U.S. NATURAL GAS INDUSTRY: DYNAMIC AS EVER

- Supply Changes
- Demand Changes
- Infrastructure Changes
- LNG Exports

Prepared for

EPRI Energy and Climate Change Research Seminar

Washington, D.C.

May 21, 2013

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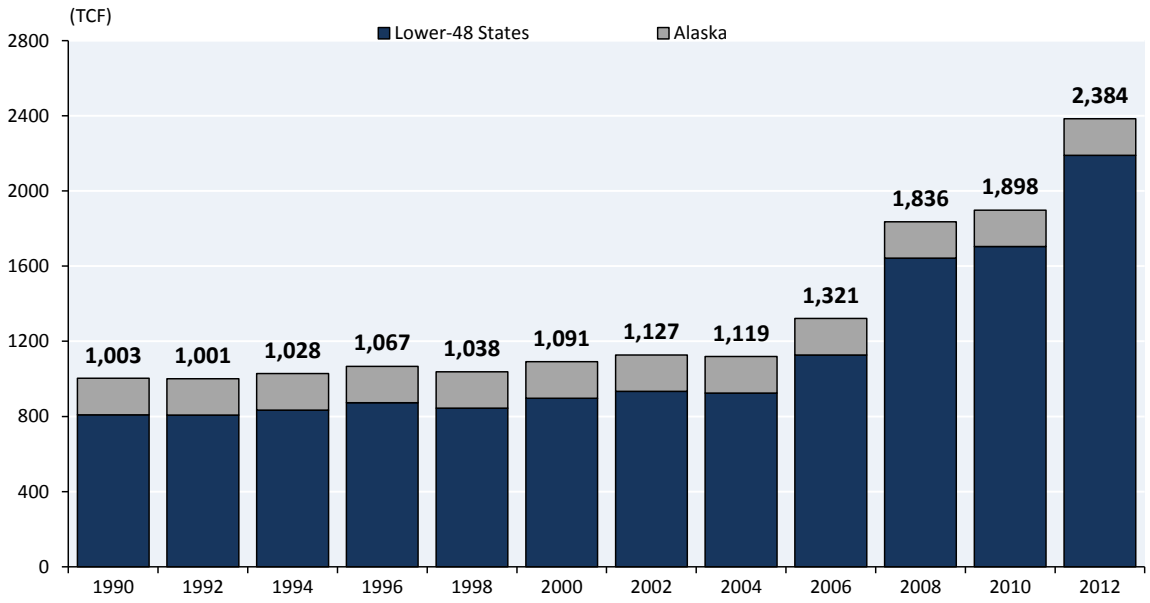
OUTLINE

- **Changing Supply Dynamics**
  - Growth in U.S. resource base
  - Changes in domestic production
  - Continuing focus on the shales
- **Changing Natural Gas Infrastructure**
  - Continued pipeline expansion
  - Near metamorphosis for midstream sector
- **Changing Demand Dynamics**
  - Growth in the industrial sector
  - Changes in the electric sector
  - Emergence of the transportation sector
- **LNG Exports**
  - Lower-48 to start exporting LNG
- **Changing Price Outlook**
  - Variation in long-term outlook
  - Critical question: Will LNG lead to a universal gas price?

GROWTH IN U.S. RESOURCE BASE

- **The Potential Resource Base Is Huge**
  - Since 2004 Lower-48 resource base has increased 135 percent (i.e., more than doubled)
    - Almost all of the increase is due to the shales.
  - There is a reasonable likelihood that it will continue to increase
    - Emerging shale plays. (1)
    - Advances in technology.

Total Potential Natural Gas Sources By The Potential Gas Committee



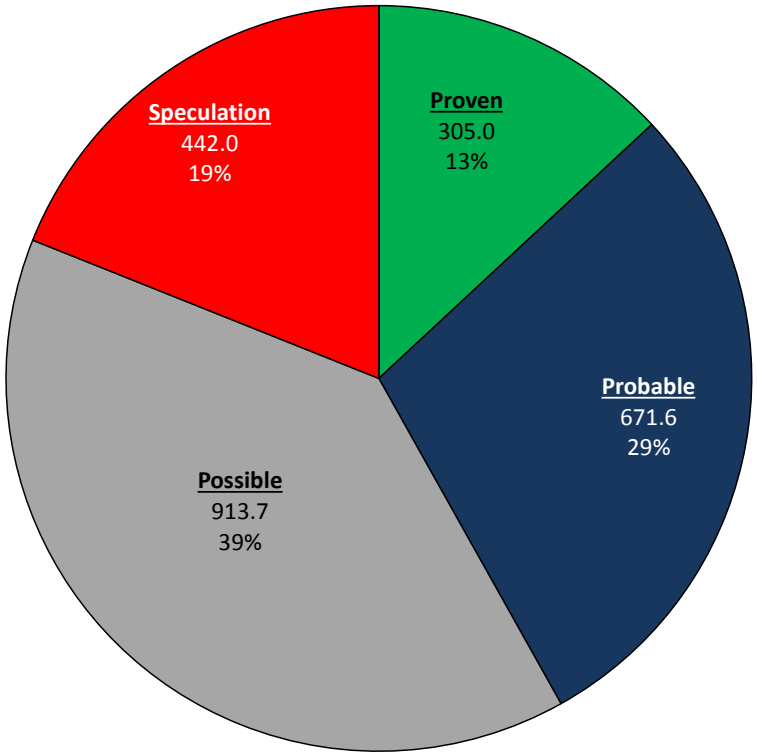
Source: Potential Gas Committee.

(1) There are approximately 13 emerging shale plays for which the industry has leased about 12 MM acres.

GROWTH IN U.S. RESOURCE BASE

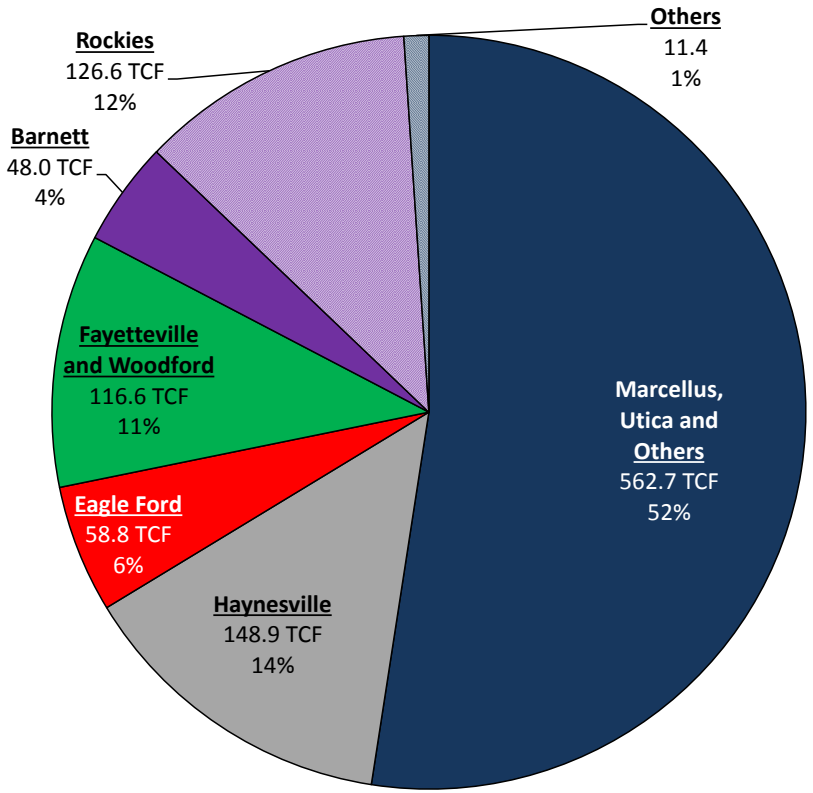
- **Key Attributes Of Current Estimated Resource Base**
  - Over 80 percent proven, probable and possible
  - About 55 percent of Lower-48 resource base is due to the shales (1,073 TCF)

Total Lower-48 Resource Base



TOTAL LOWER-48 = 2,332 TCF

Major Components Of Shale Resource Base

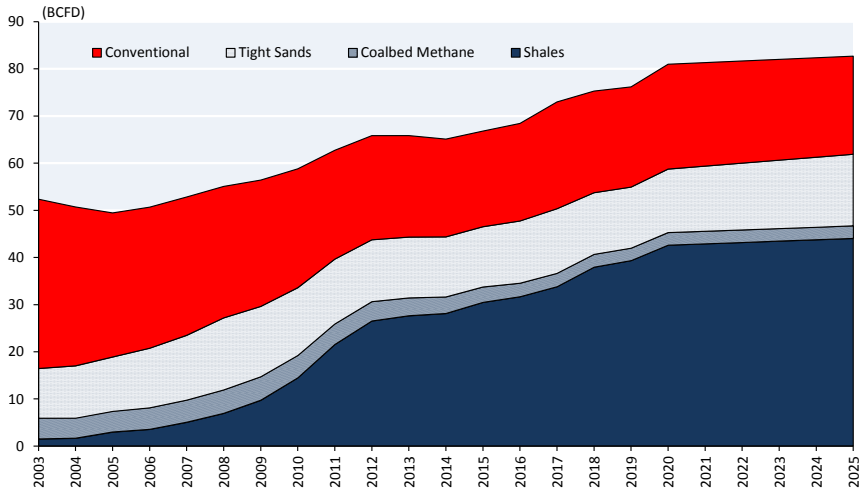


TOTAL LOWER-48 = 1,073 TCF

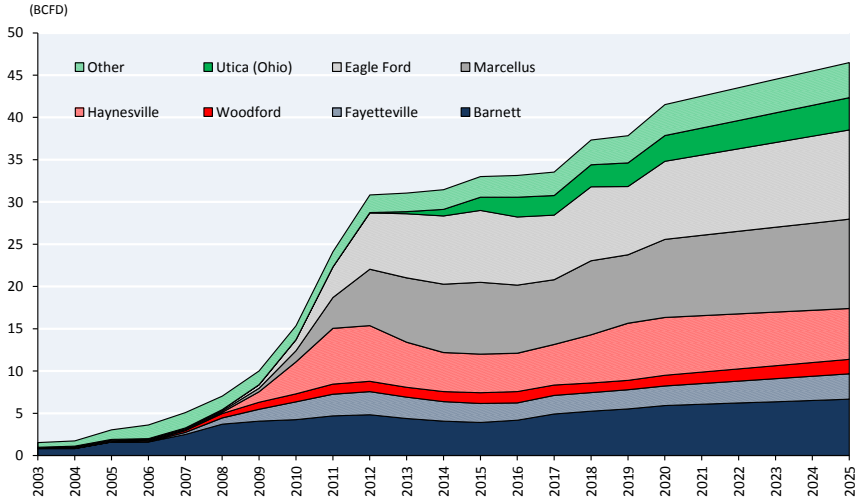
SHALE PRODUCTION

- **Outlook For Shale Production**
  - Shale production currently accounts for 20 percent of U.S. production
    - This metric likely will increase to 50 to 55 percent.
    - Shale production will continue to account for almost all of the incremental production.

