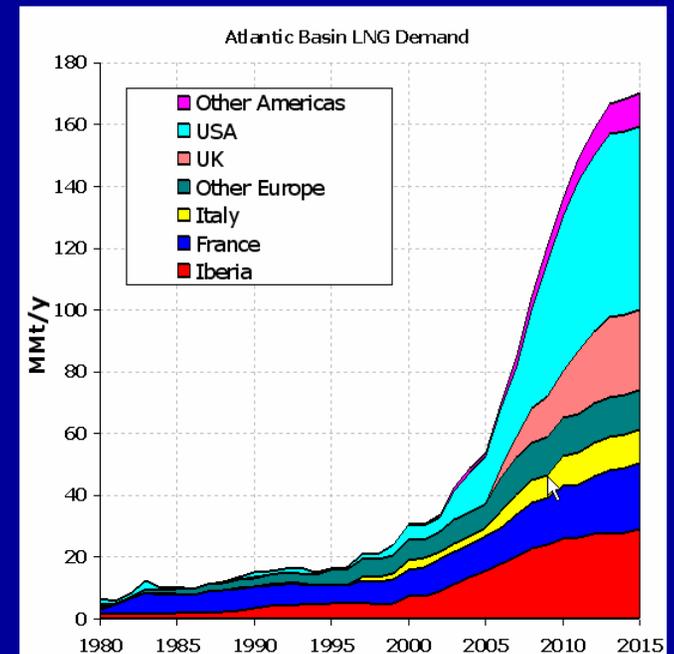
LNG can economically reach inland markets at \$2.50 – 3.50/MBtu, and compete with coal to fuel baseload generation

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

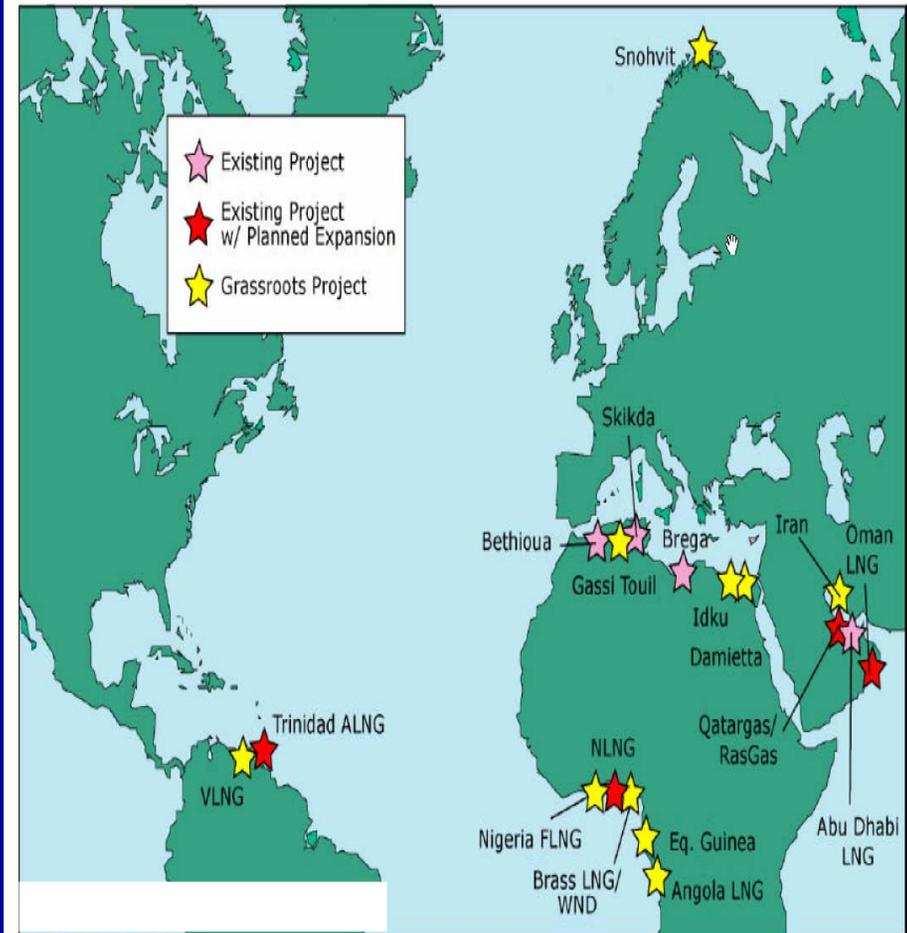
Plenty of supply resources and demand potential at “cost”



