

**Western Interstate Energy Board  
Board of Directors Meeting**

**Western Natural Gas Assessment  
Workshop  
Scenario Development**

by

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# Western Natural Gas Assessment Objective

Can western states and provinces depend on natural gas to supply their energy needs, particularly for power generation, in a reliable manner at reasonable prices?

# Western Natural Gas Assessment Concerns

- Will natural gas supplies be available for the electric generating market?
- Are natural gas resources available in the West sufficient to address our natural gas supply needs?
- Is the interstate pipeline system sufficient to allow for efficient distribution of the regional natural gas requirements?
- Do potential congestion areas exist in the interstate pipeline system?
- Can the West develop the necessary infrastructure to ensure that their natural gas resources can compete effectively in the natural gas market?
- What role will LNG play in the North American gas market?
- What impact can natural gas storage facilities have on the West's natural gas market to reduce supply volatility and ensure adequate supplies of natural gas to the end users?

# Western Natural Gas Assessment Development Approach

## 1. Reference Case

- Establish the Reference Case to describe how the natural gas market will evolve if policies and behavior continue as they exist and know today.

## 2. Scenario Development

- Establish alternative possibilities for how the natural gas market might evolve.
- The scenarios were to be sufficiently reasonable to depict plausible market outcomes.
- The scenarios would be sufficiently different from one another so that the results could aid in shaping policy choices.

# Parameters Affecting Natural Gas Market

Carbon Policy	Fuel Switching
Coal Build (Technology Advancements)	GDP Growth
LNG Development	NIMBY (Not in My Backyard)
Global Gas Demand	Renewable Technology Advances
Gas Potential (Size of Resource Base)	Electricity Restructuring
Public Land Policy	Oil Sands Gas Consumption
Natural Gas Technology Advancements	End Use Efficiency
Terror Concerns	Infrastructure Capacity
Environmental Legislation	Credit Worthiness of Energy Companies
Crude Oil Price	Demand Elasticity

# Major Themes for Scenario Development

- Carbon policy and environmental legislation
- LNG development, including world gas markets
- Timing of Arctic Gas development
- Coal development
- Public land policy, including infrastructure development
- Demand response, including efficiency and renewable technology

# Scenarios Developed

High Degree

## Scenario I

Action is taken to enable the supply of natural gas and the industry's infrastructure to expand to a greater degree while environmental policies become progressively less stringent.

## Scenario II

Action is taken to enable the supply of natural gas and the industry's infrastructure to expand to a greater degree while environmental policies become progressively more stringent.

*Gas Supply Enablement*

Less Stringent

*Environmental Policy*

More Stringent

## Scenario III

Natural gas supplies and infrastructure development are increasingly hindered while environmental policies create opportunities to increase consumption of other fuels.

## Scenario IV

Natural gas supplies and infrastructure development are increasingly hindered while environmental policies become more stringent.

Low Degree

# More Enabled Gas Supply

- Increased technology lowers cost and increases natural gas recovery
- Increased exploration activity expands resource base
- Increased LNG imports
- Faster development of Arctic gas
- Increased development of non-conventional gas sources (coal bed methane and shale gas)
- Reduced consumption of natural gas by Canada's oil sands industry
- Coal pulverized technology development results in a new generation of coal fired facilities

# Less Enabled Natural Gas

- Domestic production falls faster than expected
- Natural gas reserve growth slows
- Slower advancement in technology development
- LNG development is restricted
- Arctic gas development is delayed

# More Stringent Environment

- Increasing renewable energy requirements
- Energy efficiency standards are increased
- Public safety concerns limits development of LNG
- Pollution offsets are more difficult to obtain
- Extended environmental review and increased mitigation measures required for development
- Air quality standards impact:
  - Coal fired generating capacity (retirement of operating facilities and permitting new facilities)
  - Coal bed methane development by limiting  $\text{CO}_2$  emissions
- Licenses for nuclear generating facilities are not extended
- Exploration and development band for Outer Continental Shelf continues in place
- Limit additional capacity for hydro-electric power

# Less Stringent Environment

- Additional coal fired generating plants
- Additional hydro-electric power
- Coordination and cooperation among stakeholders in the development of Arctic gas
- Outer Continental Shelf areas are available
- Greater access to onshore resources
- Low cost development methods allow more non-conventional resources
- Environmental Impact Review expedited
- Public concern is addressed about LNG facilities
- Greater flexibility in obtaining pollution and offsetting mitigation measures

# Western Natural Gas Assessment

## Reference Case and Scenario Development Parameters

### Economic Indicators

- U.S. GDP Growth and Industrial Production
- Canada GDP Growth and Industrial Production
- World Crude Oil Forecast – EIA - High “A” World Oil Price

### Natural Gas Resource Base

- Gas Resource Base - National Petroleum Council
- Gas Supply Resource Curves - United State Geological Survey
- Alaska North Slope Pipeline – In Service 2016
- MacKenzie Valley Pipeline – In Service 2013
- Liquefied Natural Gas

### Natural Gas Demand

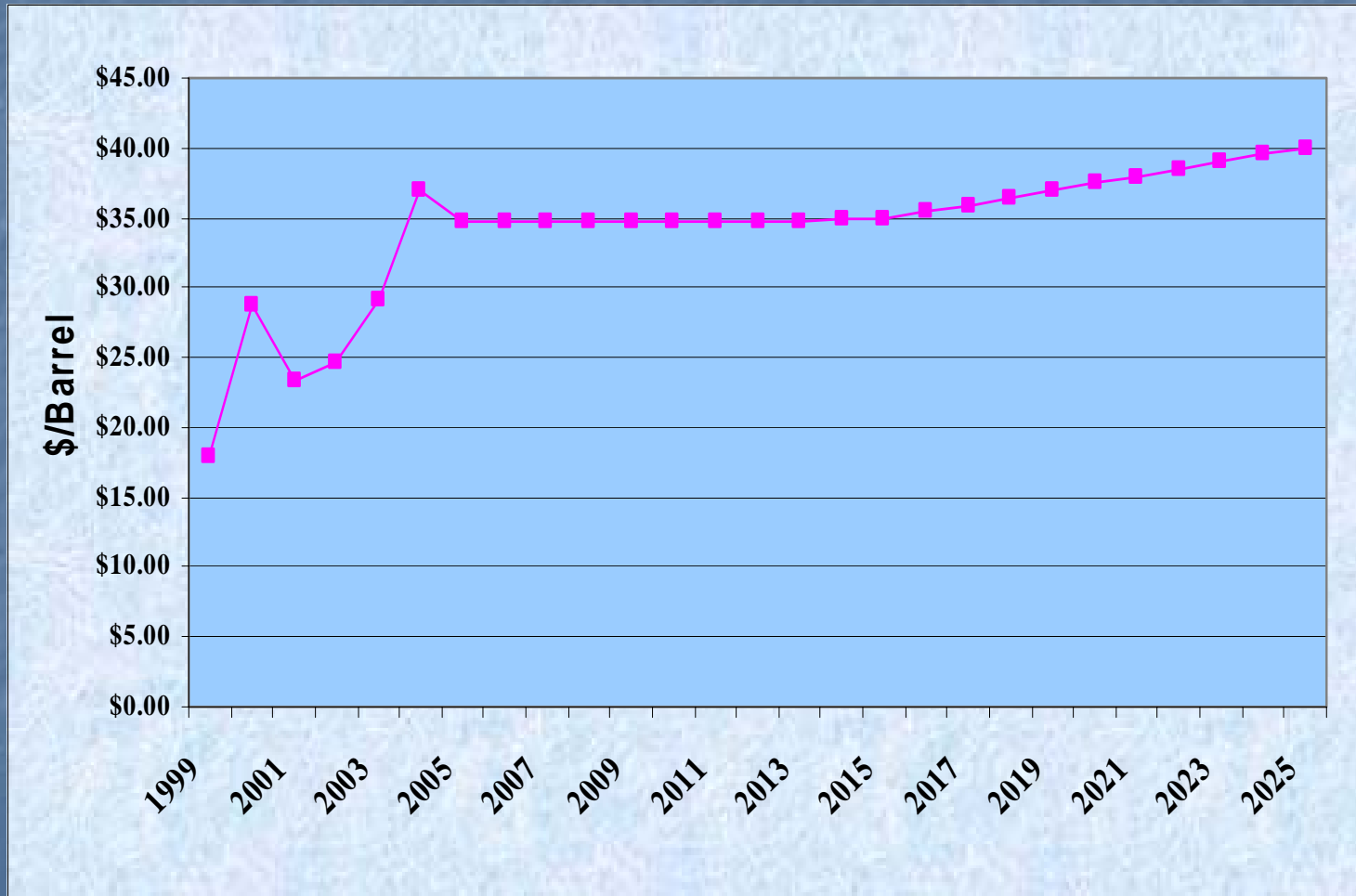
- Residential – Elastic
- Commercial – Elastic
- Industrial - Chemical – Elastic
  - Non-Chemical – Elastic
- Natural Gas Fuel Electric Generation – Inelastic
- Oil Sands – Inelastic