U.S. Gas Production By Major Component

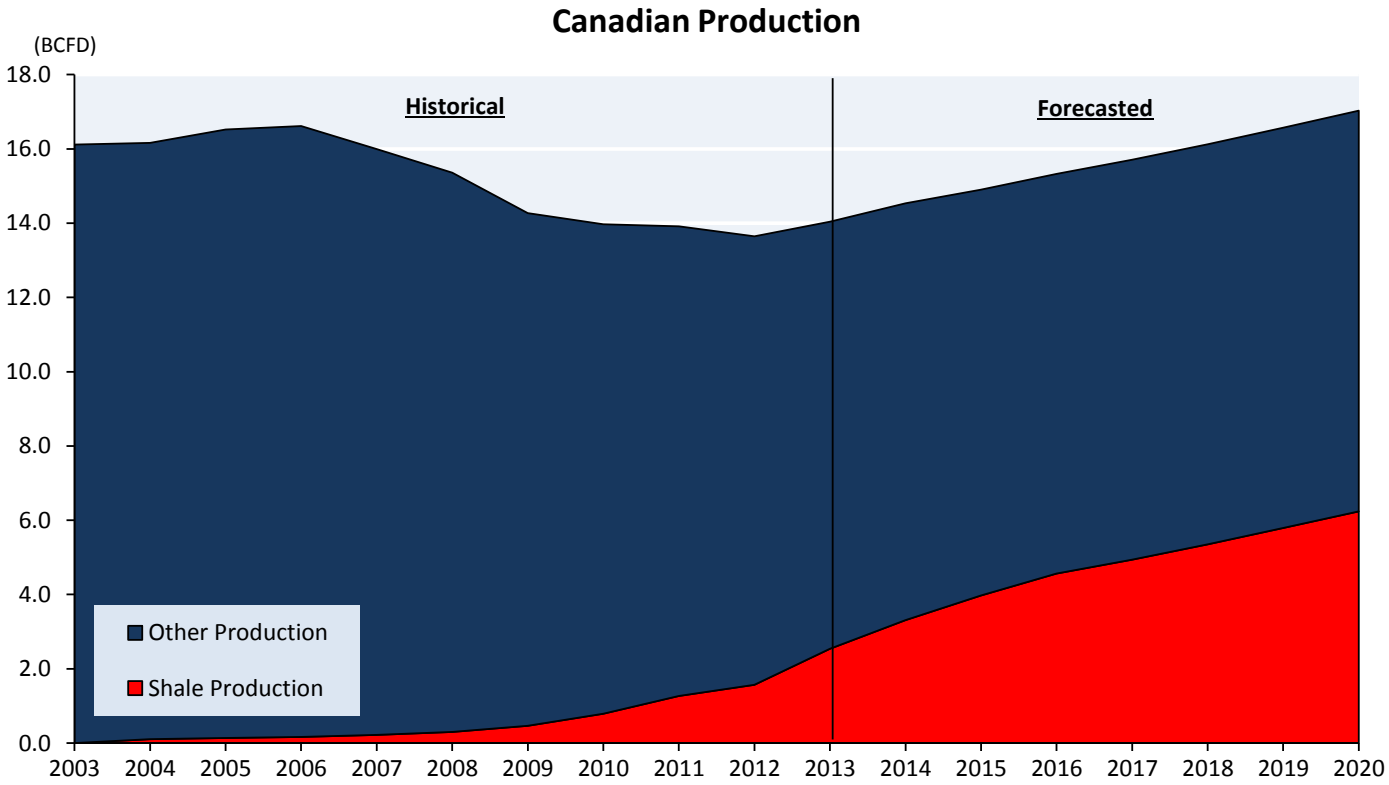


U.S. Shale Gas Production By Play

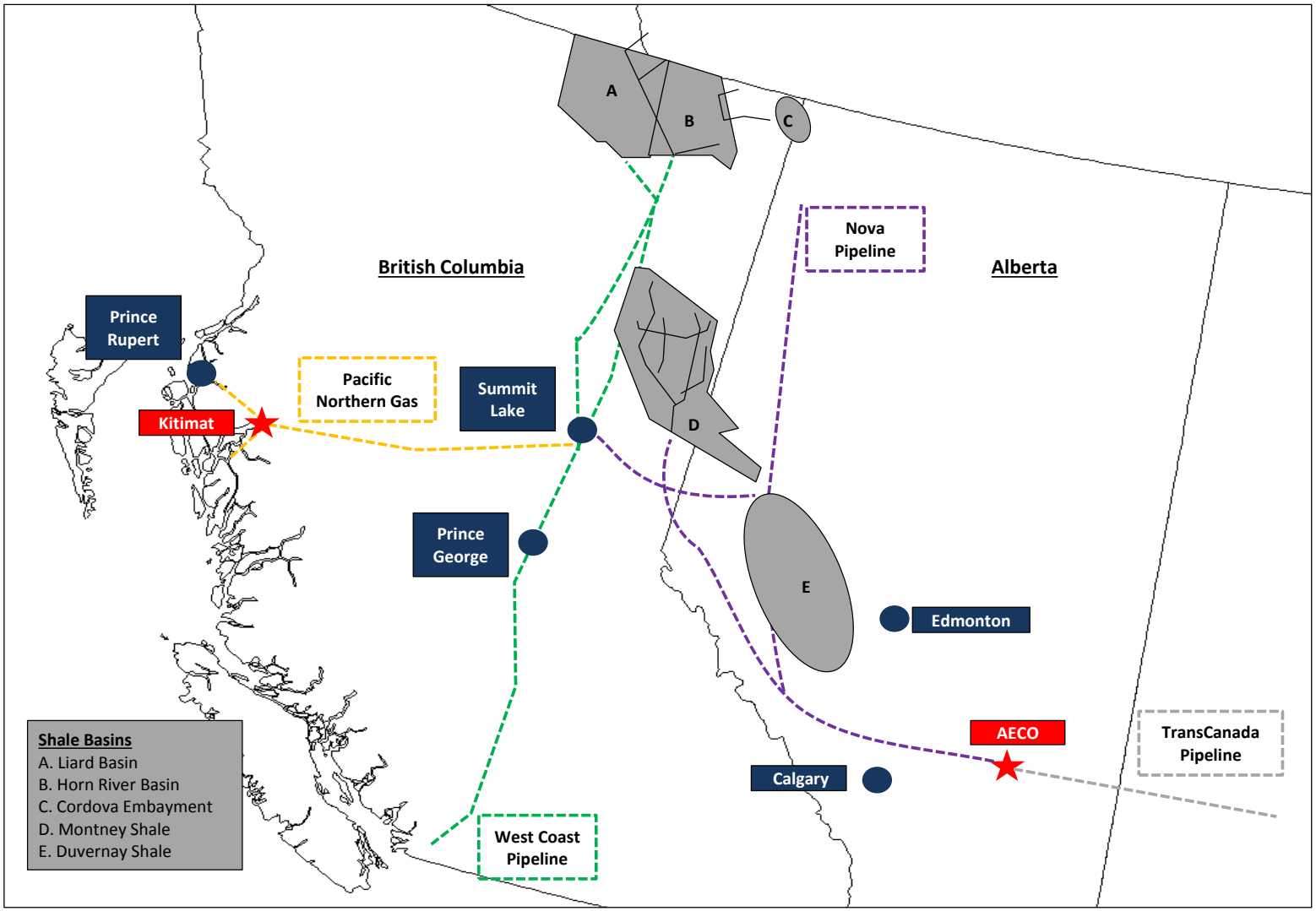


CANADIAN SHALES

- **Canada's Shales Are Equally Prolific**
  - Canadian conventional resources (Alberta) have become the marginal source of supply for North America
  - However, during the latter part of the decade and into the next, the emergence of Canadian shales will be significant



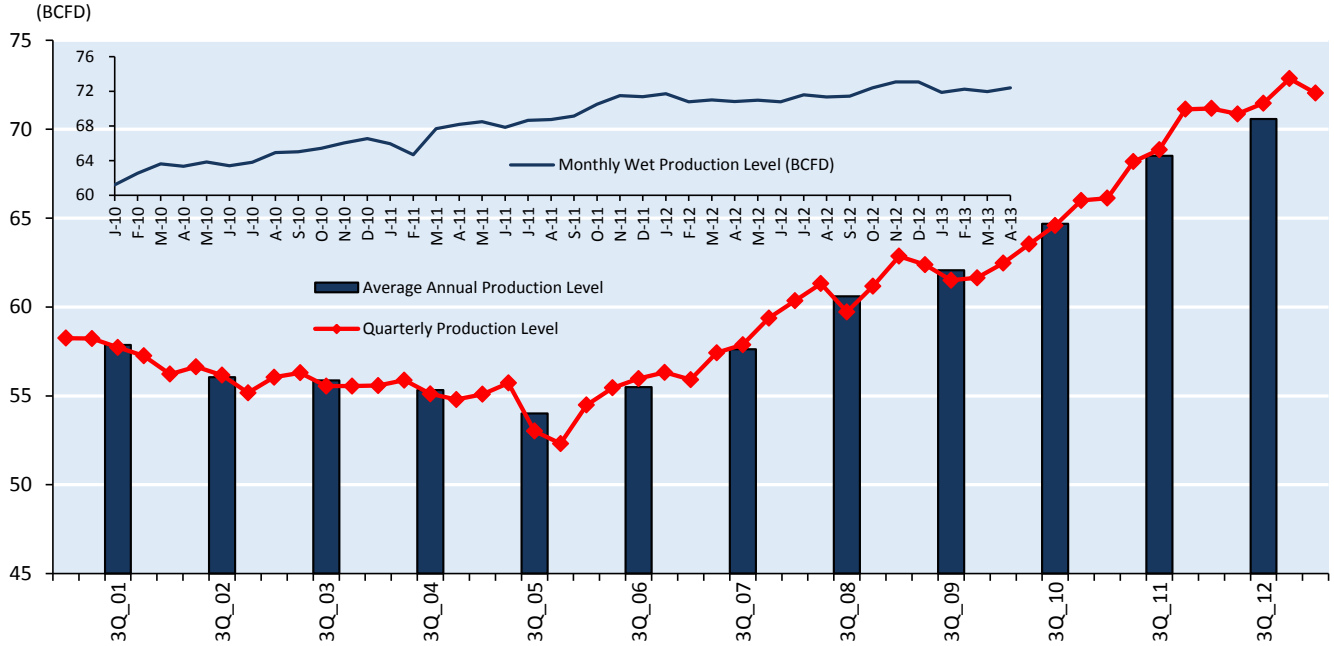
CANADIAN SHALES



DOMESTIC PRODUCTION

- **Near-Term Outlook**
  - Domestic production has flattened
    - Also, there are the first signs of decline.
  - However, for the near term there likely will be little correlation between domestic production and gas-directed drilling activity
    - Key factor is new infrastructure coming online that eliminates bottlenecks and increases takeaway capacity.

