



# Market Opportunities for LNG in North America

NEMS Conference

March 23, 2004

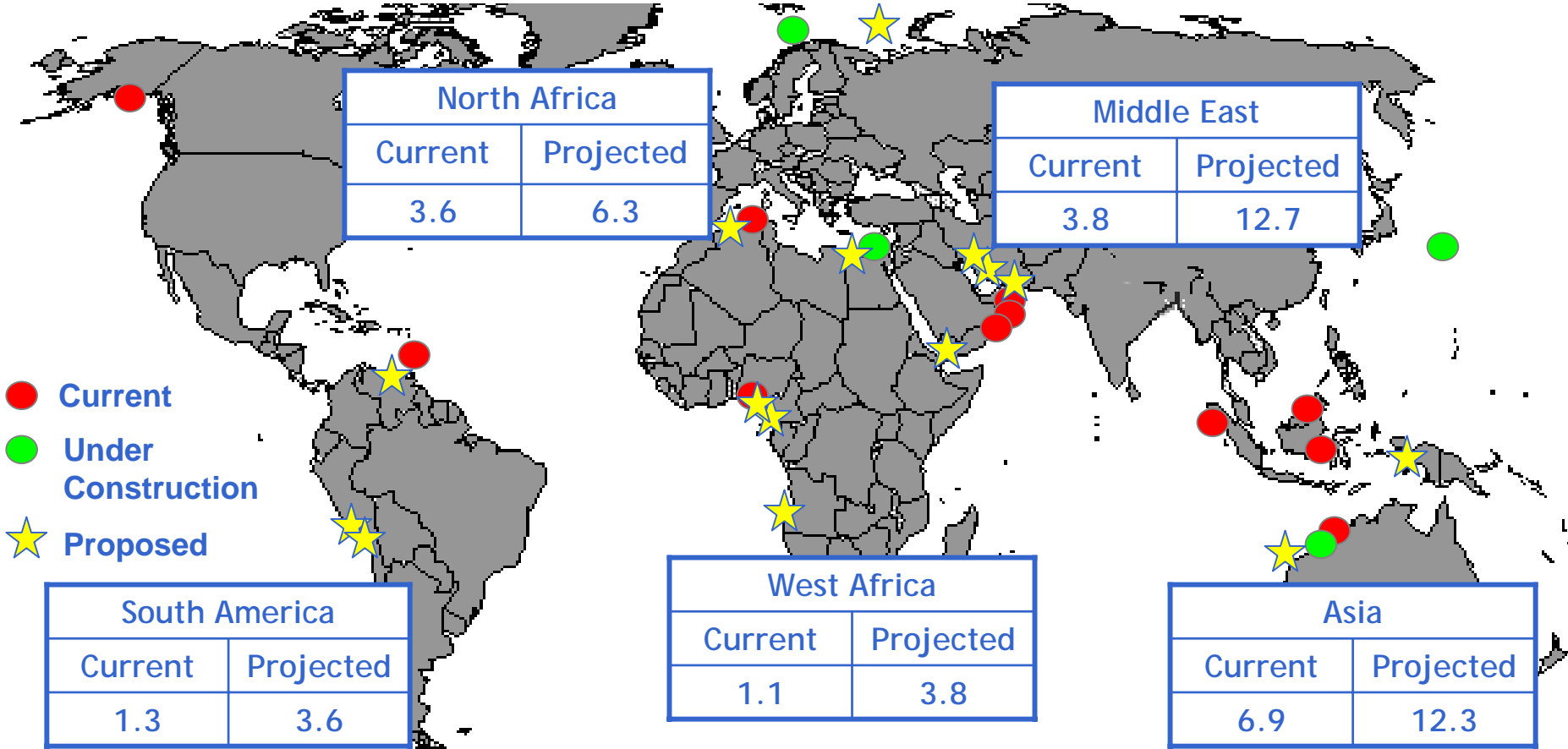