### Technology/Efficiency

- Technology/Efficiency advancements are handled in the cost function through reduced exploration and production cost for natural gas supply.
- Technology/Efficiency advancements or policy requirements are handled in the lag function for the end use elastic demand functions and outside the model for exogenous variables

# EIA – High A World Crude Oil Price Forecast

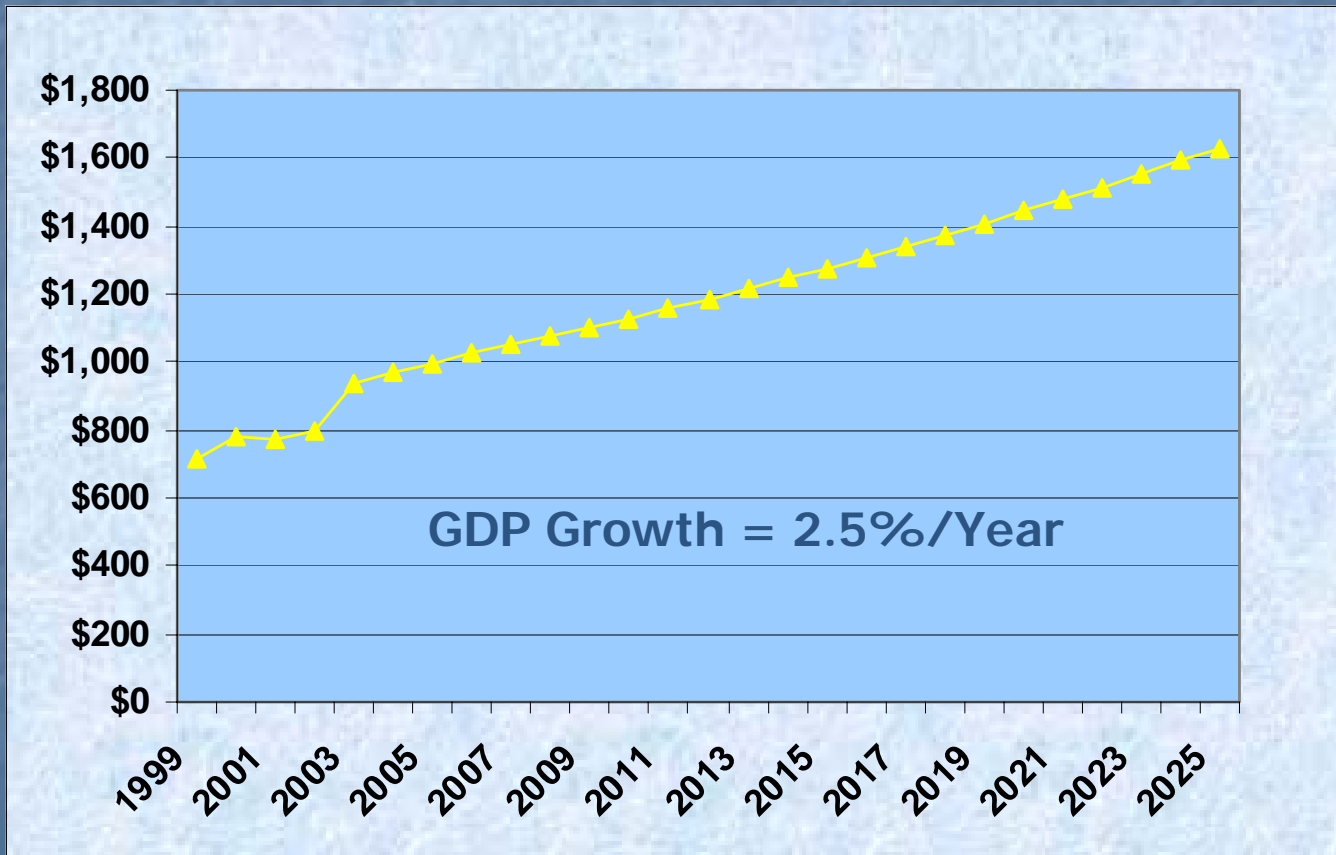
(Refiner Acquisition Cost - 2004 Dollars)