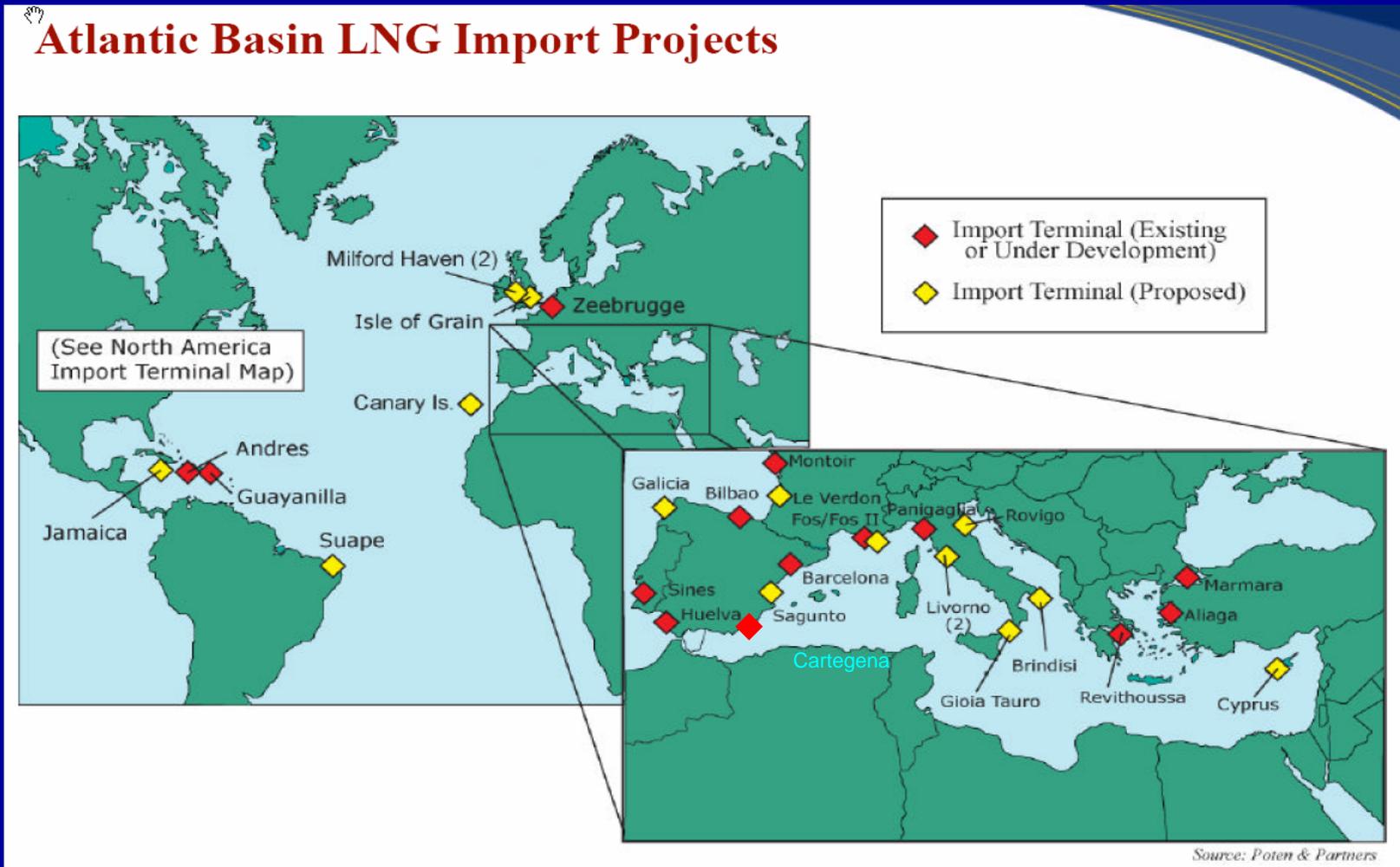
Expanded and new LNG export projects

- 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

Atlantic Basin LNG Export Projects



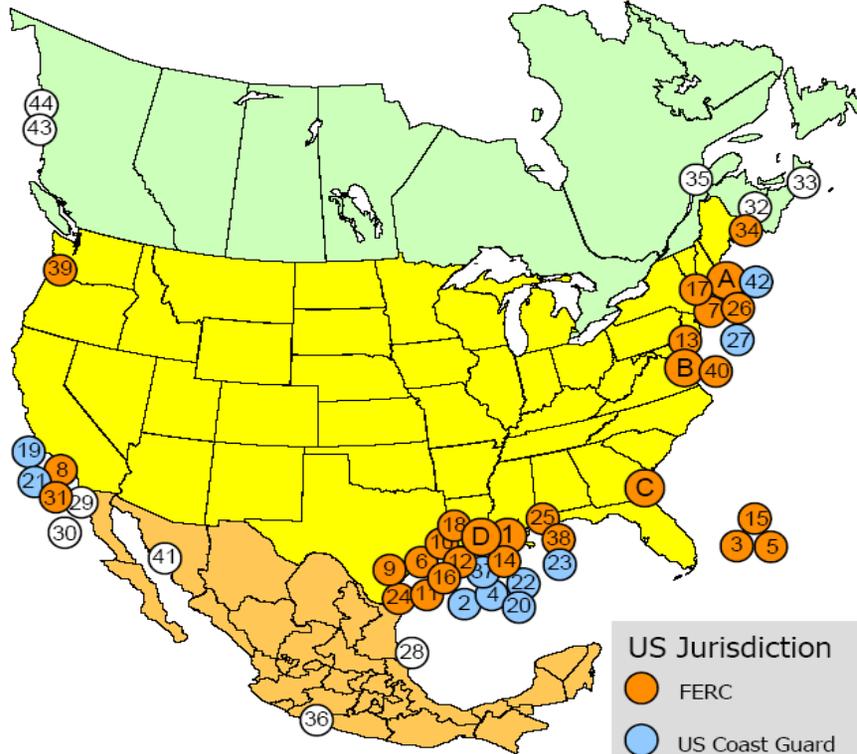
A flood of new import terminal projects in Southern Europe and UK



Flood of import terminal *proposals* in No. America

FERC

Existing and Proposed North American LNG Terminals



July 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, (El Paso Energy Bridge GOM, LLC)
- 5. Bahamas : 0.83 Bcfd, (Calypso Tractebel)*
- 6. Freeport, TX : 1.5 Bcfd, (Cheniere/Freeport LNG Dev.)

Proposed Terminals and Expansions – FERC

- 7. Fall River, MA : 0.8 Bcfd, (Weaver's Cove Energy/Hess LNG)
- 8. Long Beach, CA : 0.7 Bcfd, (Mitsubishi/ConocoPhillips – Sound Energy Solutions)
- 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)
- 15. Bahamas : 0.5 Bcfd, (Seafarer - El Paso/FPL)
- 16. Corpus Christi, TX : 1.0 Bcfd (Occidental Energy Ventures)
- 17. Providence, RI : 0.5 Bcfd (Keyspan & BG LNG)
- 18. Port Arthur, TX : 1.5 Bcfd (Sempra)