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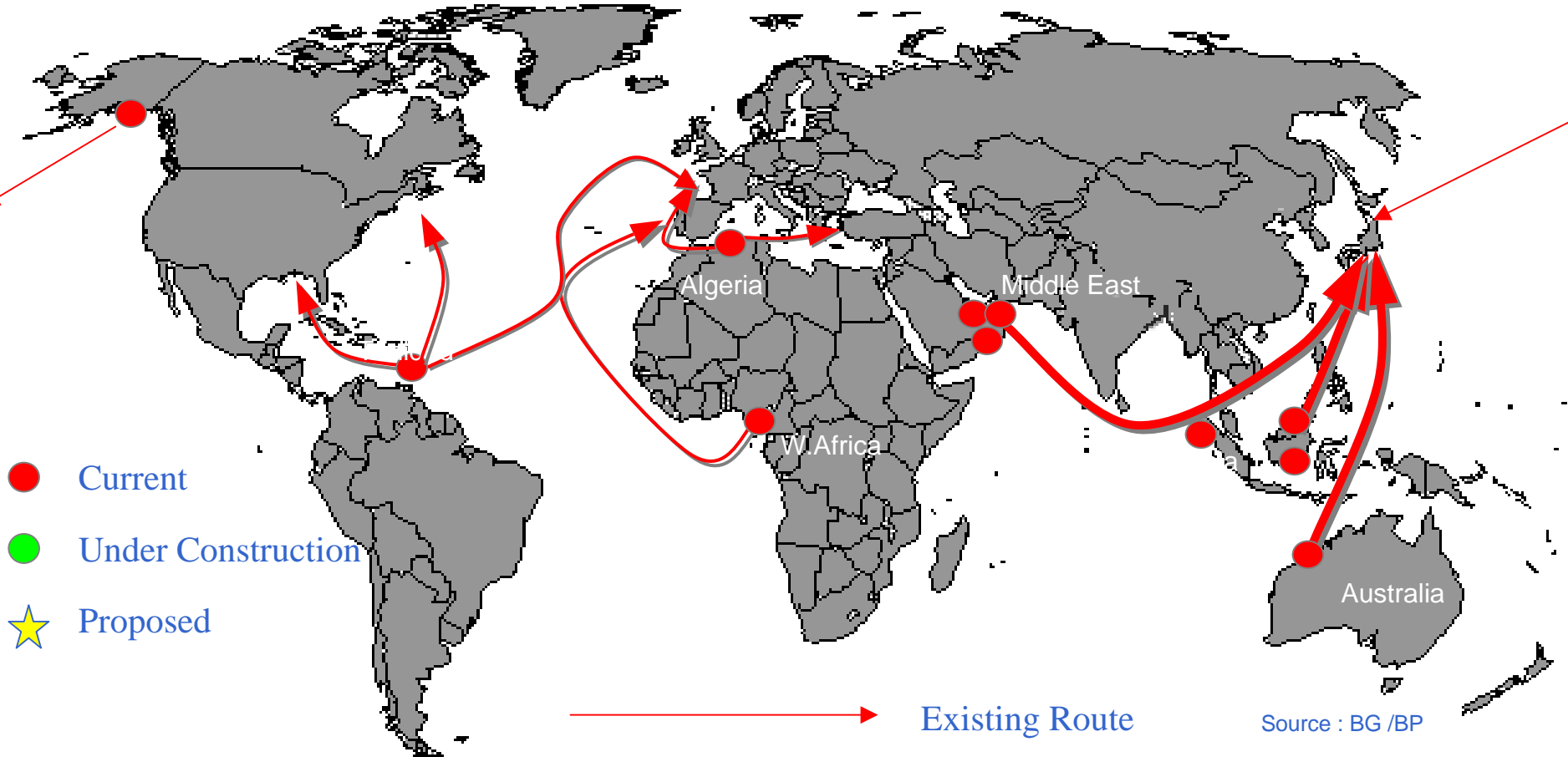
# Current and Projected LNG Liquefaction (Bcf/d)