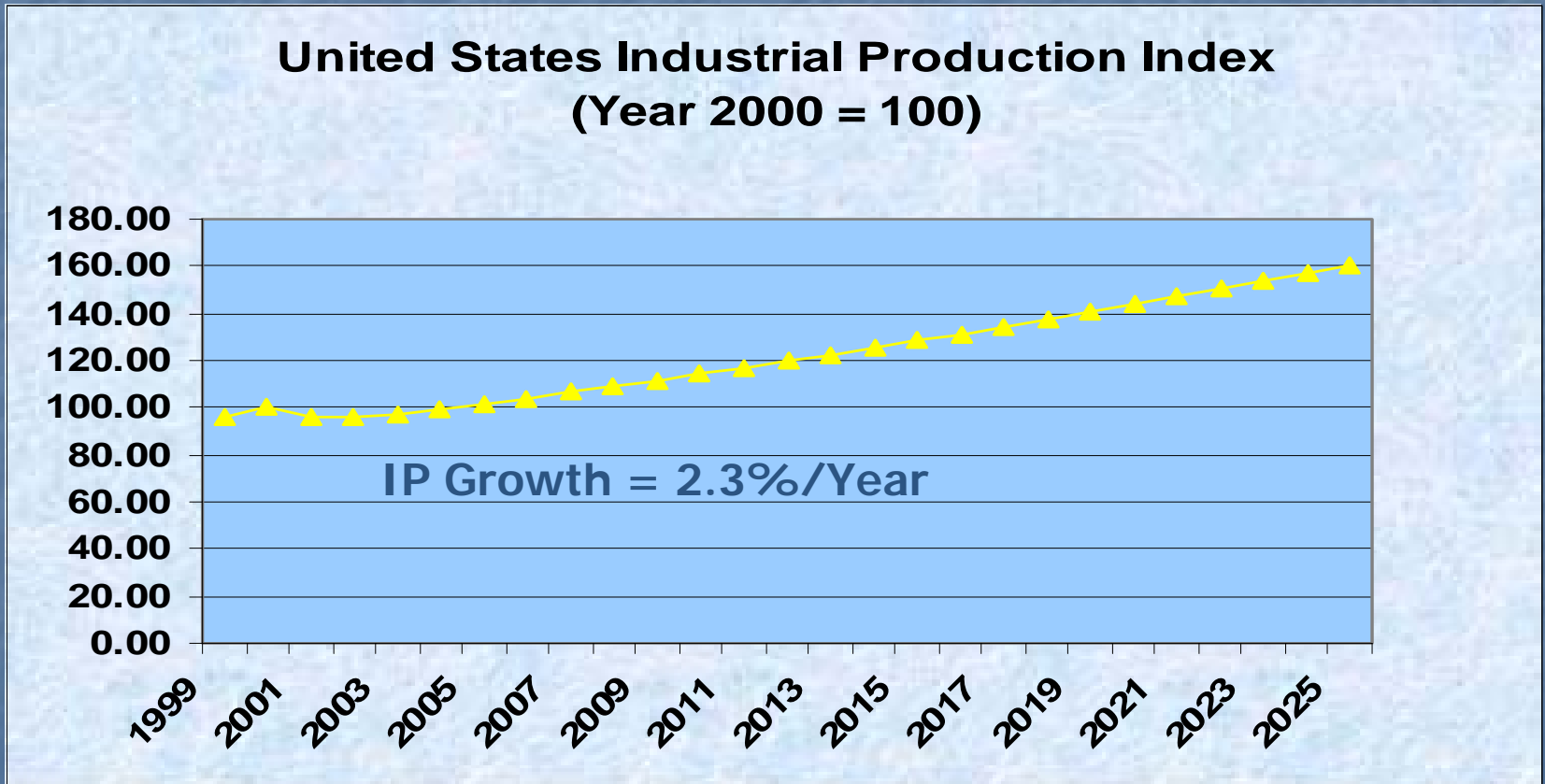
# United States Gross Domestic Product (Billion of 2004 Dollars)



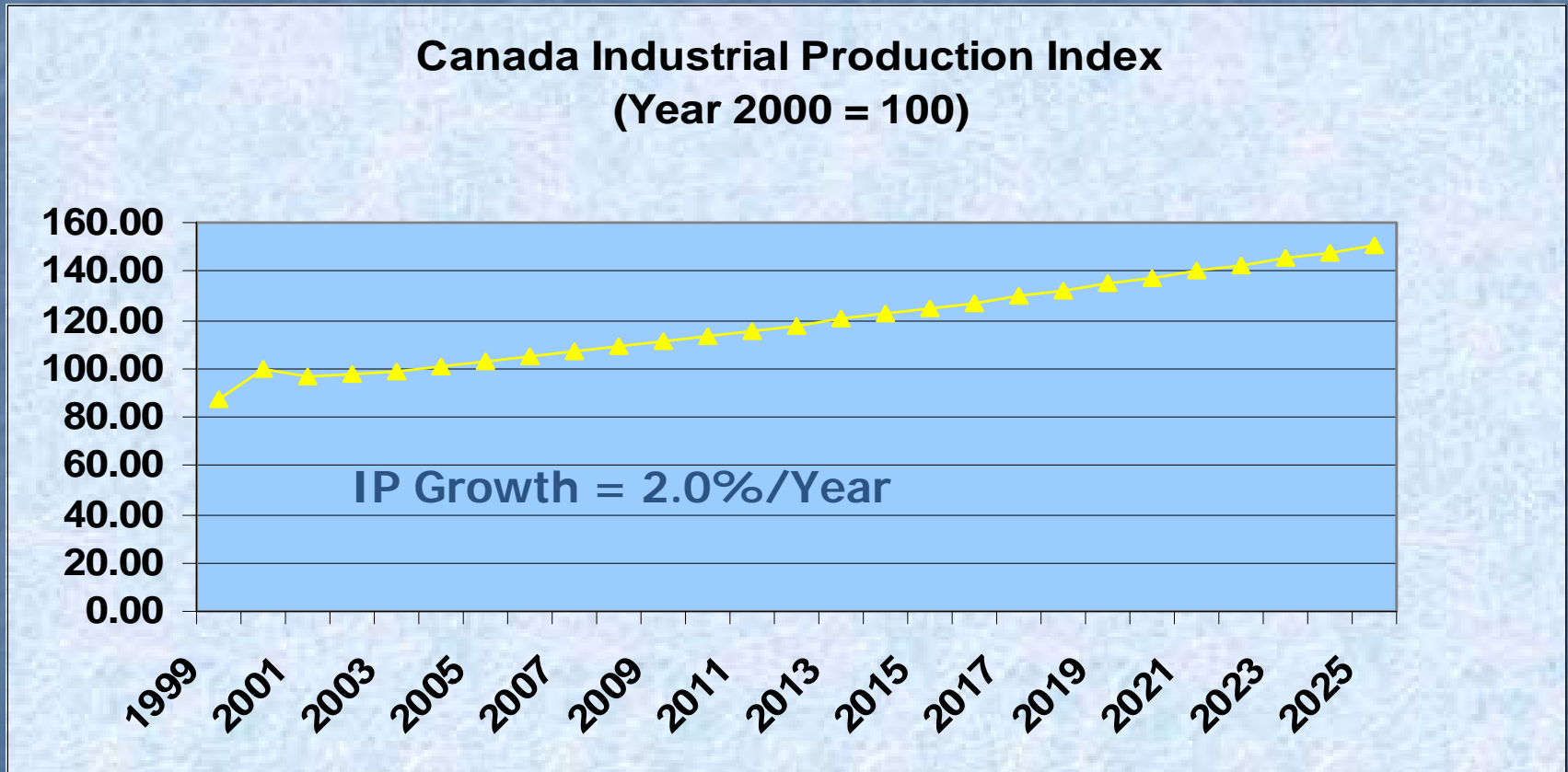
# Canada Gross Domestic Product (Billion of 2004 Dollars U.S.)



# United States Industrial Production Index (Year 2000 = 100)



# Canada Industrial Production Index (Year 2000 = 100)



# North America Natural Gas Supply

- Production from North America's natural gas resource base
- Liquefied Natural Gas imports

# Natural Gas Resource Base

## Proven reserves:

- Known and developed resources;
- Require only operation and maintenance costs for its production;
- Economical with today's technology.