Proposed Terminals – Coast Guard

- 19. California Offshore : 1.5 Bcfd, (Cabrillo Port – BHP Billiton)
- 20. Louisiana Offshore : 1.0 Bcfd (Gulf Landing – Shell)
- 21. So. California Offshore : 0.5 Bcfd, (Crystal Energy)
- 22. Louisiana Offshore : 1.0 Bcfd (Main Pass McMoRan Exp.)
- 23. Gulf of Mexico : n/a (Compass Port - ConocoPhillips)

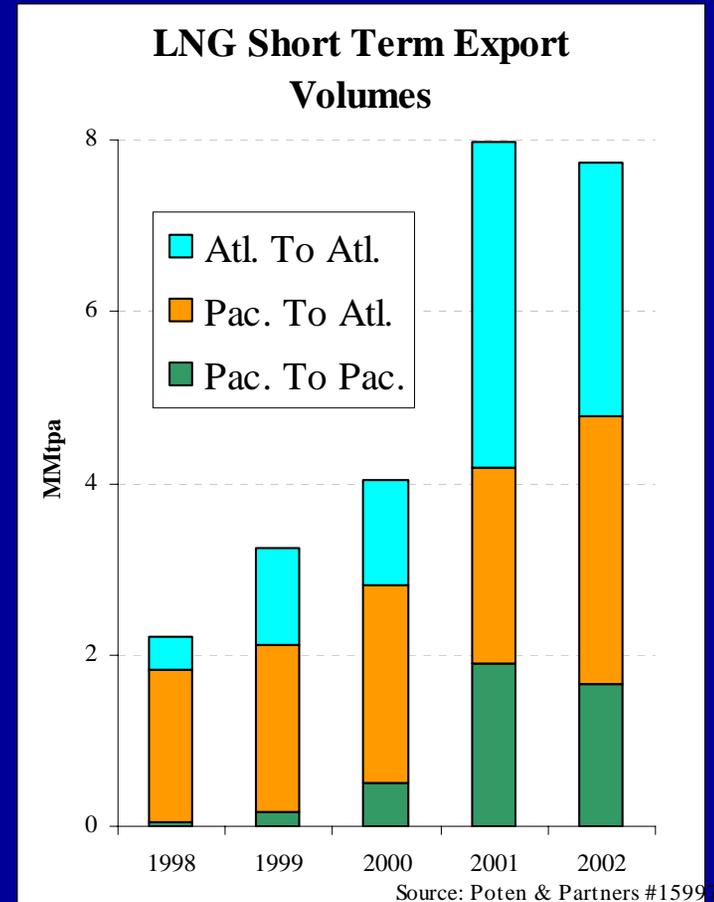
Planned Terminals and Expansions

- 24. Brownsville, TX : n/a, (Cheniere LNG Partners)
- 25. Mobile Bay, AL : 1.0 Bcfd, (ExxonMobil)
- 26. Somerset, MA : 0.65 Bcfd (Somerset LNG)
- 27. Belmar, NJ Offshore : n/a (El Paso Global)
- 28. Altamira, Tamulipas : 1.12 Bcfd, (Shell)
- 29. Baja California, MX : 1.0 Bcfd, (Sempra & Shell)
- 30. Baja California - Offshore : 1.4 Bcfd, (Chevron Texaco)
- 31. California - Offshore : 0.75 Bcfd, (Chevron Texaco)
- 32. St. John, NB : 0.5 Bcfd, (Canaport – Irving Oil)
- 33. Point Tupper, NS : 1.0 Bcf/d (Bear Head LNG - Access Northeast Energy)
- 34. Pleasant Point, ME : 0.5 Bcf/d (Quoddy Bay, LLC)
- 35. Quebec City, QC : n/a (Enbridge/Gaz Met/Gaz de France)
- 36. Lázaro Cárdenas, MX : 0.5 Bcfd (Tractebel/Repsol)
- 37. Gulf of Mexico : 1.0 Bcfd (Pearl Crossing - ExxonMobil)
- 38. Mobile Bay, AL : 1.0 Bcfd (Cheniere LNG Partners)
- 39. St. Helens, OR : 0.7 Bcfd (Port Westward LNG LLC)
- 40. Cove Point, MD : 0.8 Bcfd (Dominion)
- 41. Puerto Libertad, MX : 1.3 Bcfd (Sonora Pacific LNG)
- 42. Offshore Boston, MA : 0.8 Bcfd (Northeast Gateway – Excelerate Energy)
- 43. Kitimat, BC : 0.34 Bcfd (Galveston LNG)
- 44. Prince Rupert, BC : 0.30 Bcfd (WestPac Terminals)