Global Liquefaction Capacity More than Doubles from 17 Bcf/d to 41 Bcf/d (129 - 309 mtpa)

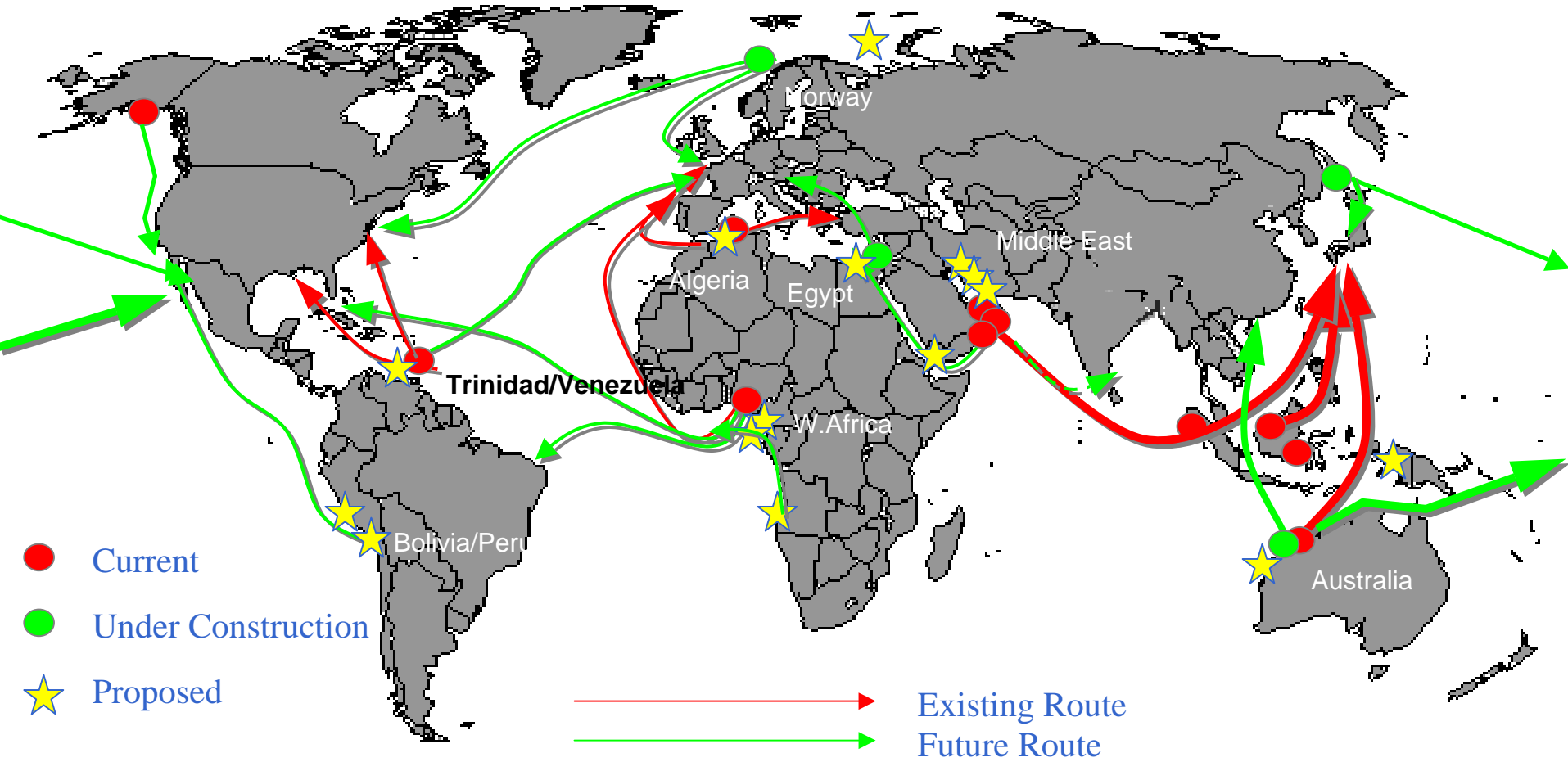


- Current
- Under Construction
- ★ Proposed

# Current LNG Trade Routes



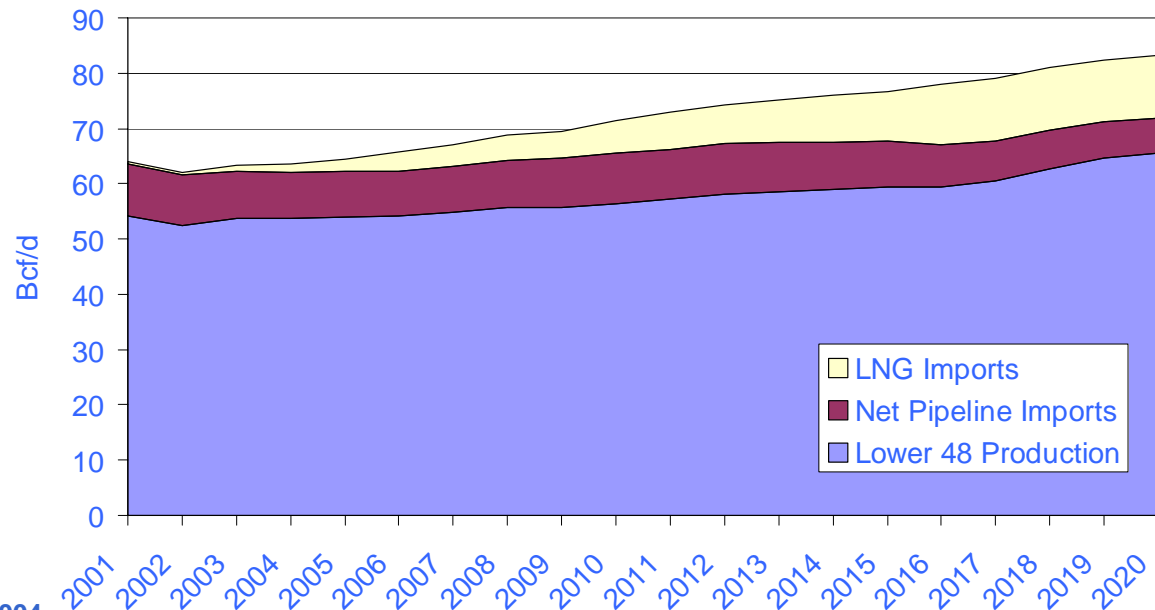
# Future LNG Trade Routes 2010?