Lower-48 States Natural Gas Production



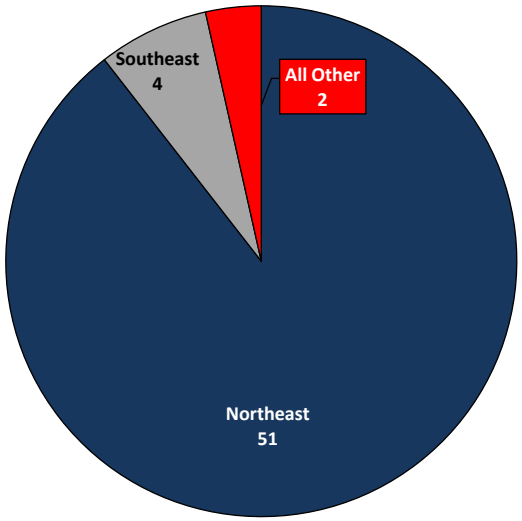
Source: Lippman Consulting.

OUTLINE

- **Changing Supply Dynamics**
- **Changing Natural Gas Infrastructure**
  - Continued pipeline expansion
  - Near metamorphosis for midstream sector
- **Changing Demand Dynamics**
- **Changing Price Outlook**

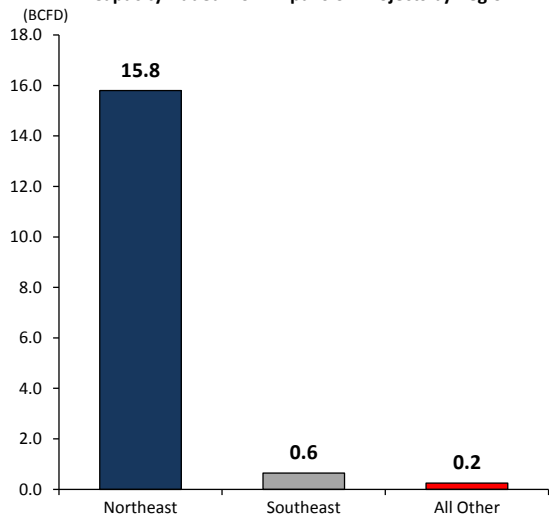
GREATEST CHANGE IN GAS INFRASTRUCTURE SINCE WWII: PHASE II (1)

Number of Pipeline Expansion Projects by Region

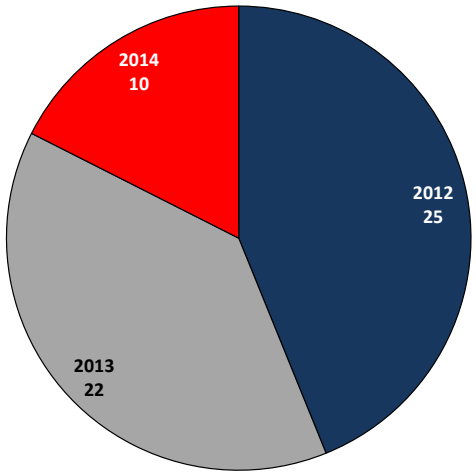


Total = 57 Projects

Capacity Added from Expansion Projects by Region

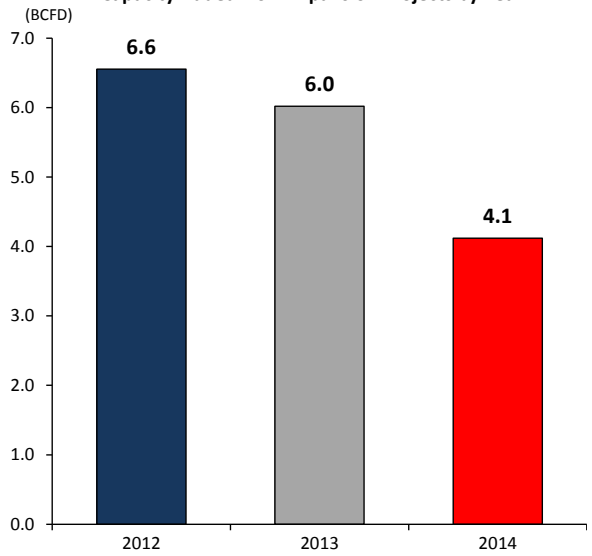


Number of Pipeline Expansion Projects by Year



Total = 57 Projects

Capacity Added from Expansion Projects by Year

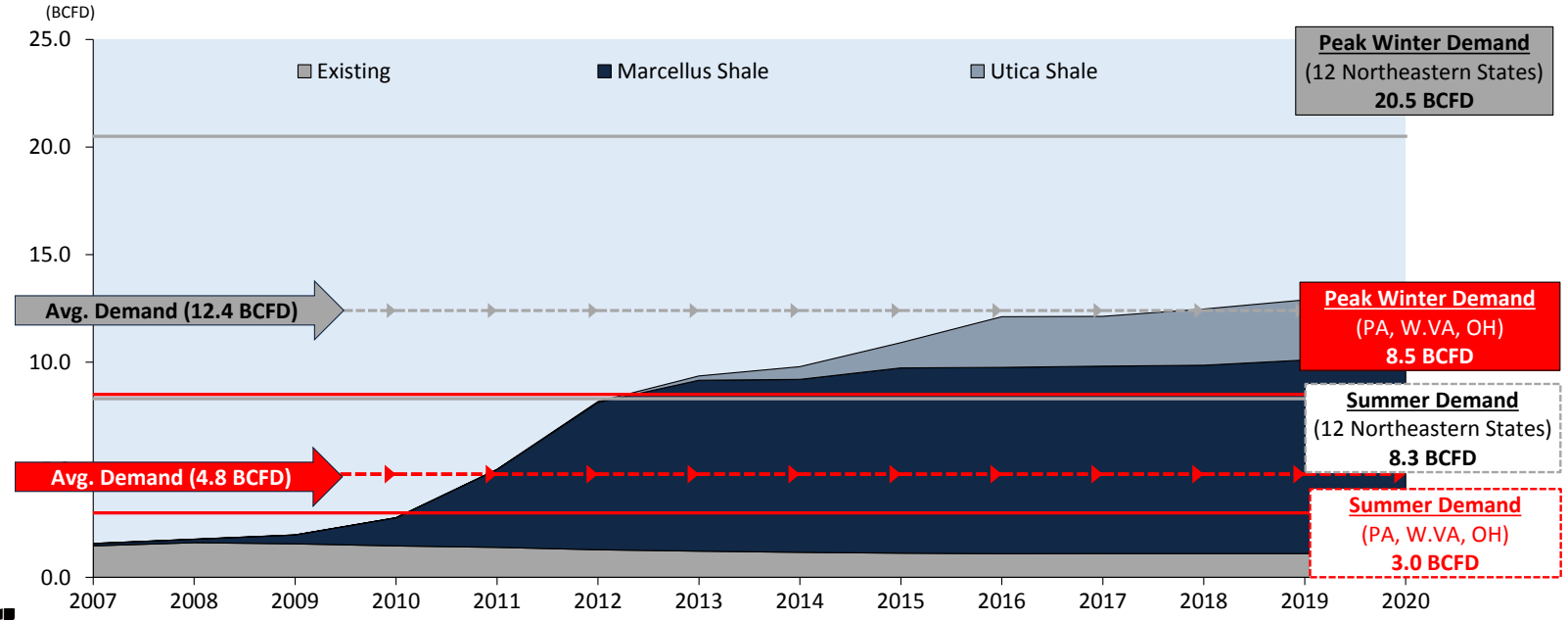


(1) See page 62-67 in the Appendix for maps of expansion projects.

CHANGING INFRASTRUCTURE: PIPELINES

- **Key Driver**
  - The key driver behind the current phase of pipeline expansion is the development of the Marcellus and Utica shales
- **Key Impact**
  - Converting the Northeast region from an importing from to an **exporting** region
    - This has a significant impact on other regions.

Natural Gas Production For The Marcellus And Utica Shales



Note: Includes Marcellus production from both Pennsylvania and West Virginia.

CHANGING INFRASTRUCTURE: PIPELINES

- **Other Impacts**
  - New pricing points and hubs
    - Provides greater transparency and liquidity.
    - Examples: TETCO M2, Millennium South, Leidy.
  - Compression of basis differentials
    - Reduces delivered price of gas.
  - Devaluation of storage capacity
    - Lowers cost of services.
  - Stranded pipeline assets
    - Gas pipelines redirect flows.
      - Reduces cost of transportation.
      - Examples: Columbia Gulf and REX.
    - Gas pipelines convert to oil pipelines.
      - Could increase cost of transportation.

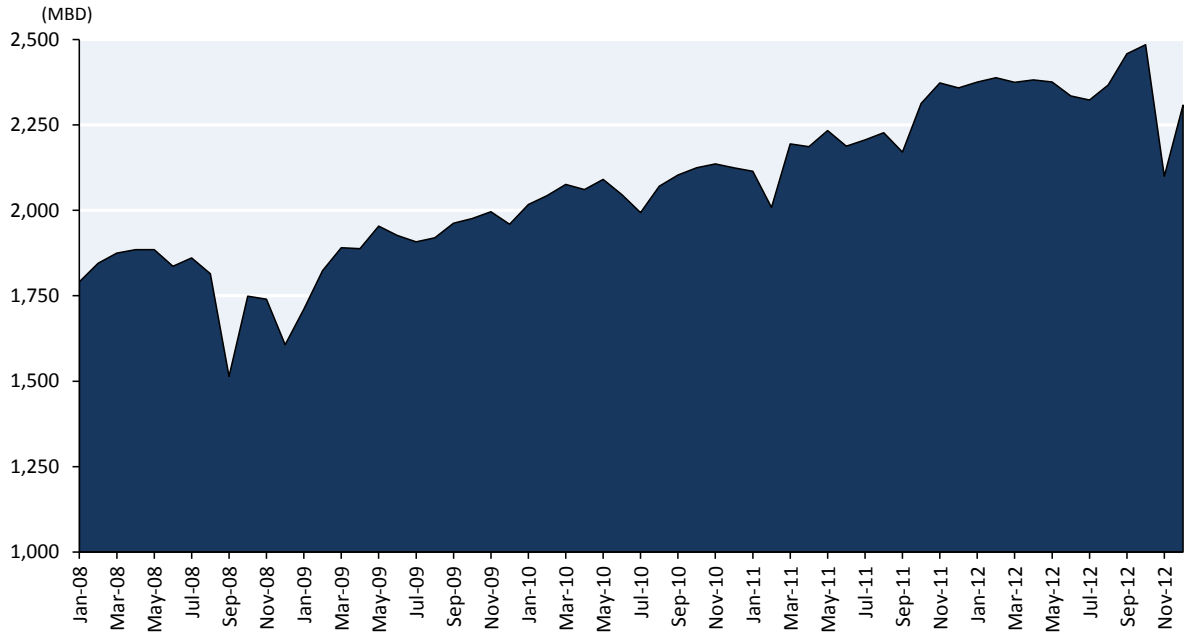
Pipeline[(1)]	Region	Capacity (MBD)	Date
Pony Express	OK	Unknown	Aug 2014
Trunkline	Gulf	420-600	Mar 2015
EPNG Freedom P/L	CA	Unknown	Dec 2016
TransCanada Eastern Oil P/L	E. Canada	500-850	Dec 2017
Texas Gas NGL P/L	Gulf	200-400	Unknown

(1) Others under consideration include REX and Texoma.