* 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 structures
- 1998-2002 – arms-length short-term 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

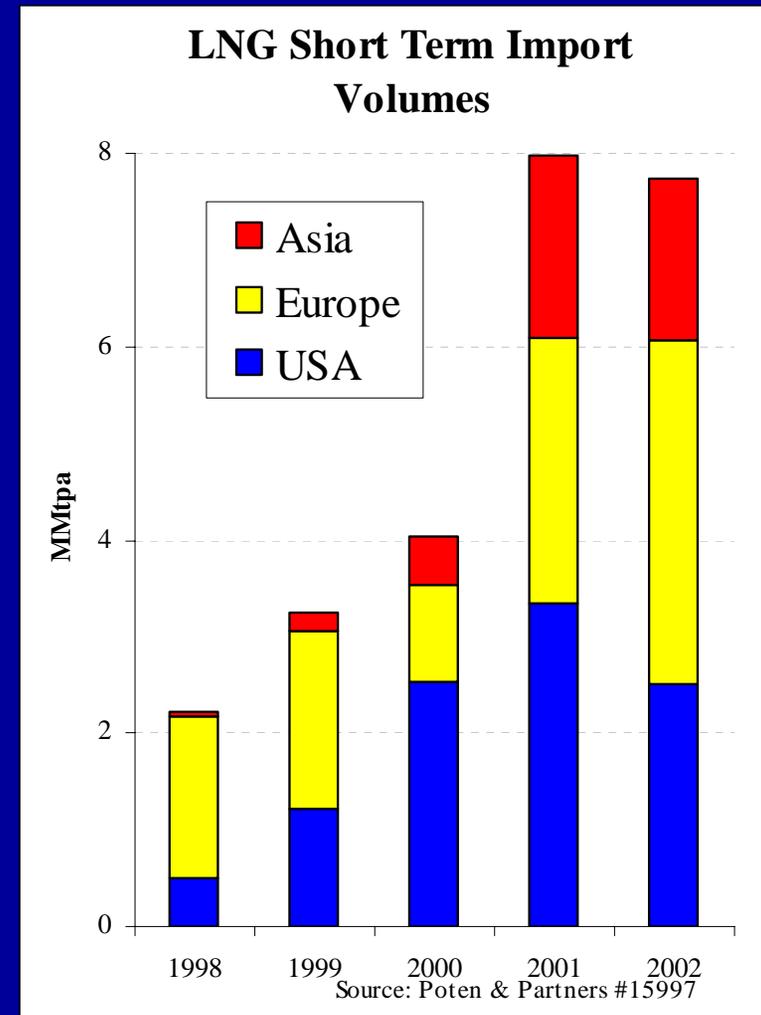


Growing short-term markets

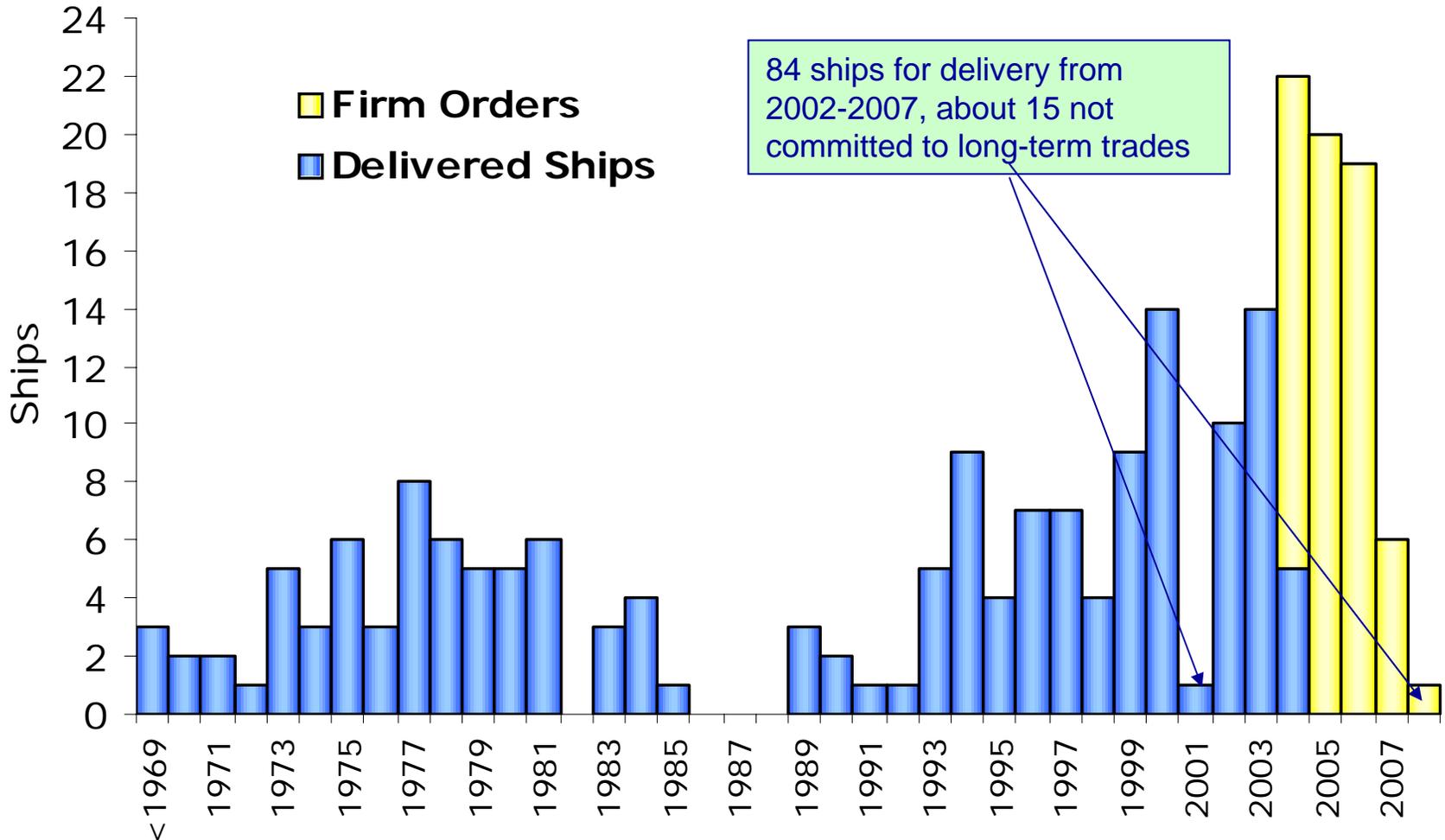
- Growing US liquidity offers markets for global spare supply capacity
- Shift to Europe in 2002 reflects opportunistic exploitation of oil-based gas prices
- Asia import - Korea reflecting winter shortfall and stalled long-term contracting (nuclear shut in in Japan in 2003)

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

Market liquidity and “destination optionality” are key



**Commercial trading requires “uncommitted capacity”
through the chain
-- ships are being bought for merchant trading**



Effective April 1 2004

Source: Poten & Partners

LNG business and commercial structure development

“Project business model”

- Purpose
 - Supply project: to assure credit-worthy revenue stream
 - Demand project: to assure reliable non-opportunistic supply
- 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
- 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

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 “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