# North American LNG Market Opportunity

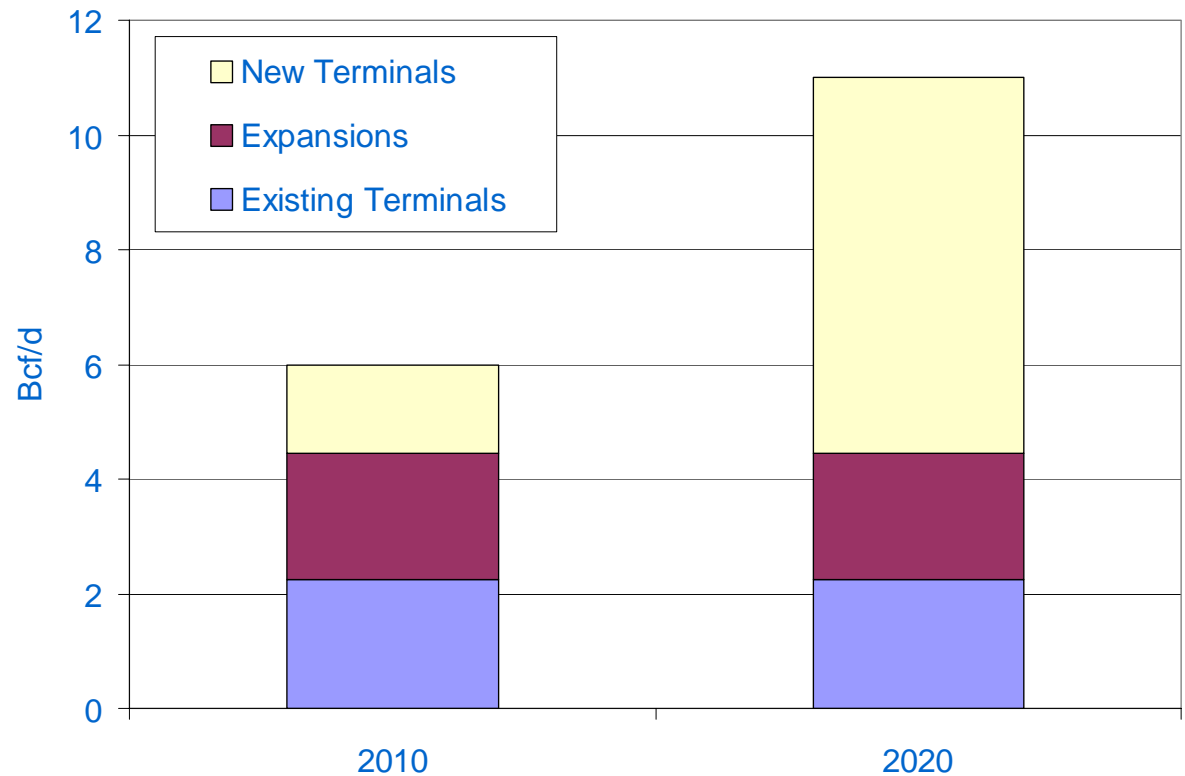
- Market and commodity price fundamentals in North America have created opportunities for importing LNG.
- Driven primarily by the power sector, EIA projects as much as 6 Bcf/d LNG may be required by 2010, growing to 11 Bcf/d by 2020.
- Most basins showing flat to declining production.
- Gas prices have not averaged below \$3.00/MMBtu since 1999.
- 8 year future strip is close to \$5.00/MMBtu.