CHANGING INFRASTRUCTURE: MIDSTREAM SEGMENT

- **Development Of Liquids Rich Shales Has Created Rebirth Of U.S. Midstream Industry (NGLs)**
  - U.S. NGL production has increased 35 percent since 2008
- **Increase In NGL Production Has Created Both:**
  - Tremendous challenges for the industry to build new infrastructure
    - Processing plants, fractionators, pipelines, etc.
    - Ethylene crackers.
  - Significant regional dislocations

Monthly U.S. NGL Production From 2008-Current

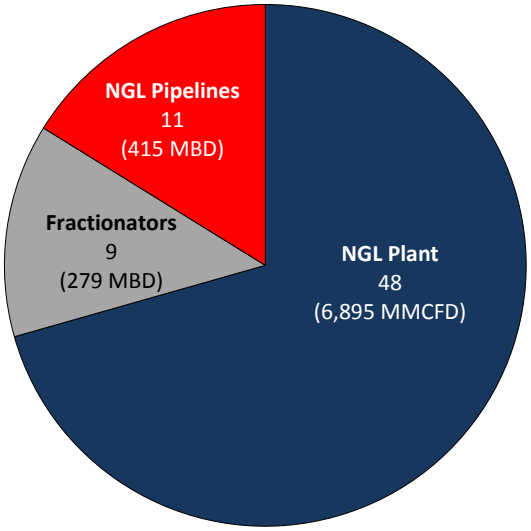


Source: EIA.

CHANGING INFRASTRUCTURE: MIDSTREAM SEGMENT

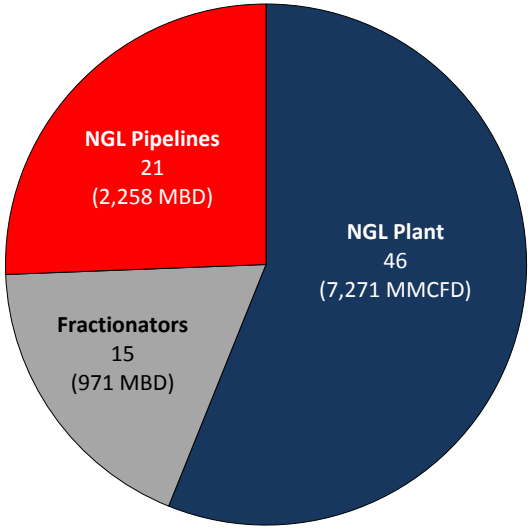
- **Midstream Industry Currently Undergoing A Period of Rapid Expansion**

Number of NGL Projects in 2012



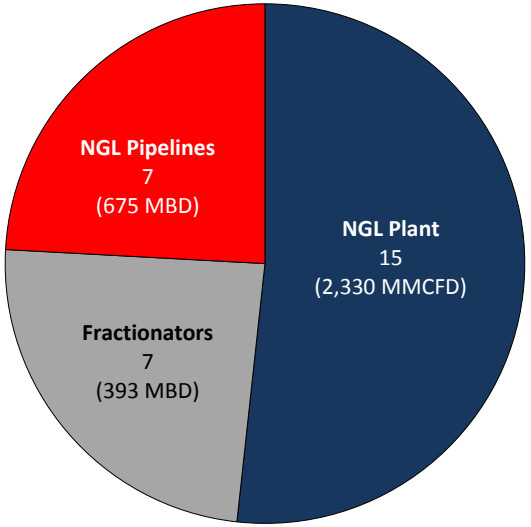
Total = 68

Number of NGL Projects in 2013



Total = 82

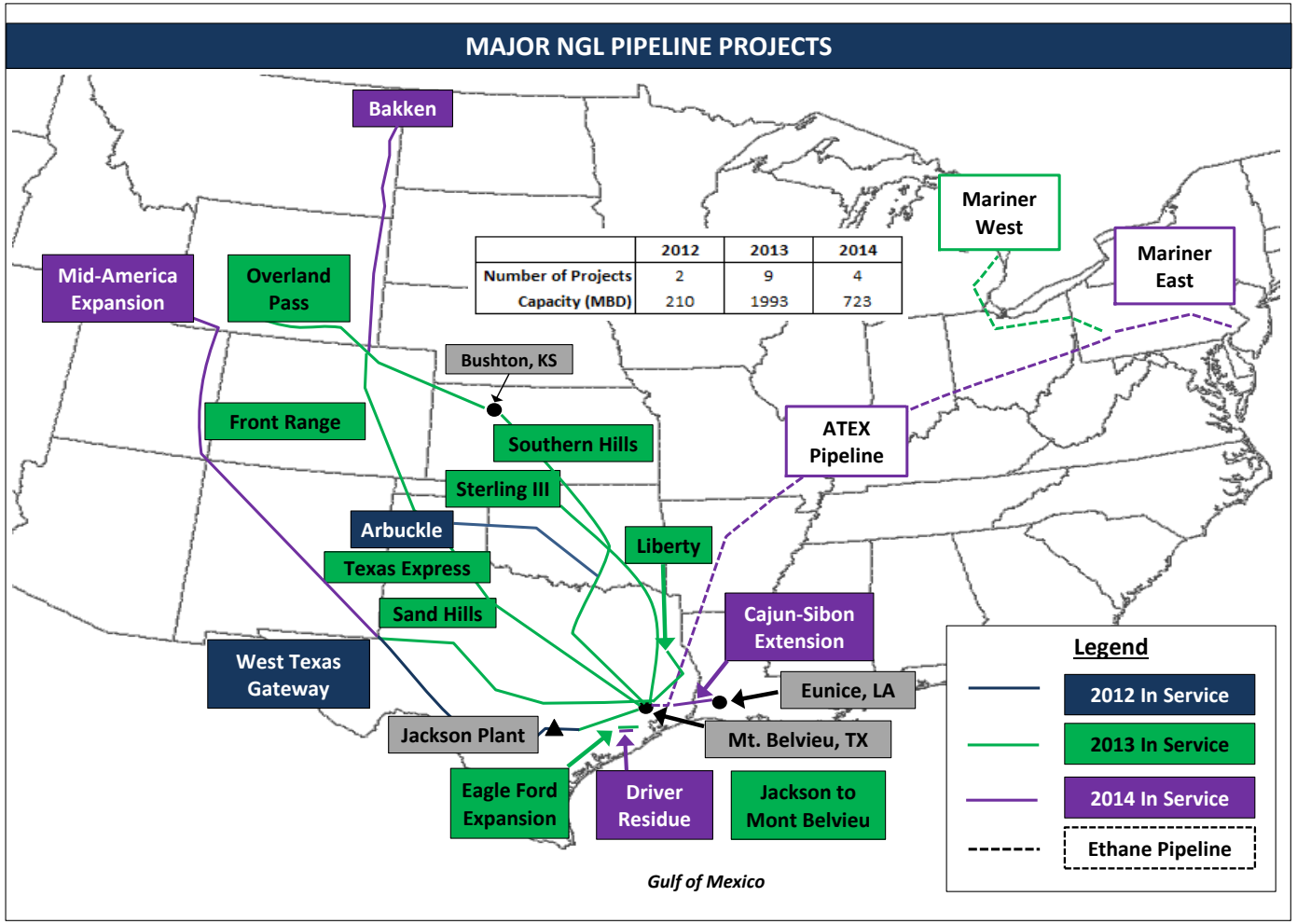
Number of NGL Projects in 2014



Total = 29

CHANGING INFRASTRUCTURE: NGL PIPELINES

- **Approximately 7,250 Miles Of New NGL Pipelines**
  - Until pipeline and related infrastructure expansions are completed expect regional dislocations and bottlenecked natural gas production