## Potential reserves:

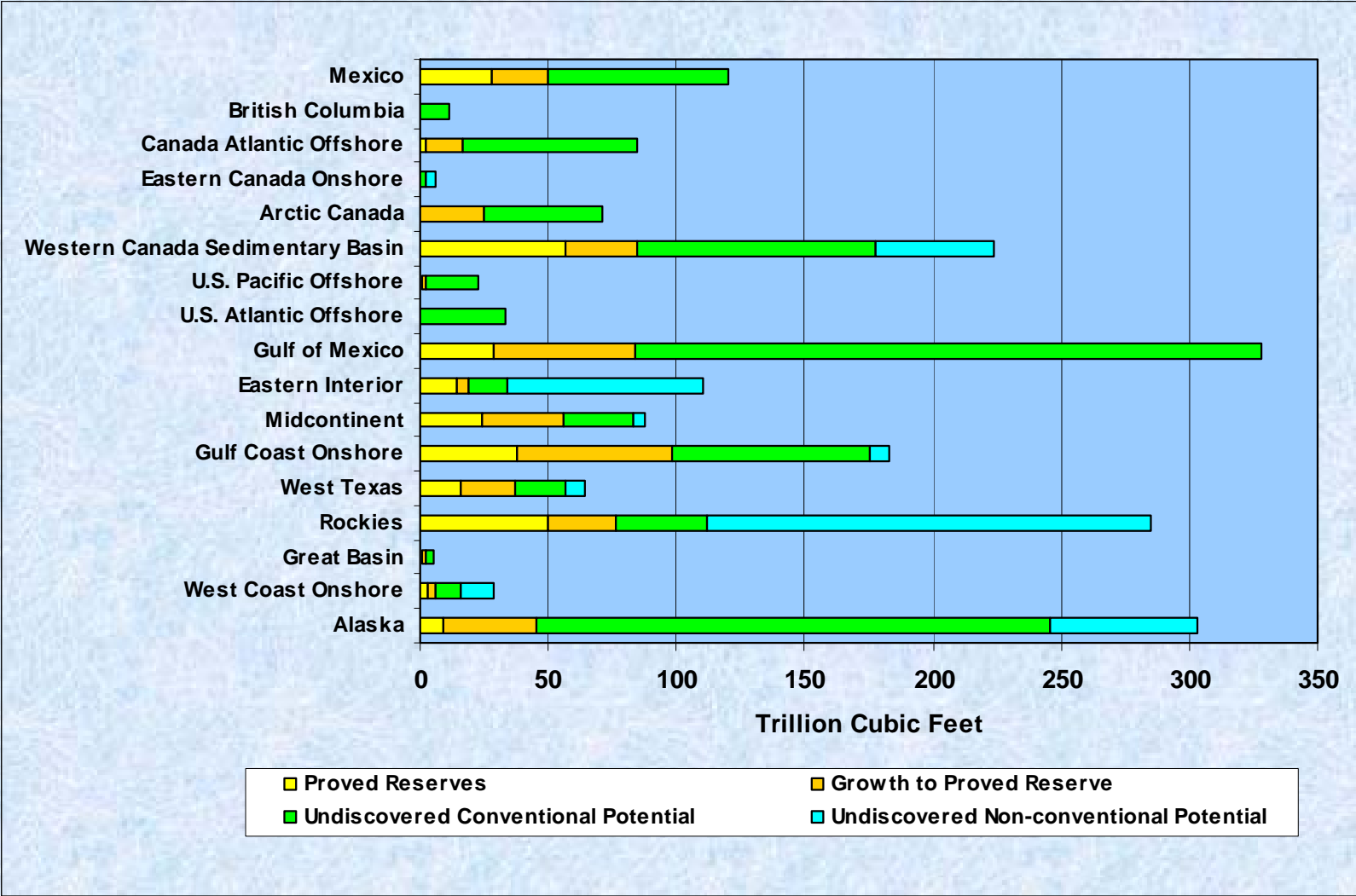
- Known, but not yet developed;
- Require both exploration and development capital, and operation and maintenance costs.

# Natural Gas Resource Base



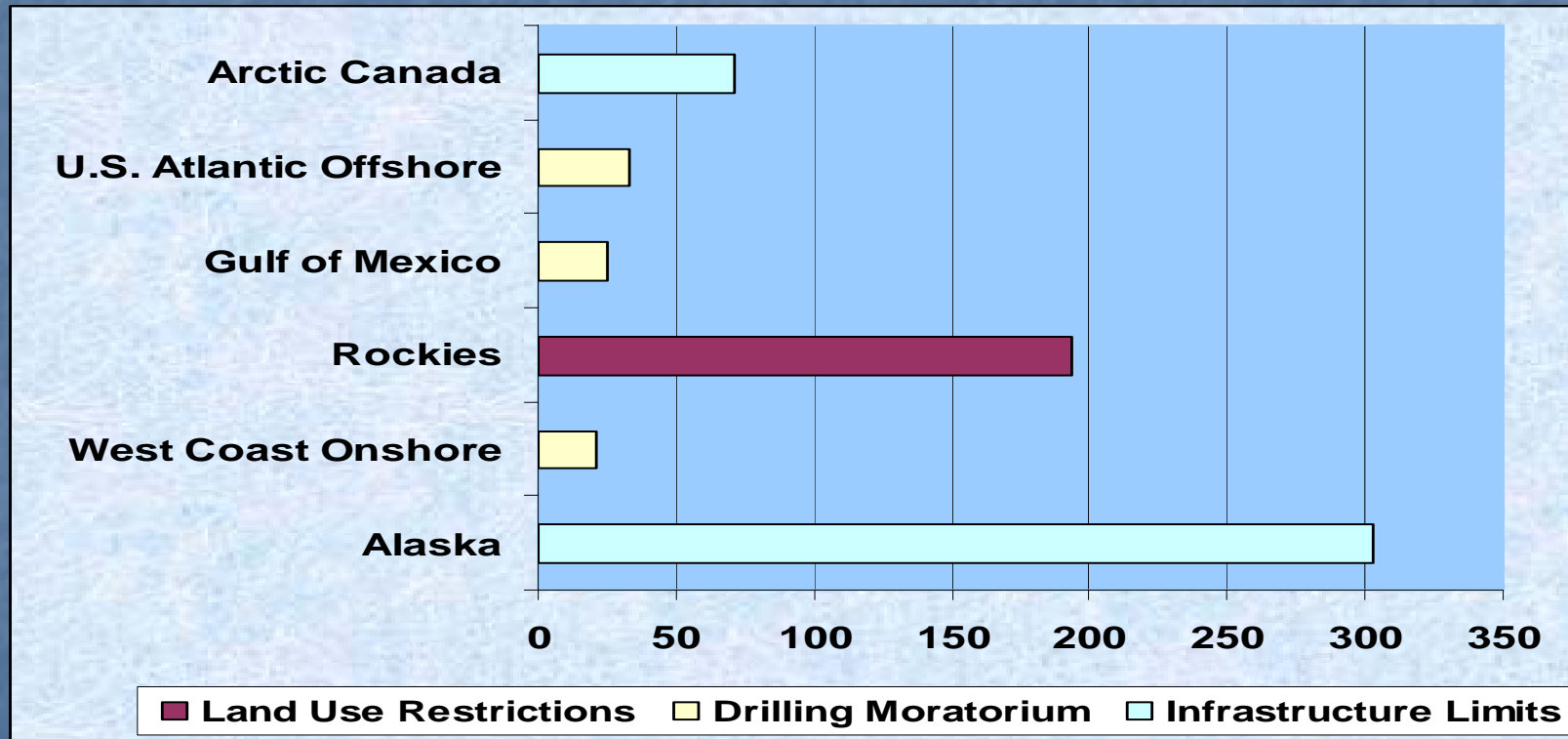
# North America's Natural Gas Resource Base