Lower 48 Gas Supplies



# U.S. Regasification Terminal Requirements

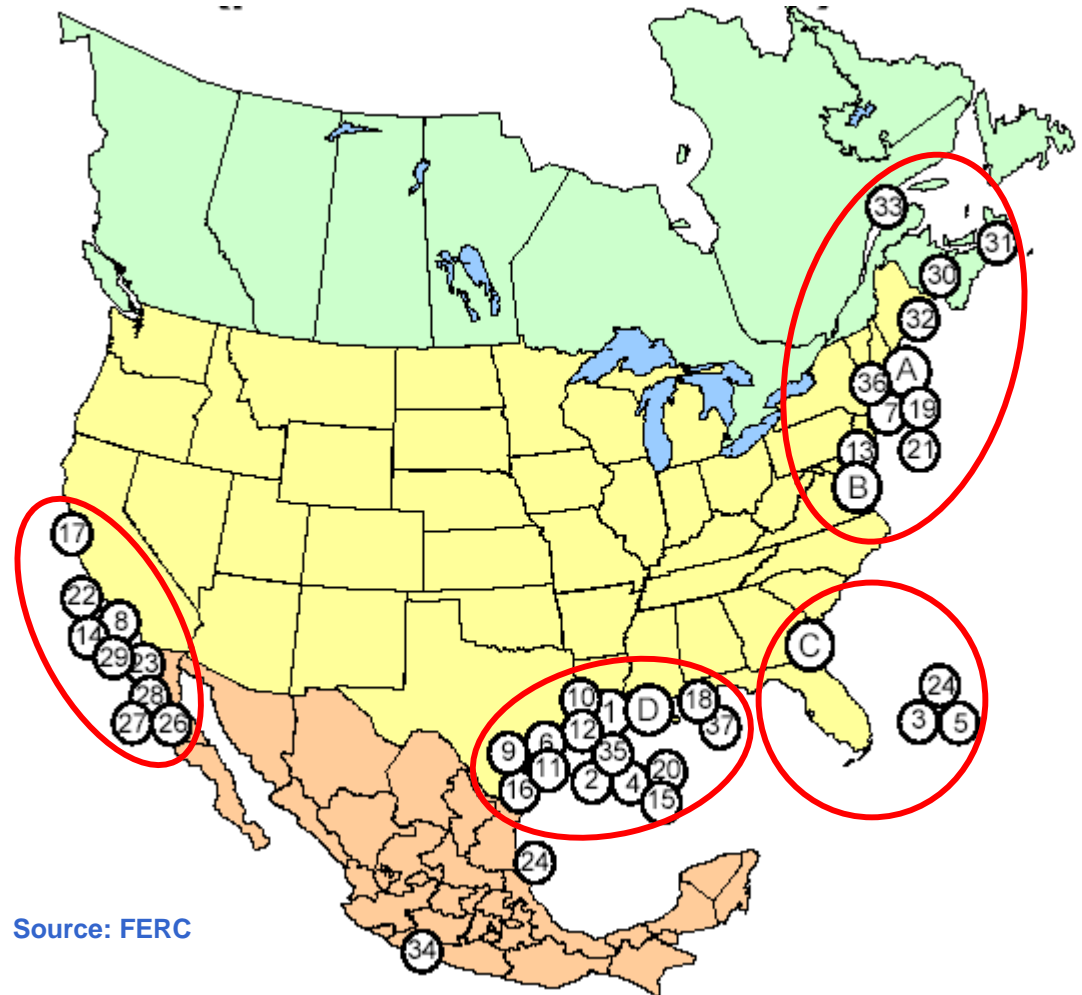
- EIA projections suggest 1 or 2 regasification terminals needed by 2010.
- A further six terminals required by 2020.