LNG Export Projects -- Atlantic Basin

Project	Participants	Size Mt/y (existing)	Probable market
Algeria Gassi Touil	SONATRACH + 12	5 (+ 22)	Europe
Angola	ChevTex, Sonangol, Total, BP, Esso	8	Europe, USA
Equatorial Guinea	Marathon	3	USA
Egyptian LNG	BG, BP	7 + more	Gdf, BG-Italy and USA
Egypt (SEGAS LNG)	Union Fenosa (+ENI), Egypt	5	Spain
Nigeria LNG	Shell, Agip, Total, NNPC	14 (+ 8)	Europe, USA
Nigeria Brass	ChevTex, Agip, ConPhillips, NNPC	10	USA, Europe
Nigeria (WND)	ExMob, ChevTex, ConPhillips	5	USA, Europe
Norway	Statoil, Total, Gdf	(4)	Europe, USA
Trinidad	BP, BG, Repsol, Tractebel (Tr 1), NGC (Tr 1)	5 (+10)	USA, Spain
Russia	Gazprom, Norsk Hydro	big	USA, ?
Venezuela	Shell, Mitsubishi, PdVSA	5	USA, Mexico

Merchants emerge from both ends of the chain

<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
ChevronTexaco	Angola, Nigeria, Australia		New terminals in GOM and MX
ConocoPhillips	Nigeria, Qatar		New terminals in MX
ExxonMobil	Qatar, West Niger Delta LNG (prop.), Angola LNG (prop.), Indonesia	Yes	UK, France, and Gulf of Mexico (all prop.)
SONATRACH	Algeria	Yes	El Ferrol, Spain (prop.)
Royal Dutch/ Shell	Nigeria LNG, Venezuela (prop.), Oman LNG, also Brunei, Australia NWS, Malaysia, Sakhalin	Yes	Cove Point, MD, Elba Island, GA, Baja, MX (prop.) Altamira, MX (prop.)

Buyer merchants moving 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) Bolivia	Yes	Bilbao, Spain, Altamira and Lazaro Cardenas, MX(prop.)
Tractebel	Trinidad (Atlantic LNG)	Yes	Zeebrugge, Bel., Everett, MA, Bahamas-FL (prop.), Lazaro Cardenas, MX (prop.)
Union Fenosa/ENI	SEGAS LNG (Egypt), and purchase from Oman LNG		Sagunto El Ferrol, Spain (prop.)

Implications for commercial structure

- Mostly long-term contracts because LNG is “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 will permit and share arbitrage
- Liquid markets support some “spot” trading
- True ‘swaps’ are rare – 2 sellers, 2 buyers, 2 shippers

Prospective balance

- New access has limited help
- Need Alaska
- Need LNG

LNG import terminal regulation change

- FERC Hackberry decision
 - “non-jurisdictional” -- new onshore LNG terminals do not have to provide “open season”
 - “just another gas well” and gas supply is competitive
 - enables “merchant” terminals to be controlled by owner
 - FERC retains jurisdiction over safety and environment
- FERC Application streamlining (2 years) but doesn't deal with state issues
- Deepwater Port Act extended to LNG – safety and environment regulated by Coast Guard (Dept. of Homeland Security)
- FERC-State of Calif. jurisdiction conflict over Mitsubishi Long Beach project, also may affect Hess LNG Fall River, MA project

US LNG import terminals – existing (5.8 Bcfd or 2 Tcf/y by 2007)

Location	Capacity Holders	Capacity Bcf/d (Mt/y)	Sourcing
Everett, MA	Tractebel LNG	1.0 (7)	Trinidad, Algeria
Cove Pt. MD	Shell, BP, Statoil	1.0+0.8 (13)	Nigeria, Trinidad Norway
Elba Island, GA	El Paso, Shell	0.8+0.4 (8)	Trinidad, (Nigeria, Venezuela?)
Lake Charles, LA	BG	1.2+0.6 (13)	Trinidad, (Egypt),

US LNG import terminals – East coast proposed (at least 1.5 Bcf/y or 0.5 Tcf/y likely by 2010)