Estimated Resource Base 1,968 Trillion Cubic Feet



# North America Natural Gas Resources Land Use Restrictions and Drilling Moratorium

Estimated Restricted Resources 656 Trillion Cubic Feet

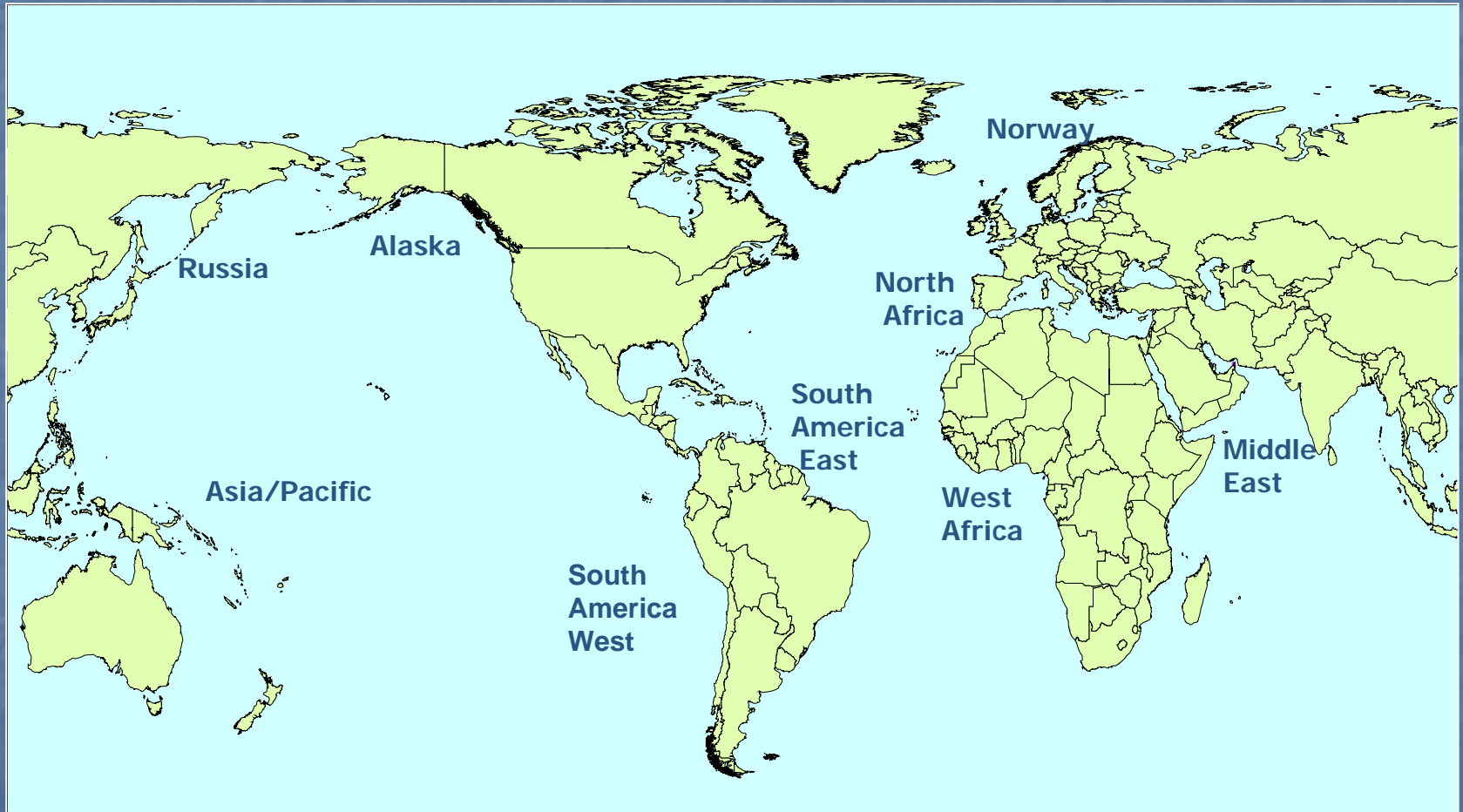


# LNG Supply

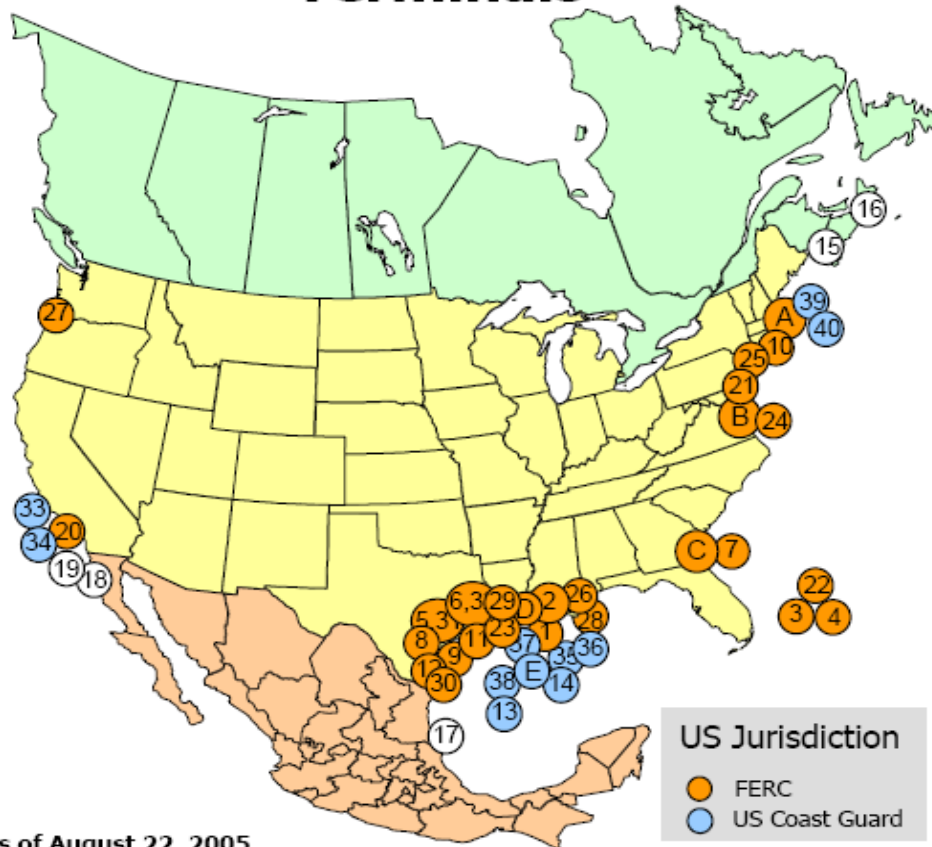
## LNG Value Chain

- Natural Gas Feedstock
- Liquefaction
- Transportation
- Regasification

# LNG Supply Sources



# Existing and Proposed North American LNG Terminals



As of August 22, 2005

\* US pipeline approved; LNG terminal pending in Bahamas

**CONSTRUCTED**

- A. Everett, MA : 1.035 Bcfd (Tractebel - DOMAC)
- B. Cove Point, MD : 1.0 Bcfd (Dominion - Cove Point LNG)
- C. Elba Island, GA : 0.68 Bcfd (El Paso - Southern LNG)
- D. Lake Charles, LA : 1.0 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: 1.1 Bcfd (Southern Union - Trunkline LNG)
- 2. Hackberry, LA : 1.5 Bcfd, (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. Elba Island, GA: 0.54 Bcfd (El Paso - Southern LNG)
- 8. Corpus Christi, TX: 2.6 Bcfd, (Cheniere LNG)
- 9. Corpus Christi, TX : 1.0 Bcfd (Vista Del Sol - ExxonMobil)
- 10. Fall River, MA : 0.8 Bcfd, (Weaver's Cove Energy/Hess LNG)
- 11. Sabine, TX : 1.0 Bcfd (Golden Pass - ExxonMobil)
- 12. Corpus Christi, TX: 1.0 Bcfd (Ingleside Energy - Occidental Energy Ventures)