Source: EIA AEO 2004 & FERC

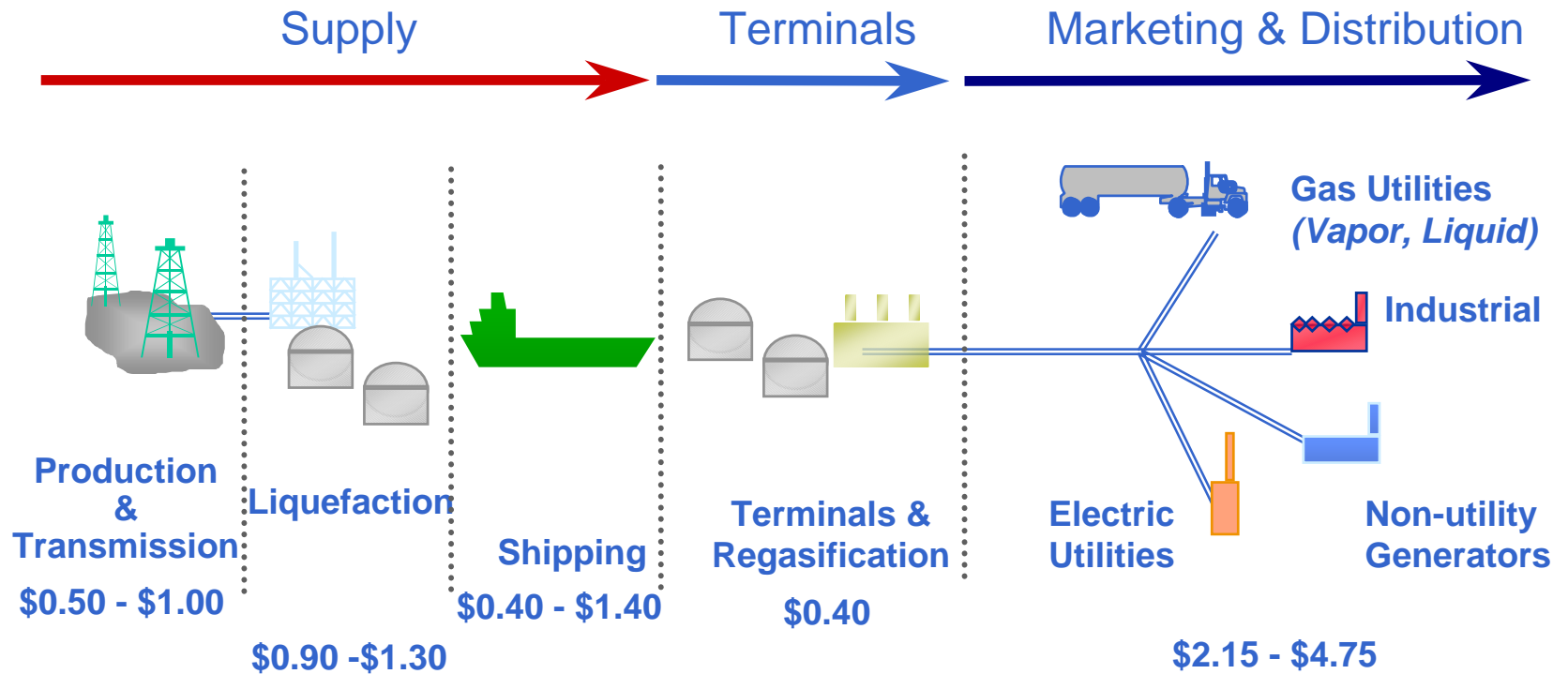
# Proposed North American LNG Terminals

- Initial wave of proposals were for offshore terminals.
- Secondary wave targeted onshore locations.
- Market extremities are prime targets.
  - Higher price.
  - Lower liquidity.
  - Added Pipeline costs.
- Gulf Coast.
  - Lower Price.
  - Highly Liquid.



Source: FERC

# The LNG Value Chain (\$/MMBtu)





# The LNG Value Chain

## Liquefaction Costs

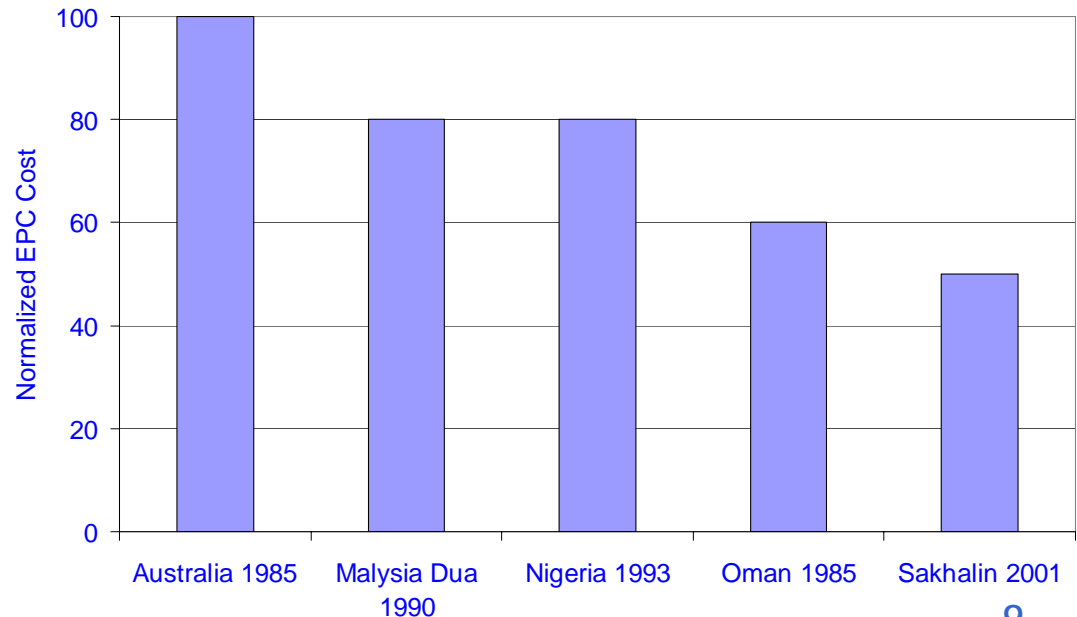
- Liquefaction plants have increased in capacity and unit costs have declined.

High cost items are port facilities and storage tanks.

\$1.2 - \$2.5 billion investment.

New liquefaction terminals have capital costs in the range of \$200-250/ton.