Project	Owners	Location	Cap'y Bcf/d	Status
Ocean Express	AES	Bahamas	0.8	P/L approved
Calypso	Tractebel	Bahamas	0.8	P/L approved
Seafarer	El Paso/FPL	Bahamas	0.5	Sales contract w/ FPL
Weaver's Cove	Hess LNG	Fall River, MA	0.5	Waiting for FERC override
Providence LNG	Keyspan, BG	Providence, RI	0.5	Existing site upgrade
Canoport	Irving/ChevTex	Canoport, NB,CA	0.5	announced
Access NE	Access NE	Bearhead, NS,CA	0.5	announced
Other (4 projs)			2.0	announced

Note: projects to be sited on municipal land in Hopeswell, ME (TCPL, ConocoPhillips) and Sears Island, ME, have been defeated in referendums

US LNG import terminals – GOM approved (4.4 Bcf/d or 1.4 Tcf/y by 2008)

Project	Owners	Location	(Bcf/d)	Status (Sourcing)
Cameron LNG	Sempra	Hackberry, LA	0.8	Approved-2007
Freeport LNG	Freeport/Cheniere	Freeport, TX	1.5	Approved-2005
Port Pelican	ChevTex	Offshore, LA	1.6	Approved-2007
Energy Bridge	El Paso	Offshore vessel	0.5	Approved-2005

US LNG import terminals GOM

– proposed for approval (up to 13 Bcfd or

Cheniere/C-C	Cheniere	Corpus Christi, TX	2.6	ConPhillips (RasGas)
Cheniere/S-P	Cheniere	Sabine, LA	2.6	ConPhillips (RasGas)
Cheniere/M-B	Cheniere	Mobile Bay, AL	1.0	ConPhillips (RasGas)
ExMob LNG	ExMob	Quintana Isl., TX	1.0	(RasGas III)
ExMob LNG	ExMob	Sabine Pass, TX	1.0	(RasGas III)
Vista del Sol	ExMob	Corpus Christi, TX	1.0	(RasGas III)
Occidental	Occidental	Corpus Christi, TX	1.0	
Port Arthur	Sempra	Port Arthur, TX	1.5	
Offshore (3 proj)	Freeport McMoRan, ConPhillips, Shell	Offshore GOM	3.0	Coast Guard approval sought

Planned but not yet proposed include
 Brownsville, TX (Cheniere)
 Mobile Bay, AL (Cheniere)
 Mobile Bay, AL (ExMob)

US West Coast import terminals

Project	Owners	Location	(Bcf/d)	Status (Sourcing)
Sound Energy	Mitsubishi, ConPhillips	Long Beach, CA	0.8	(Sakhalin?, Australia?)
Cabrillo LNG	BHP Billiton	Oxnard, CA	1.5	Offshore
Crystal LNG	Crystal	Oxnard, CA	0.5	Offshore
4 more planned	ChevTex, etc.	Offshore CA, OR, BC		

Mexico LNG import terminals

Project	Owners	Location	(Bcf/d)	Status (Sourcing)
Costa Azul	Sempra, Shell	Baja, MX	1.0	(Sakhalin?, Australia?)
Baja Offshore	ChevTex	Baja, MX	1.5	Australia (Gorgon)
Lazaro Cardenas	Repsol YPF	Lazaro Cardenas, MX	0.5	(Bolivia)
Lazaro Cardenas	Tractebel	Lazaro Cardenas, MX	0.5	(Peru)
Altamira	Shell	East coast, MX	0.5	(Nigeria?, Venezuela?)

LNG and GTL for transportation

- GTL transportation delivered inland is \$2/b, => \$0.35/MBtu, LNG chain delivered inland is at least \$2.00/MBtu (\$12/boe)
- LNG has nothing to do with transportation except as it affects the domestic market price of gas and the feasibility of CNG, fuel cells and the like
- GTL is big deal for producers of remote, cheap gas, but announced new capacity of 600 kbd, it is

GTL – total construction and announced - 660 kbd

Recent worldwide GTL activity and announcements



GTL Plants located near European and Asian Markets