**APPROVED BY MARAD/COAST GUARD**

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

**CANADIAN APPROVED TERMINALS**

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

**MEXICAN APPROVED TERMINALS**

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

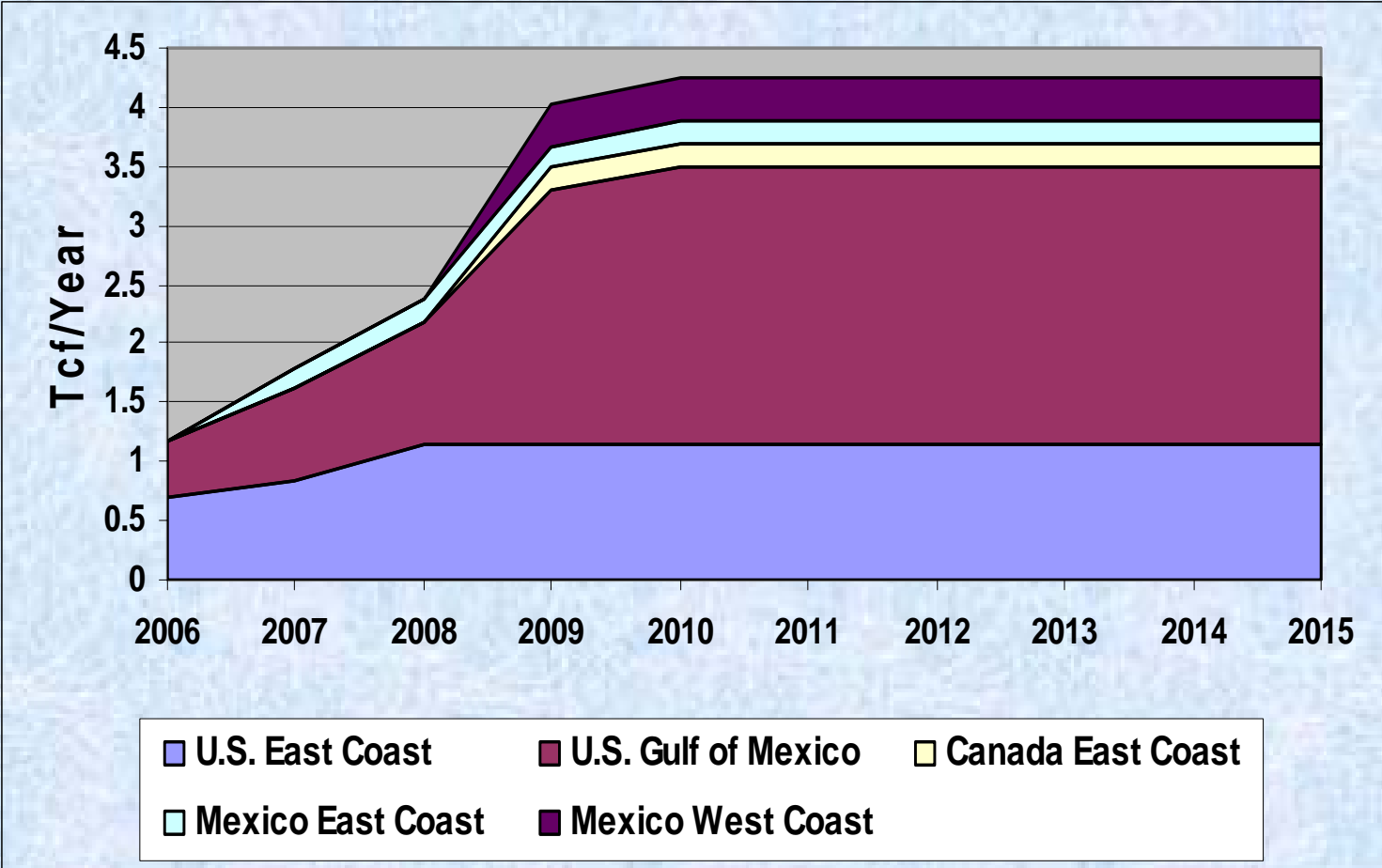
**PROPOSED TO FERC**

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

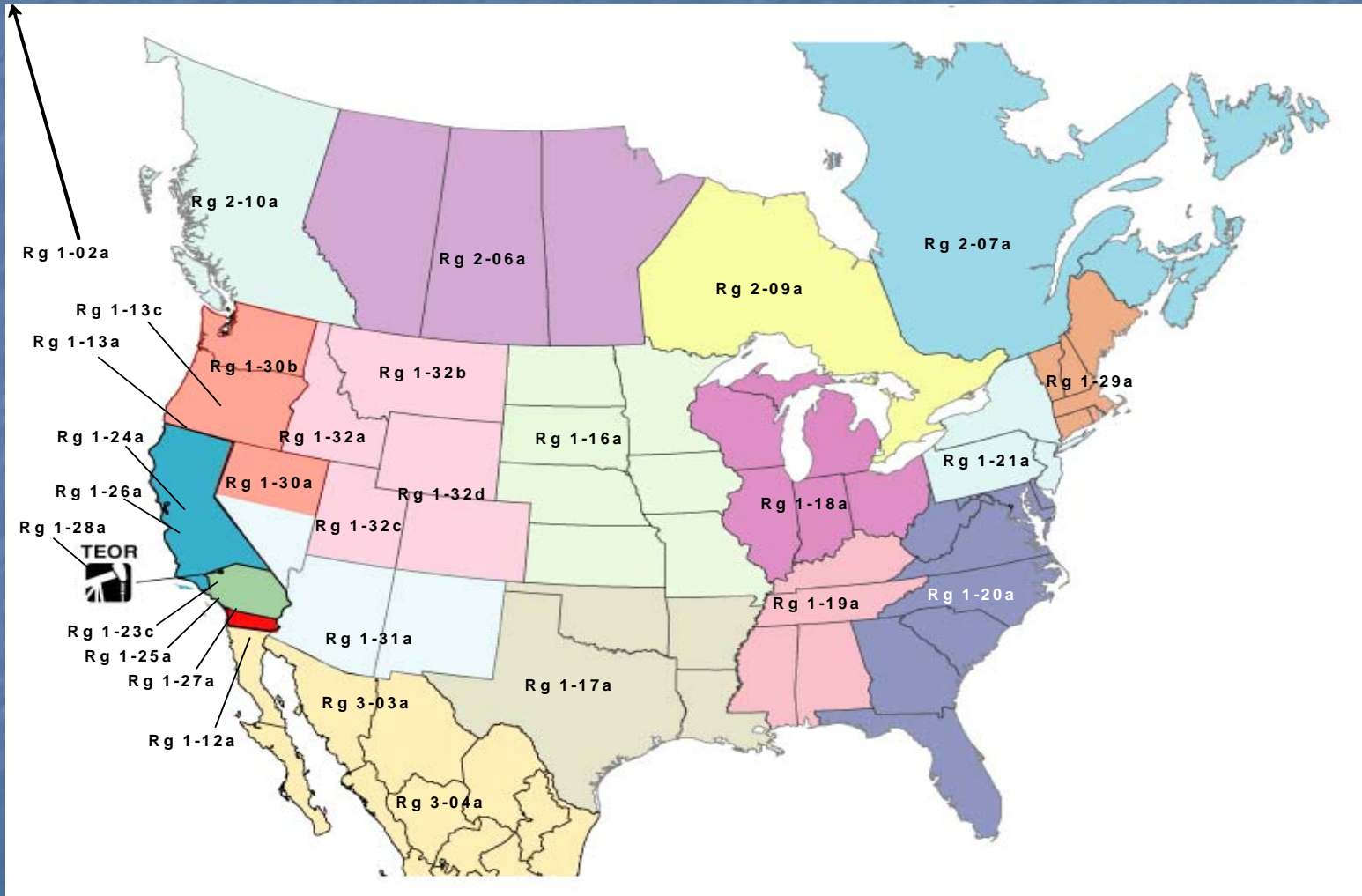
**PROPOSED TO MARAD/COAST GUARD**

- 33. California Offshore: 1.5 Bcfd (Cabrillo Port - BHP Billiton)
- 34. So. California Offshore : 0.5 Bcfd, (Crystal Energy)
- 35. Louisiana Offshore : 1.0 Bcfd (Main Pass McMoRan Exp.)
- 36. Gulf of Mexico: 1.0 Bcfd (Compass Port - ConocoPhillips)
- 37. Gulf of Mexico: 2.8 Bcfd (Pearl Crossing - ExxonMobil)
- 38. Gulf of Mexico: 1.5 Bcfd (Beacon Port Clean Energy Terminal - ConocoPhillips)