- Liquefaction trains can now be scaled up to 5.0 MTPA.
- Greater marketing risks with large trains.

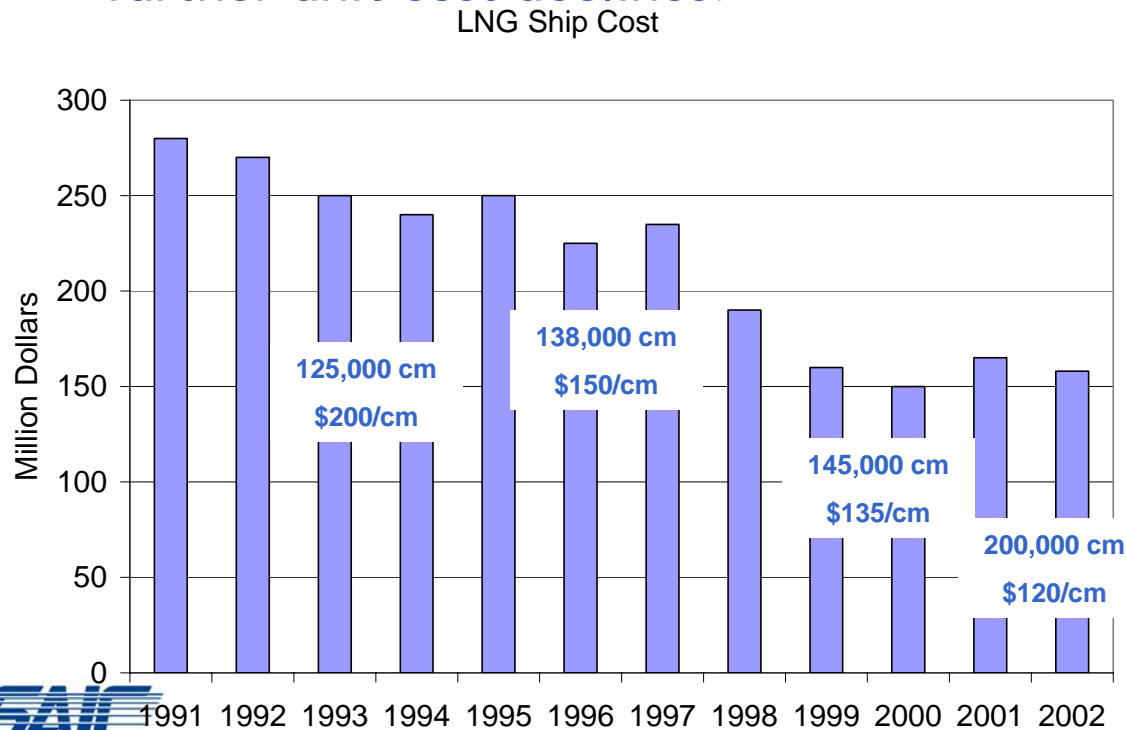


Source: Shell

# The LNG Value Chain

## Shipping Costs

- Real price of new LNG ships has fallen by nearly 50% in the past 10 years, from \$300 million to \$160 million.
- Trend towards larger vessels and new shipyards suggests further unit cost declines.



# The LNG Value Chain

## Regasification Costs

- Onshore regasification terminals have increased in capacity and unit costs have declined.
  - Largest cost items are port facilities and storage tanks.
  - \$300 - \$375 million investment for a large terminal.
- Offshore terminals incur greater costs, but sidestep NIMBY issues.