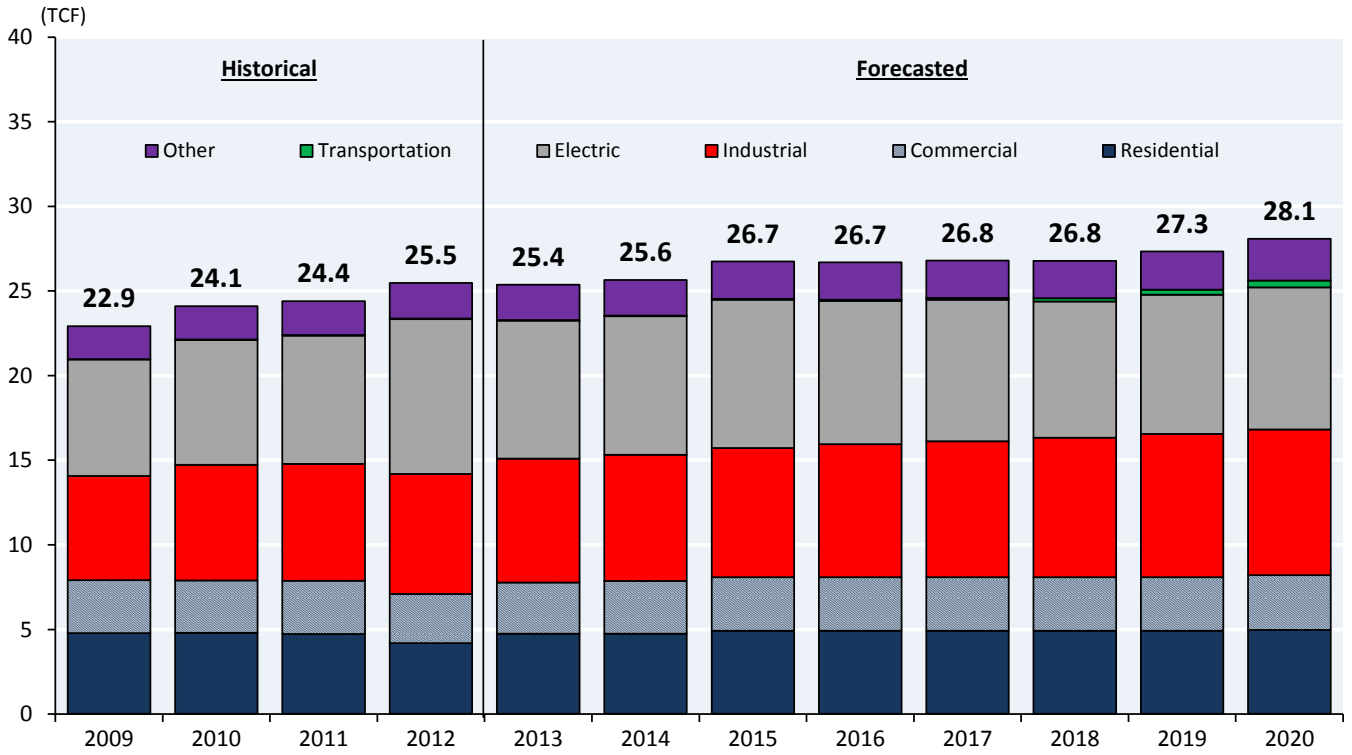
OUTLINE

- **Changing Supply Dynamics**
- **Changing Natural Gas Infrastructure**
- **Changing Demand Dynamics**
  - Growth in the industrial sector
  - Changes in the electric sector
  - Emergence of the transportation sector
- **LNG Exports**
- **Changing Price Outlook**

INTERMEDIATE-TERM PERSPECTIVE

- **Demand Is Increasing**
  - 1.9 percent per annum growth rate after 13 years of flat demand(1)
  - Growth in industrial, electric and transportation sectors
  - Residential and commercial sector demand primarily driven by changes in winter weather

HISTORICAL AND FORECASTED NATURAL GAS DEMAND

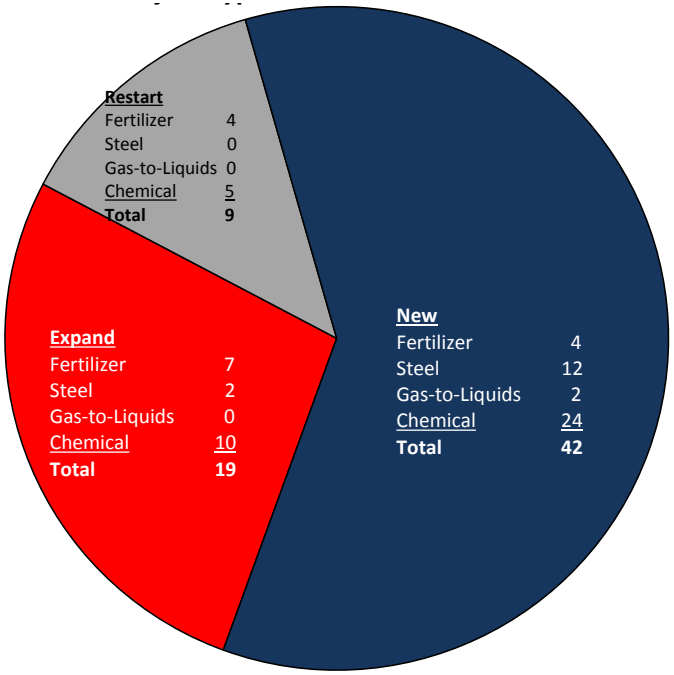


(1) For 13 years from 1996 to 2009 gas demand basically was flat.

INDUSTRIAL SECTOR

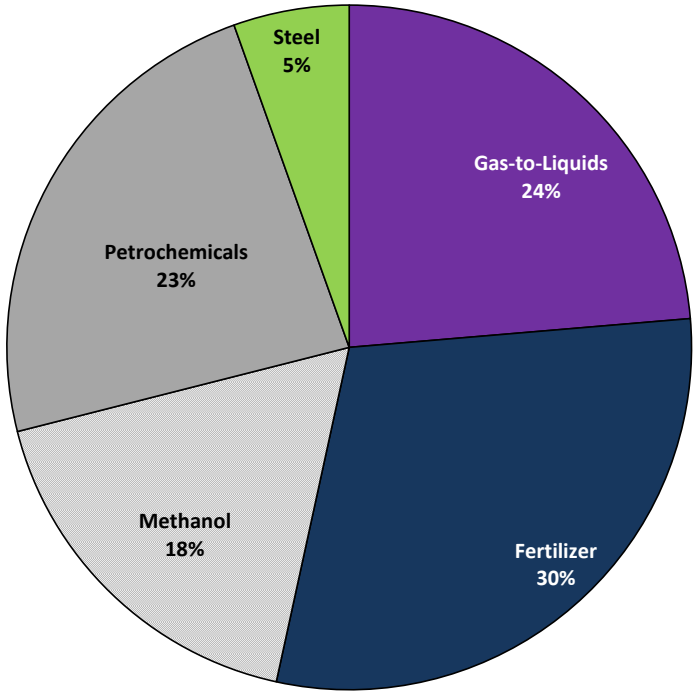
- **Key Industries**
  - Several industries have endorsed the concept of a long-term outlook for sustained low gas prices and are expanding capacity
    - Fertilizer, Steel, Chemicals and Gas-to-Liquids.
  - Wide variation in gas consumption between individual projects

Comparison Of Project Type Court For Various Industries



Total Projects = 70

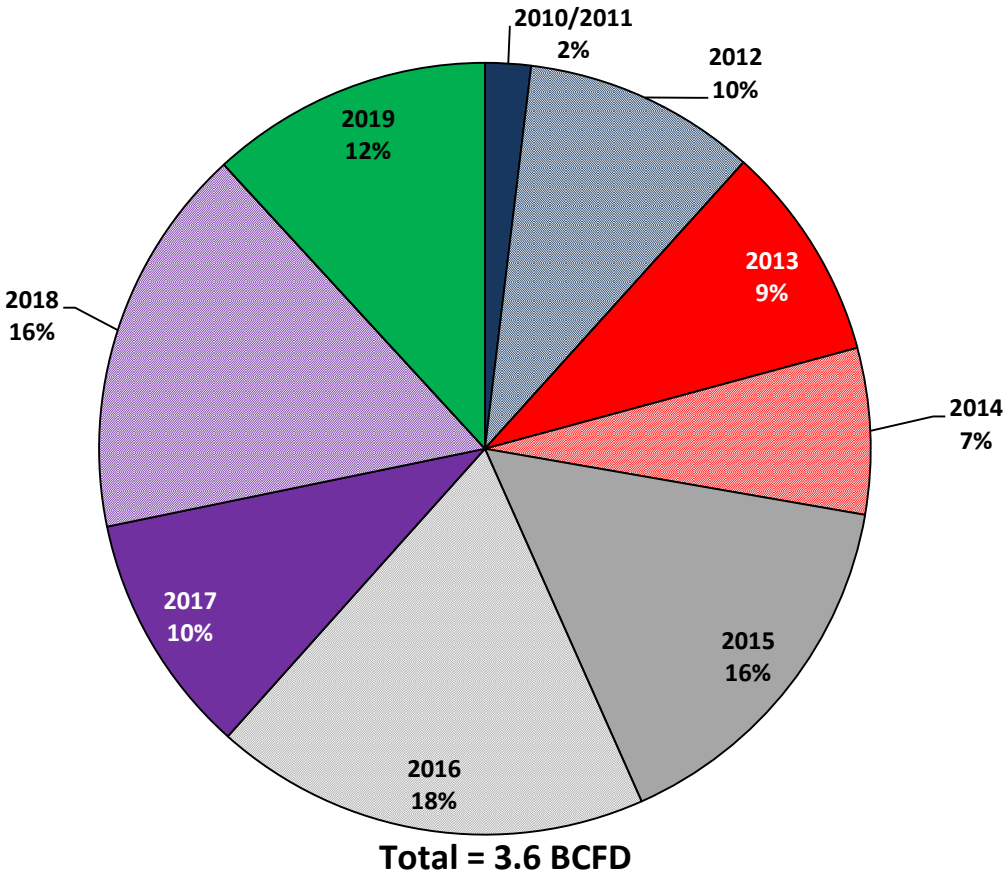
Impact Of Capacity Expansion On industrial Gas Demand