- 39. Offshore Boston, MA: 0.4 Bcfd (Neptune LNG - Tractebel)
- 40. Offshore Boston, MA: 0.8 Bcfd (Northeast Gateway - Excelerate Energy)

# LNG Facilities Operational and Under Construction Base Load Capacity



# Natural Gas Demand Sub-Regions



# Natural Gas Demand Sectors

- Residential
- Commercial
- Industrial
  - Chemical
  - Non-chemical
- Power Generation
- Oil Sands

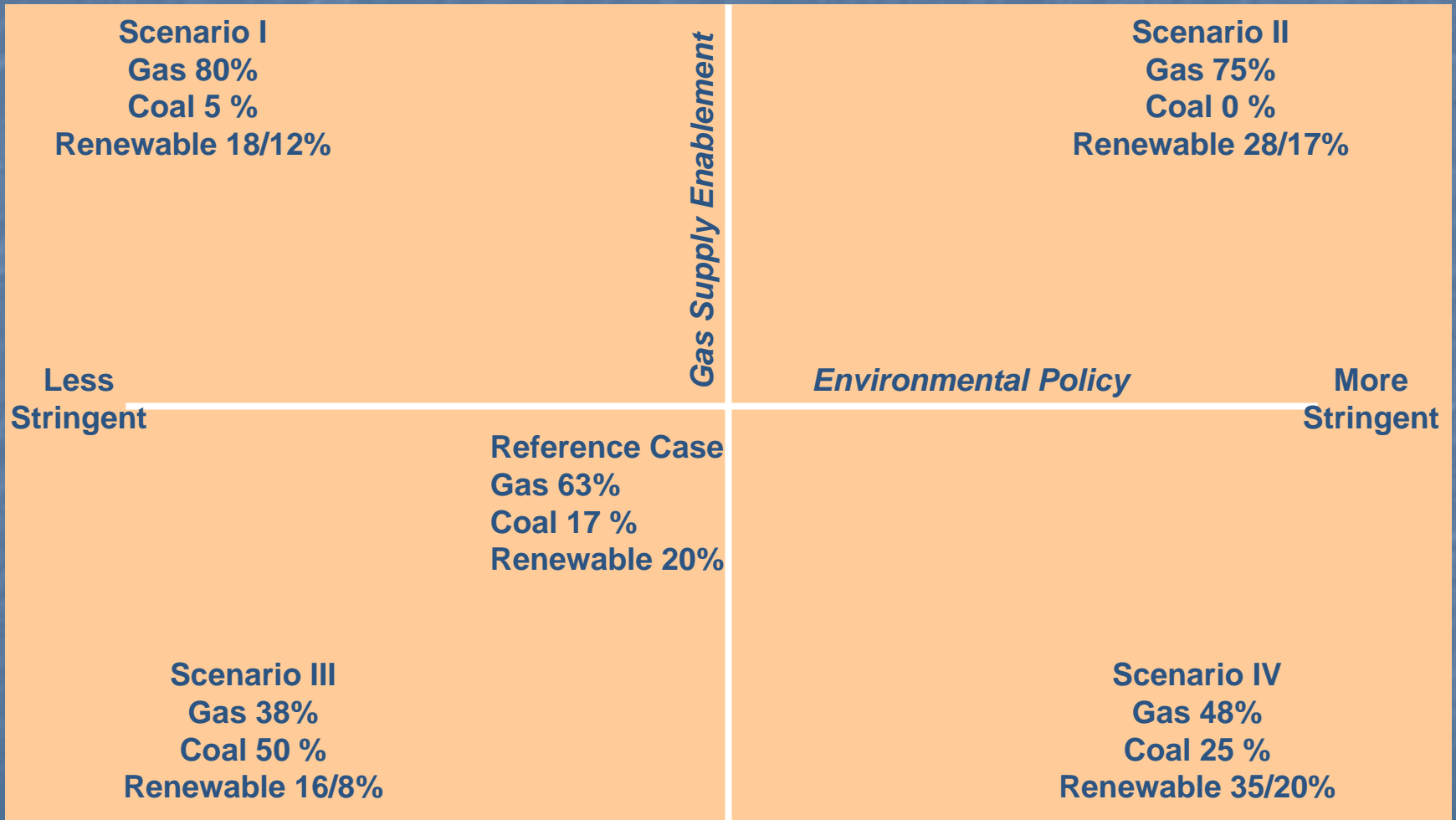
# Natural Gas Demand Sectors

- **Residential**- natural gas price, gross domestic product, heating degree days, and population
- **Commercial** - natural gas price, gross domestic product, heating degree days, and population
- **Industrial**
  - **Chemical** - natural gas price, industrial production, and crude oil price
  - **Non-Chemical** - natural gas price, industrial production, and crude oil price