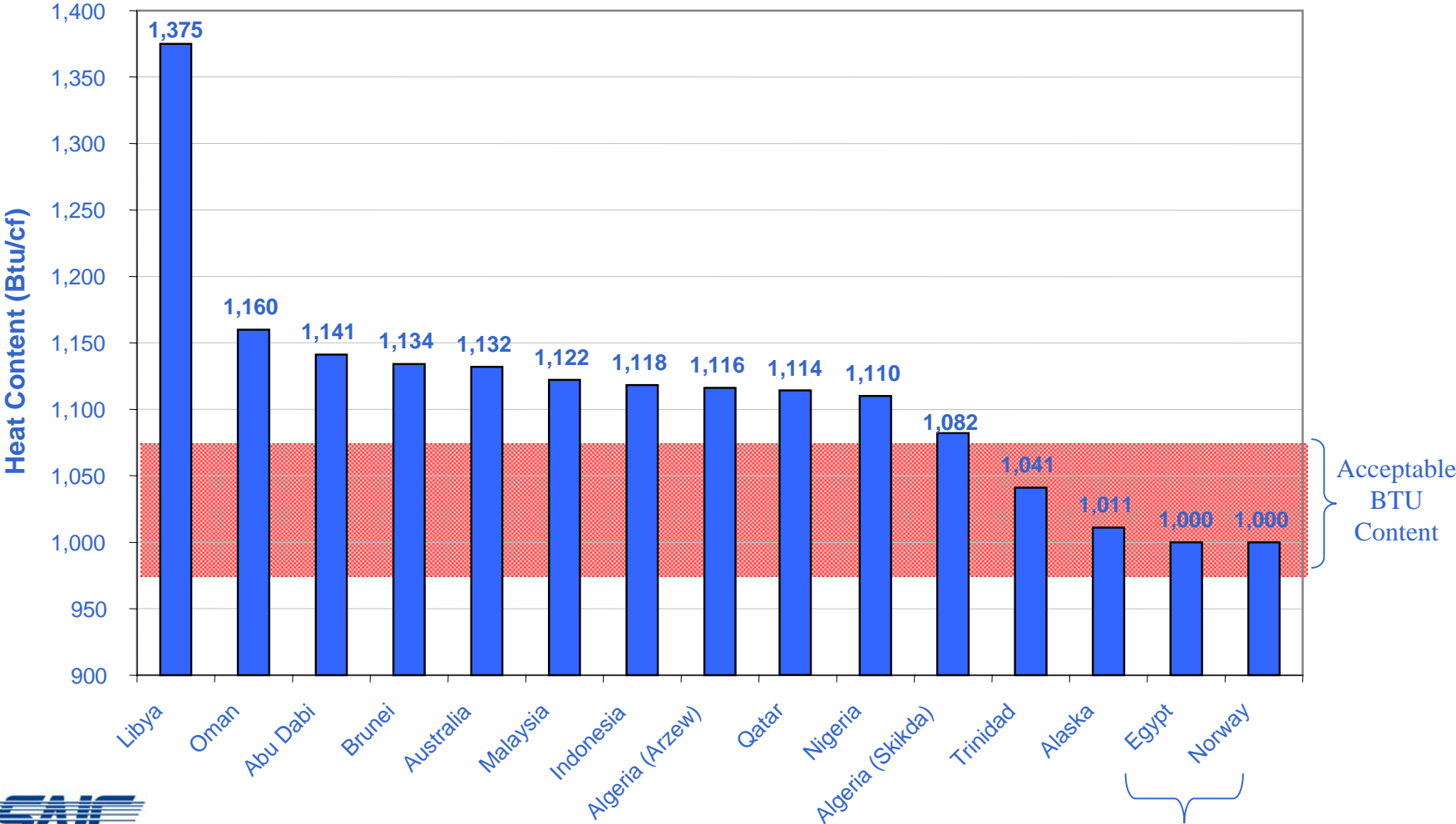


# Are there Sufficient Ships?

- Current Fleet = 137 ships.
- Between 70 and 120 additional vessels required for expected growth in global LNG trade by 2010.
- 47 on order.



# Most LNG Sources are Too Rich for the U.S.



Source: Conversion Gas Imports, LLC & ILNGA

Estimates

# Solutions to Hot LNG Problem

- **In-Tank Blending** – High Btu content LNG is mixed with lower Btu content LNG in the storage tank. Low cost.
- **Pipeline Gas Blending** – LNG is mixed with lower Btu content domestic gas. Low cost.
- **Air Injection** - injecting a 3.8% air mixture into vaporized LNG on sendout.
- **Nitrogen Injection** – injecting a 2% nitrogen mixture into the vaporized LNG on sendout.
- **NGL Stripping** – High capital costs
- **Supply Generation Plants**– Power plants can utilize very high Btu content gas.

# Evolving LNG Pricing

- Asian LNG prices traditionally indexed to Japanese Crude Cocktail.
- European LNG prices linked to crude and product prices, occasionally other energy forms.
- Most contracts in the U.S. feature LNG commodity price formulas that are indexed to the Henry Hub or other regional price indices.

# Evolving LNG Contracting

- Long-term agreements traditional in Asian markets.
- Greater supplier and purchaser diversity and market liquidity could reduce contract lengths and increase flexibility in Atlantic market.
- Destination flexibility desirable for market liquidity, but requires technology advance.
- Buyer control of shipping (“lease or buy”) becoming more common.
- Increase in non-dedicated ships should lead to greater trading opportunities.
- Increased trading should lower costs.



# Conclusions

- The LNG industry is technologically mature, primarily serving Asian and Southern European markets.
- LNG can help the U.S. overcome the current shortage of natural gas and moderate high gas prices.
- LNG can be landed in the U.S. at a cost well below present gas prices.
- The presence of experienced integrated oil and gas companies suggests that LNG supply, shipping, regasification, finance, and contract issues can be successfully resolved.