Total = 3.6 BCFD

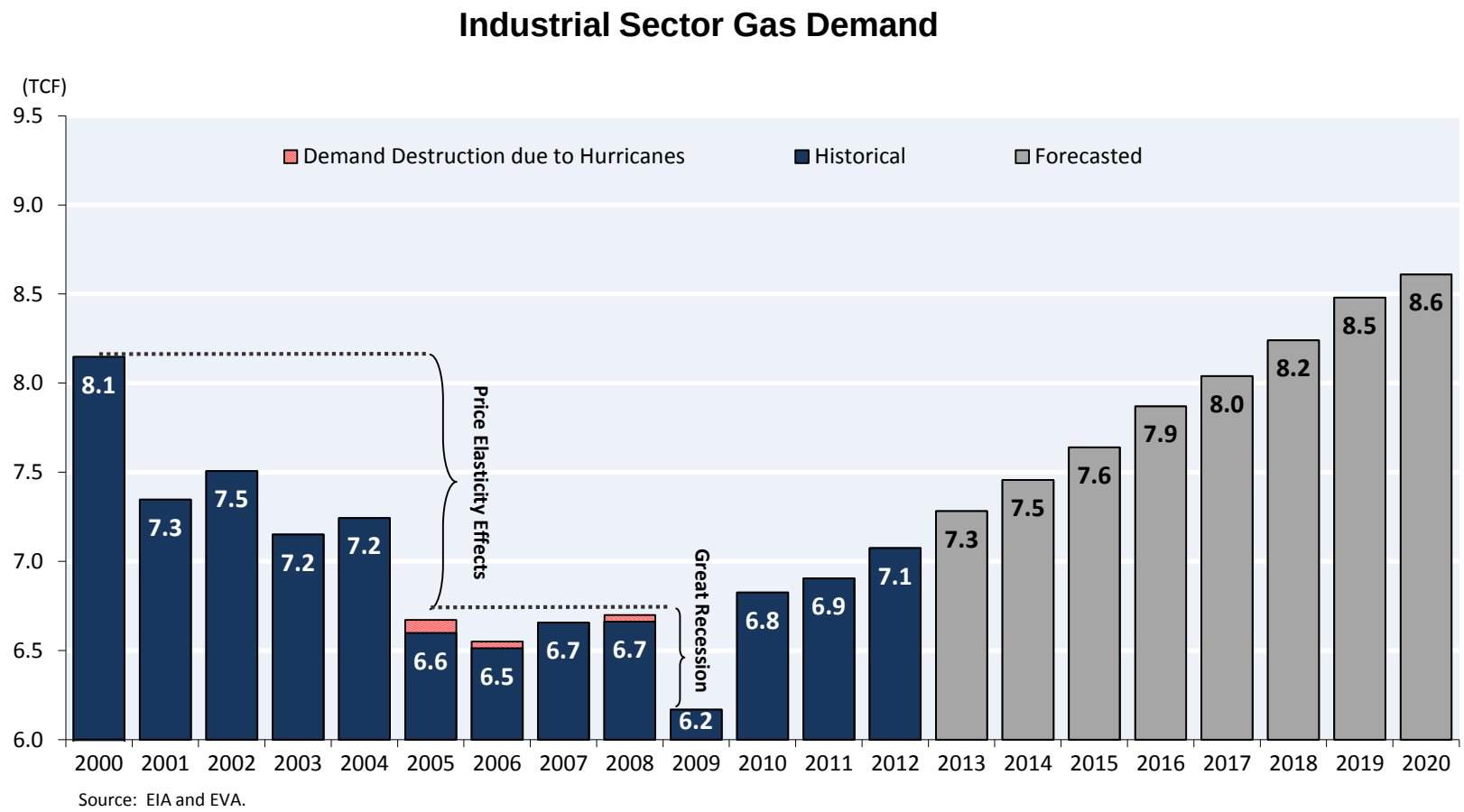
INDUSTRIAL SECTOR

Impact of Capacity Expansion on Industrial Gas Demand: By Year[(1)]



INDUSTRIAL SECTOR

- **Composite Assessment**
  - Likely exceed 2000 demand levels by 2020



Source: EIA and EVA.

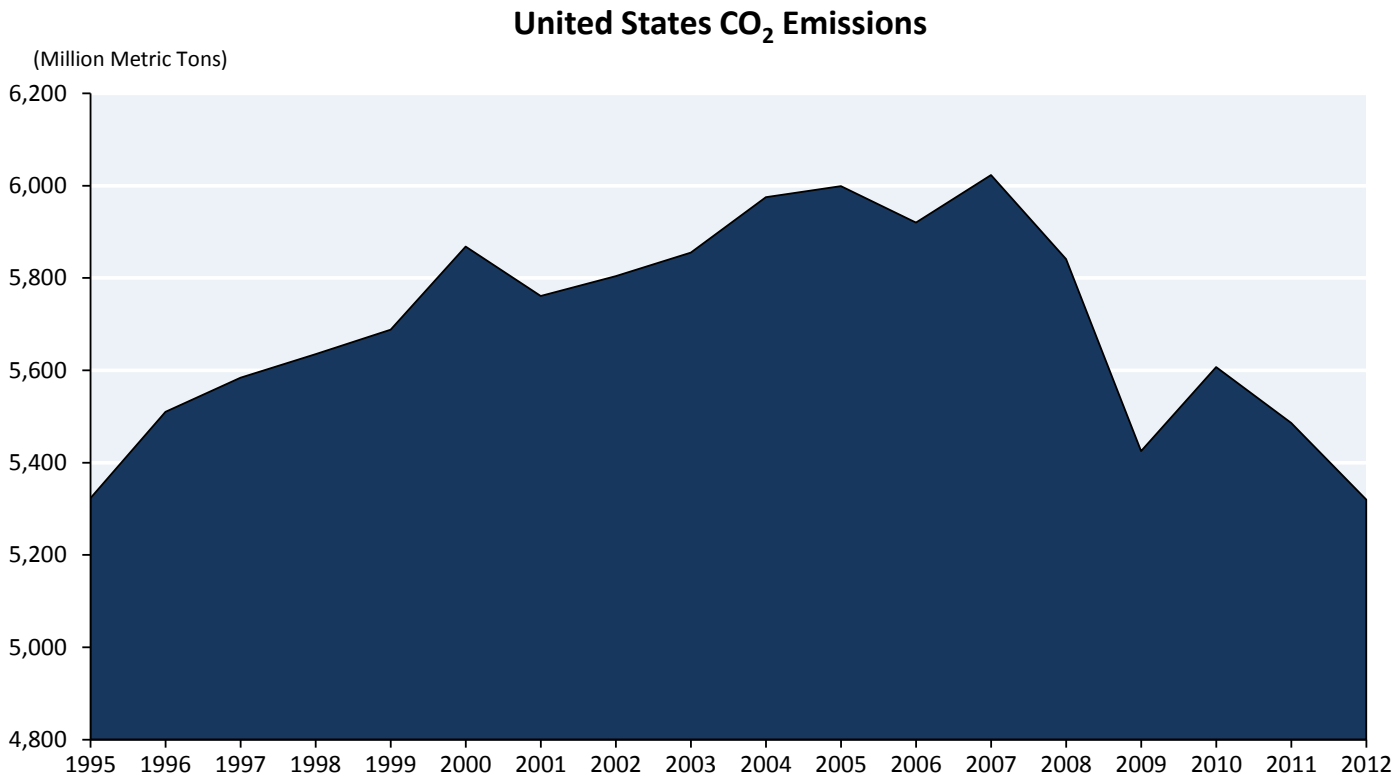
ELECTRIC SECTOR

- **Gas-Fired Generation Heavily Dependent Upon The Outlook For Other Types Of Generation**
  - Coal
    - Coal-to-gas fuel switching peaked in 2012 (6.1 BCFD).
      - Fuel switching is a key factor in lowering U.S. CO_2 emissions.
    - Coal plants retiring between 2012 and 2020 (63 GW or 22 percent of fleet).
  - Nuclear
    - New units online 2015 to 2020 (six units or 6.9 GW).
      - Offset by some recent retirements (four units or 2.6 GW).
  - Renewables
    - Nearly 70 percent of the states have mandates.(1)
    - Uncertainty over status of federal subsidies.
      - Impairs financing.
    - There are over 1,000 state level renewable subsidies.
  - Gas Capacity
    - Industry will add new combined cycle units (154 GW by 2020).
    - However, average capacity factor of fleet will decline.

(1) Qualification criteria for renewables varies significantly by state.

COAL-TO-GAS FUEL SWITCHING

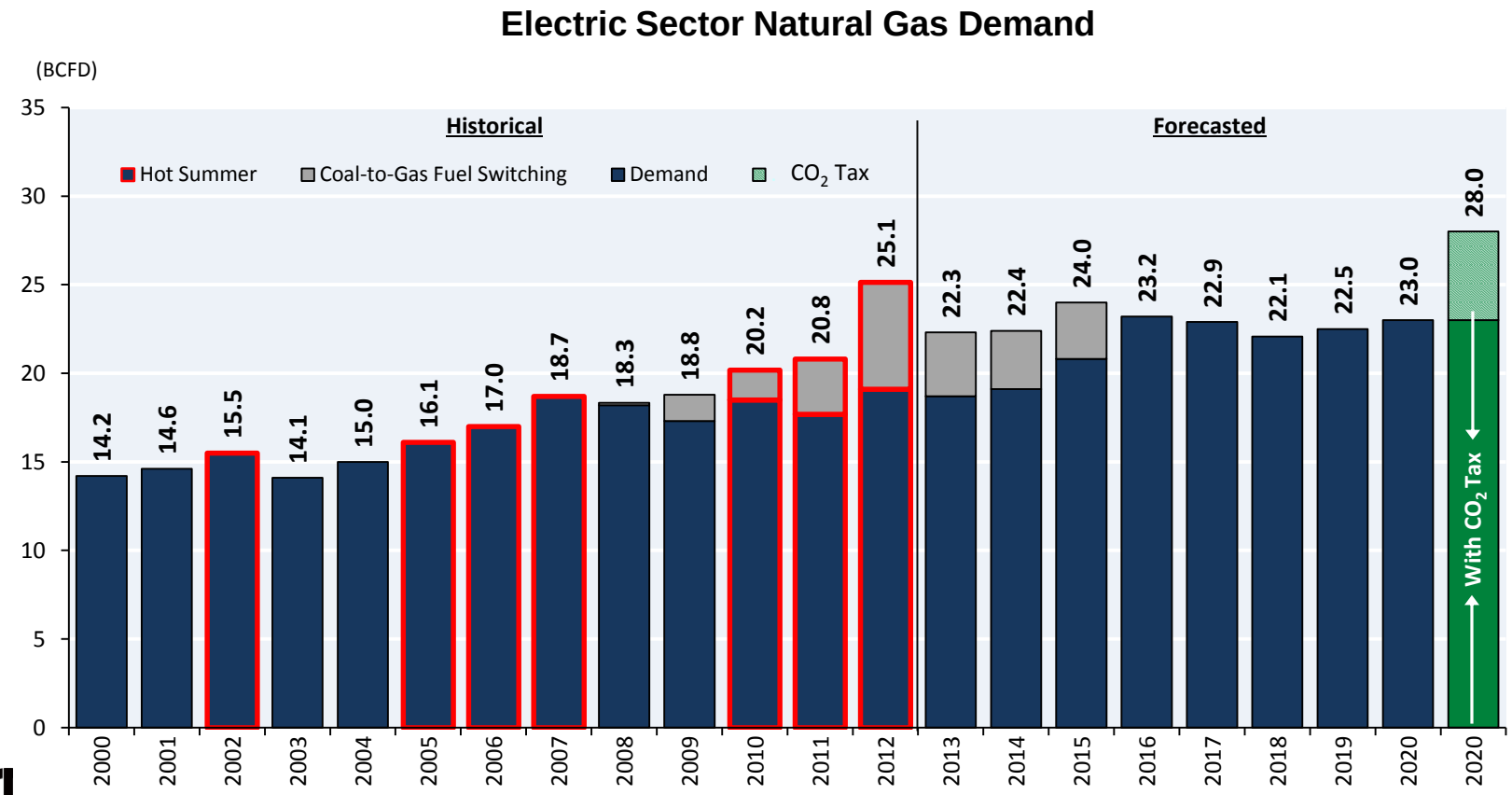
- **Key Impact Decline in U.S. CO_2 Emissions**
  - Back to early 1990s levels
  - May defuse immediate action by Congress on the issue for **environmental** reasons



Note: 2012 CO_2 emissions are estimated.
Source: EIA MER, STEO.