# Scenarios For Electric Generation Capacity

## New Capacity Additions

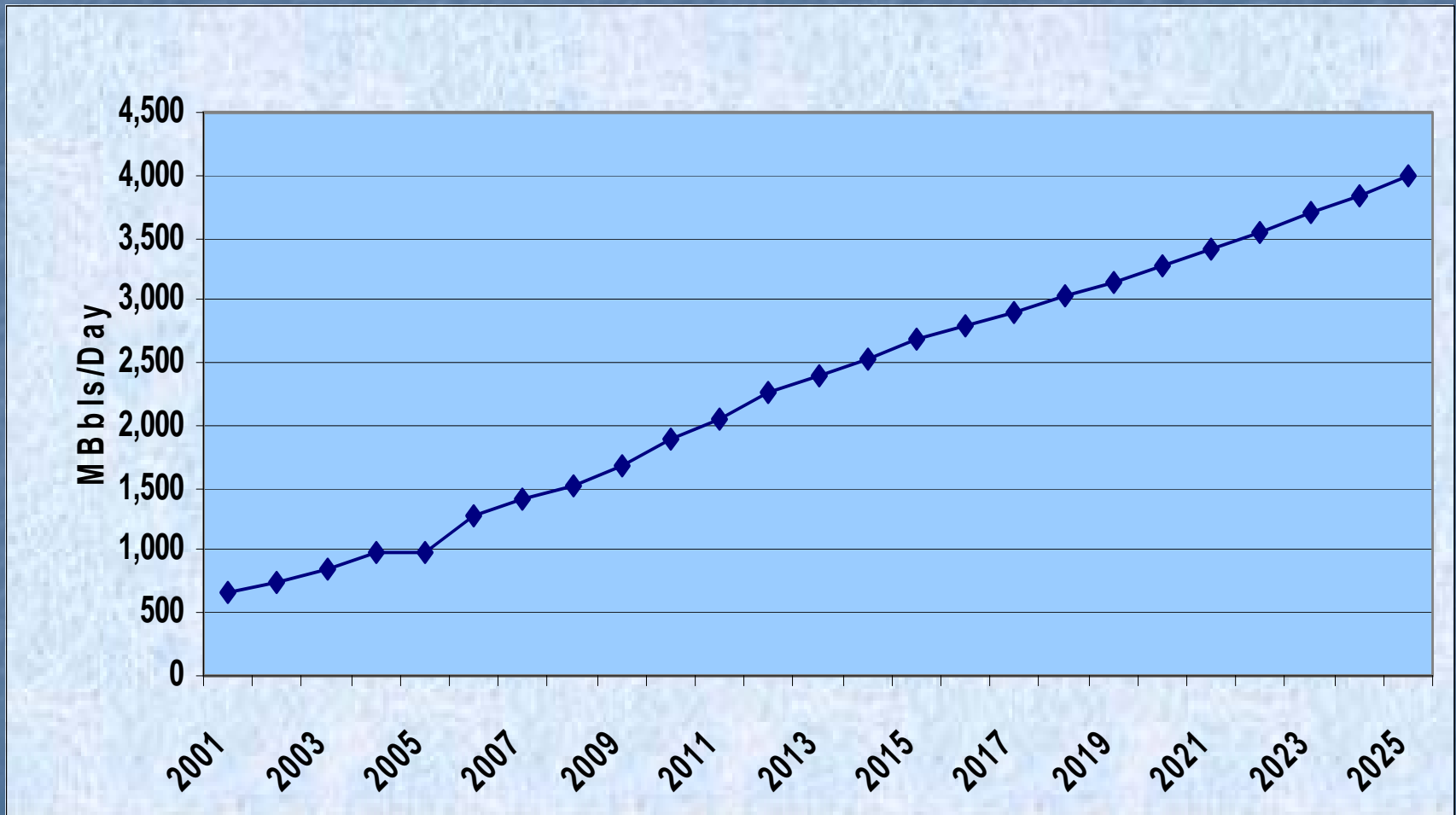
High Degree



**Reference Case**  
Gas 63%  
Coal 17 %  
Renewable 20%

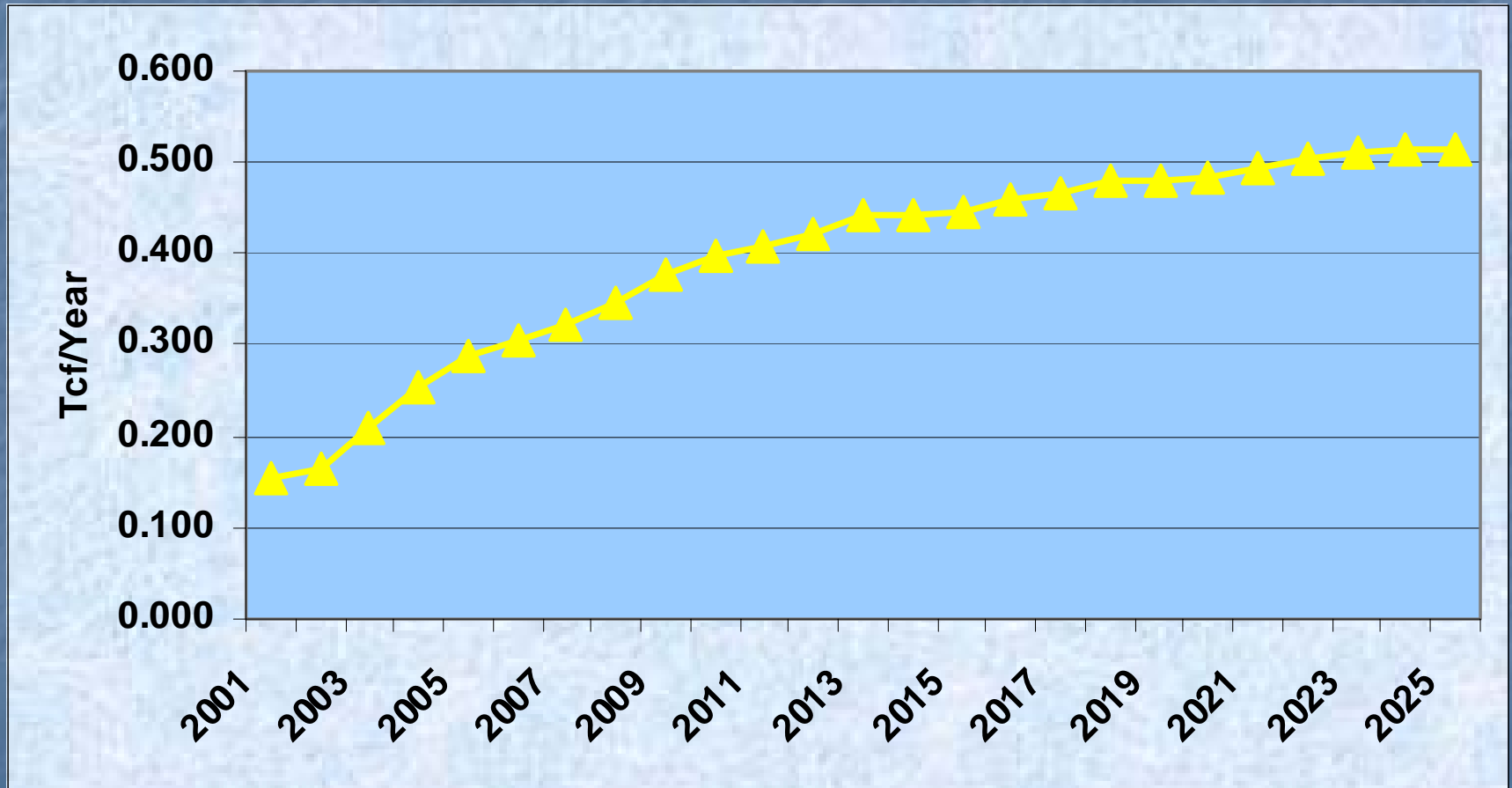
Low Degree

# Canadian Oil Sands Production Forecast (Canada's National Energy Board)



# Oil Sand Natural Gas Demand

Trillion cubic feet/Year



# Canadian Oil Sands Natural Gas Use

Natural Gas used to produce and convert one barrel of bitumen into syncrude

- Surface Mining – 131 cubic feet
- In Situ Production – 1,000 to 1,500 cubic feet
- Petroleum coking – 168 cubic feet
- Hydro-cracking – 490 cubic feet

? Questions

## Contact Information

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