ELECTRIC SECTOR

- **Composite Assessment**
  - Growth continues but offset by decline in fuel switching as gas prices increase
  - Impact on new nuclear capacity significant



TRANSPORTATION SECTOR

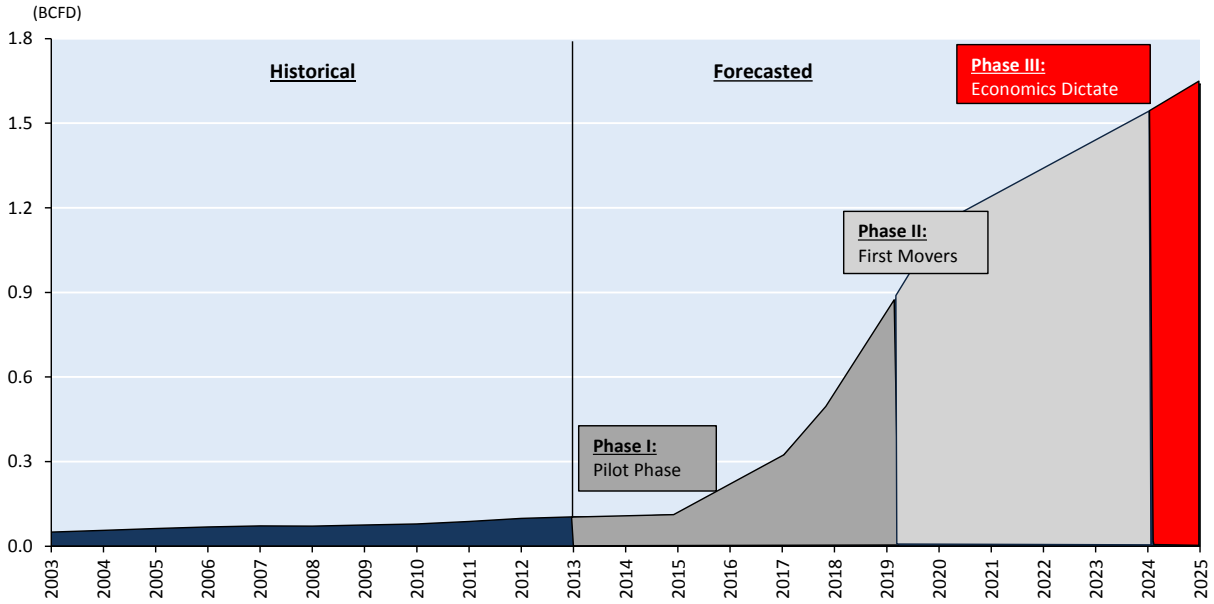
- **Growth Concentrated in Heavy Duty Vehicle Sector**
  - LDV: Significant penetration unlikely
    - Lack of refueling stations.(1)
    - Range and cost.
  - HDV: Likely significant penetration
    - Joint ventures without subsidies targeting semi-tractor trailer vehicles is key driver.
      - Clean Energy Fuels partnerships.
        - Goal is 150 stations in 33 states.
      - Shell/Travel Centers of America.
        - Goal is 100 locations with 200 fuel lanes.
      - Trillium CNG/AMP Americas.
        - Goal is I-65 and I-75.
      - Apache/Stripes convenience stores.
      - Questar/Swift Transportation/Central Freight Lines

(1) Less than 1,000 natural gas refueling stations in the U.S., with only about 50% open to the public. Represents 0.4% of all U.S. refueling stations.

TRANSPORTATION SECTOR

- For long-haul trucks focus is on specific interstate corridors (i.e., continuous Point A to Point B routes).
- Fleet vehicles, railroads and barges also converting.(1),(2)
  - Particularly the mileage intensive waste management fleet.
  - Others: UPS, Ryder Trucking, CNG buses.
- Favorable economics.(3)

Natural Gas Demand For The Transportation Sector



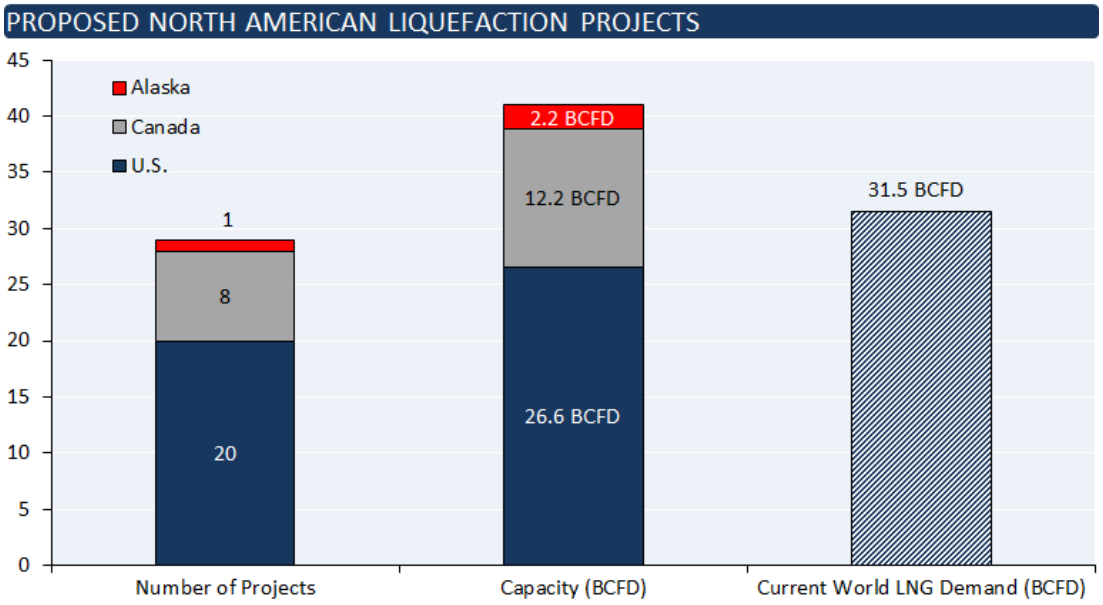
(1) Shell/Edison Chouest Offshore and Shell/Interlake Steamship Co. enter into agreements for inland water vessels.
(2) Taxi fleets in New York, Las Vegas, Baltimore, Pittsburgh, Columbus and Grand Rapids are converting some of their vehicles to natural gas.
(3) Long-haul trucks - three-year payback. Waste management trucks - 12-18 month payback. Assumes 3.91 per gallon diesel and $1.70 per diesel gallon-equivalent of LNG. Also, $65,000 to $75,000 higher costs for conversion or new natural gas engine.

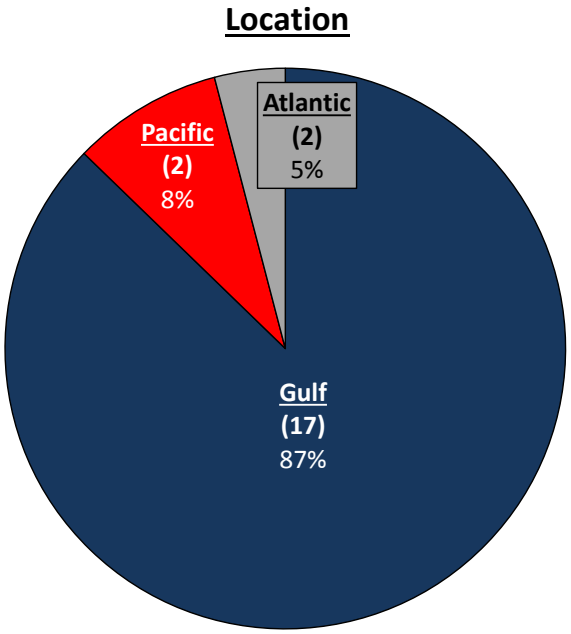
OUTLINE

- **Changing Supply Dynamics**
- **Changing Natural Gas Infrastructure**
- **Changing Demand Dynamics**
- **LNG Exports**
  - Lower-48 to start exporting LNG
- **Changing Price Outlook**

NORTH AMERICAN LNG: A FEW HIGHLIGHTS

- **29 Liquefaction Projects Proposed (41 BCFD)**
  - Equals 130 percent of global LNG demand
- **Lower-48 Exports To Start In 2016**
  - Two projects to proceed (Sabine Pass (TX) and Elba Island (GA))
    - Very debatable for remaining projects
  - 87% of U.S. capacity located in the Gulf
  - 50% brownfield, 32% greenfield and 18% floaters
  - Intense global competition for available market(1)





Note: Percentages are based on capacity (26.7 BCFD).
Number in parenthesis represents the number of projects.

Footnote:

1. 31 viable liquefaction projects (27.4 BCFD) elsewhere in the world, with 23 earmarked for the Asian market (24 BCFD).

NORTH AMERICAN LNG

- **Only 29 Percent Of U.S. Capacity Has Contract Commitments**
  - Not all MOUs are binding

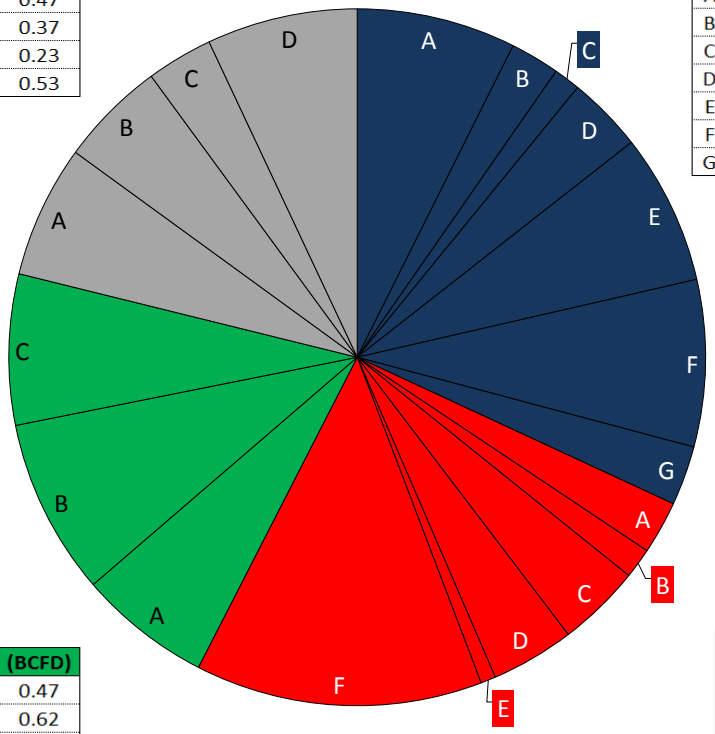
U.S. LNG COMMITMENTS TO DATE (BCFD) (1)

	All Other Countries	(BCFD)
A	Spain- Fenosa	0.47
B	Korea- Kogas	0.37
C	UK- Centrica	0.23
D	Pakistan - Sarwarzad	0.53

All Other Countries
1.6 BCFD
21%

	Major LNG Firms	(BCFD)
A	British Gas	0.56
B	British Gas	0.17
C	Total	0.09
D	Total	0.27
E	GDF Suez	0.53
F	British Petroleum	0.59
G	Shell	0.21

Major LNG Firms
2.4 BCFD
32%



	India	(BCFD)
A	India- Gail	0.47
B	India- Gail	0.62
C	India - Petronet	0.53

India
1.6 BCFD
21%

Total = 7.6 BCFD

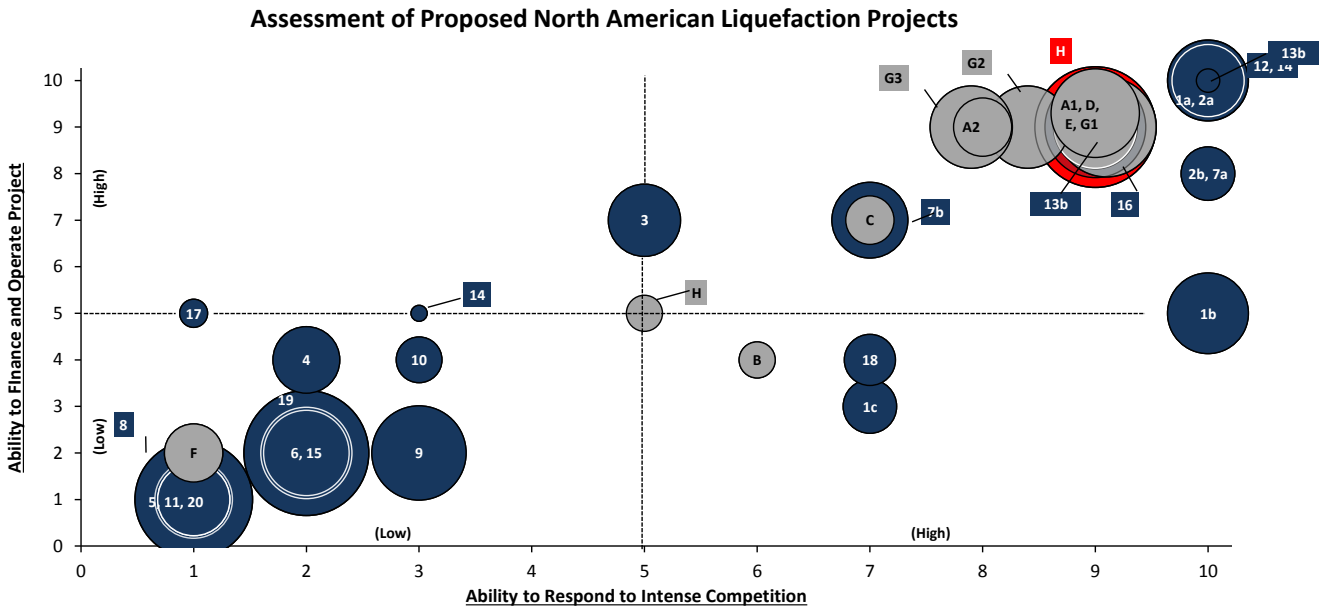
	Japan	(BCFD)
A	Sumitomo/Tokyo Gas	0.19
B	Sumitomo/Kansai Elec	0.11
C	Chubu Gas	0.29
D	Osaka Gas	0.29
E	TEPCO	0.05
F	Mitsubishi & Mitsui	1.01

Japan
1.9 BCFD
26%

Note:
1. In general, no destination clauses.

NORTH AMERICAN LNG

- **Some Proposed Projects Are More Competitive Than Others**



I. U.S. Lower 48 States			
1a	Sabine Pass LNG Phase I	9	Corpus Christi LNG
1b	Sabine Pass LNG Phase II	10	Port Lavaca (Floater)
1c	Sabine Pass LNG Phase III	11	CE LNG (Floater)
2a	Cameron LNG Terminal-Phase I	12A	Elba Island-Phase I
2b	Cameron LNG Terminal-Phase II	12B	Elba Island-Phase II
3	Cove Point	13	SB Power Solutions
4	Jordan Cove Energy	14	Gulf LNG Clean Energy
5	Oregon LNG	15	Golden Pass
6	Lake Charles	16	Waller LNG
7a	Freeport LNG-Phase II	17	Magnolia LNG-Phase I
7b	Freeport LNG-Phase I	18	Main Pass Energy Hub
8	Gulf Coast LNG Export	19	South Texas LNG Export

II. U.S. Alaska	
I	Valdez, AK

III. Canada	
A1	Kitimat LNG Phase I-II
A2	Kitimat LNG Phase III
B	Douglas Channel LNG/BC LNG Export Co-op
C	Penn West LNG
D	Pacific Northwest LNG
E	LNG Canada
F	Golboro LNG
G1	BG LNG Terminal-Phase I
G2	BG LNG Terminal-Phase II
G3	BG LNG Terminal-Phase III
H	Atlas Gas

Note: Projects with green shading indicate transportation cost advantage.

NATURAL GAS PRICES

- **Two Challenging Questions**

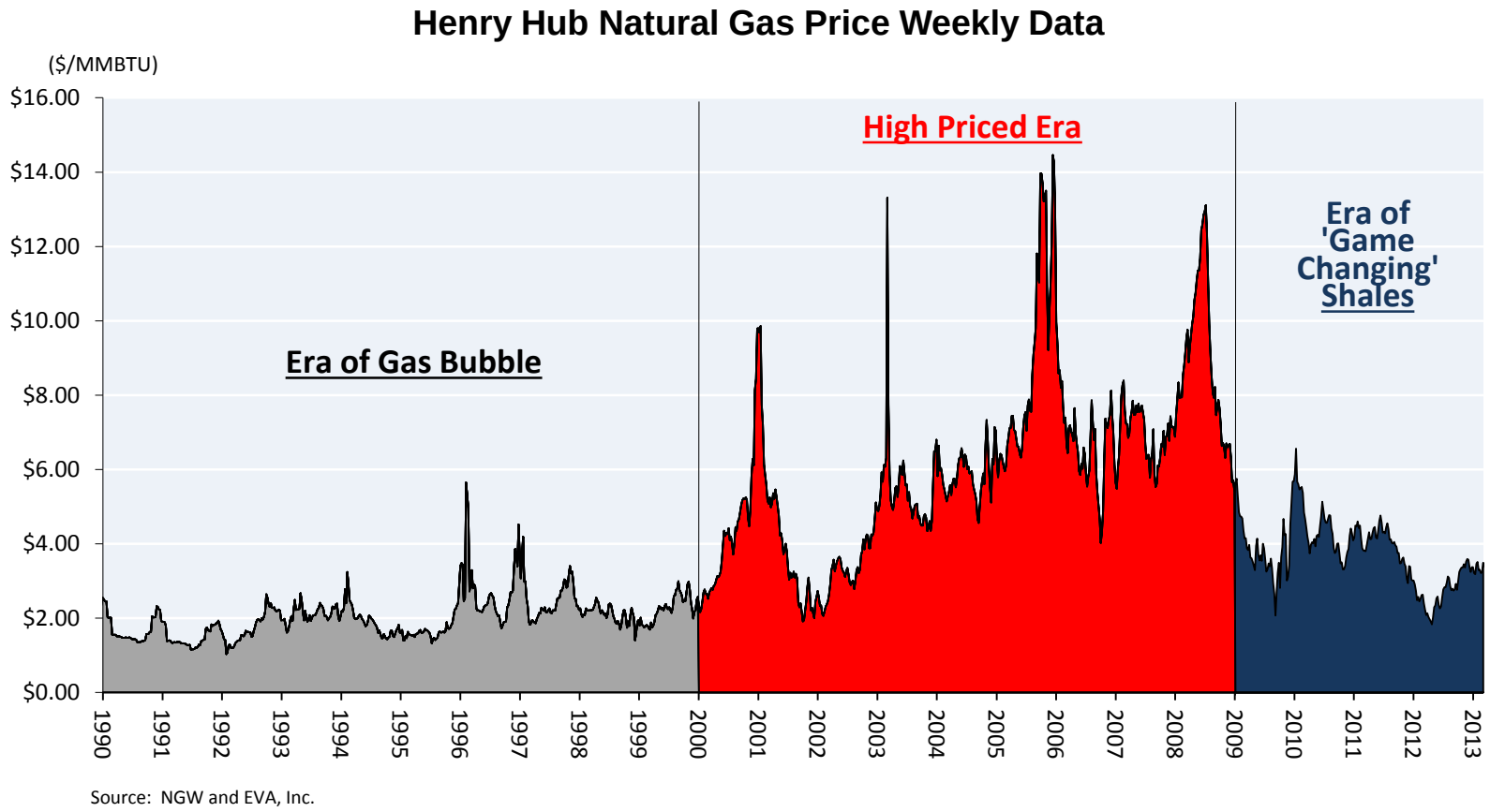
  - For U.S.: What is the long-term outlook for gas prices
    - Prices will increase from 2012 levels, but how much?
    - Is the current era of low gas prices sustainable?

  - Global Question: Will LNG lead to a single gas price throughout the world?
    - What are the key drivers?
    - What are the key impediments?
    - How long before such a transition could occur?

Topic For Another Presentation

NATURAL GAS PRICE

- **New Era For North American Gas Market**
  - Lower gas price regime with reduced price volatility(1)



Source: NGW and EVA, Inc.

(1) Job openings for commodity traders, particularly natural gas traders, declined 49 percent in 2012. At present there are 13 applicants for every 3 commodity trader openings.

FINAL NOTE

If You Want More Information Consult The Following:

- **U.S. Supply**
  - EPRI, *Natural Gas and Power in the Marcellus Super-Region: Regional and National Implications (1024068)*, November 2012
  - EPRI, *Impact on Environmental Issues on Shale Gas Supply ( )*, November 2012
  - EPRI, *Impacts of the Power Sector in Natural Gas Markets Under Climate Change ( )*, December 2009
  - EPRI, *New Era of Natural Gas Capability: Technical Briefing on Shale Gas Economics or "Breakeven" Prices*, September 2011
- **Infrastructure**
  - EPRI, *Natural Gas and Power in the Marcellus Super-Region: Regional and National Implications (1024068)*, November 2012
  - EPRI, *Market Impacts of Changing Natural Gas Infrastructure (015703)*, October 2008
  - EPRI, *U.S. Natural Gas Infrastructure: Continuing Pipeline Expansion*, December 2010

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- **U.S. Demand**
  - EPRI, *Tracking Power Plant Development: Gas and Wind Dominate Industry Capacity Plans,* September 2012
  - EPRI, *The Build-Up of Natural Gas Demand*, October 2012
- **LNG**
  - EPRI, *Impacts of Power Sector on Natural Gas Markets Under Climate Change*, ( ), December 2009
  - EPRI, *Global Natural Gas Market Analysis (1014921),* February 2008
  - EPRI, *Putting LNG into Perspective on a Global Basis (1013693),* July 2006