Outlook for Natural Gas and CO_2 Infrastructure
Recent Studies and Analysis

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Recent INGAA Infrastructure Studies

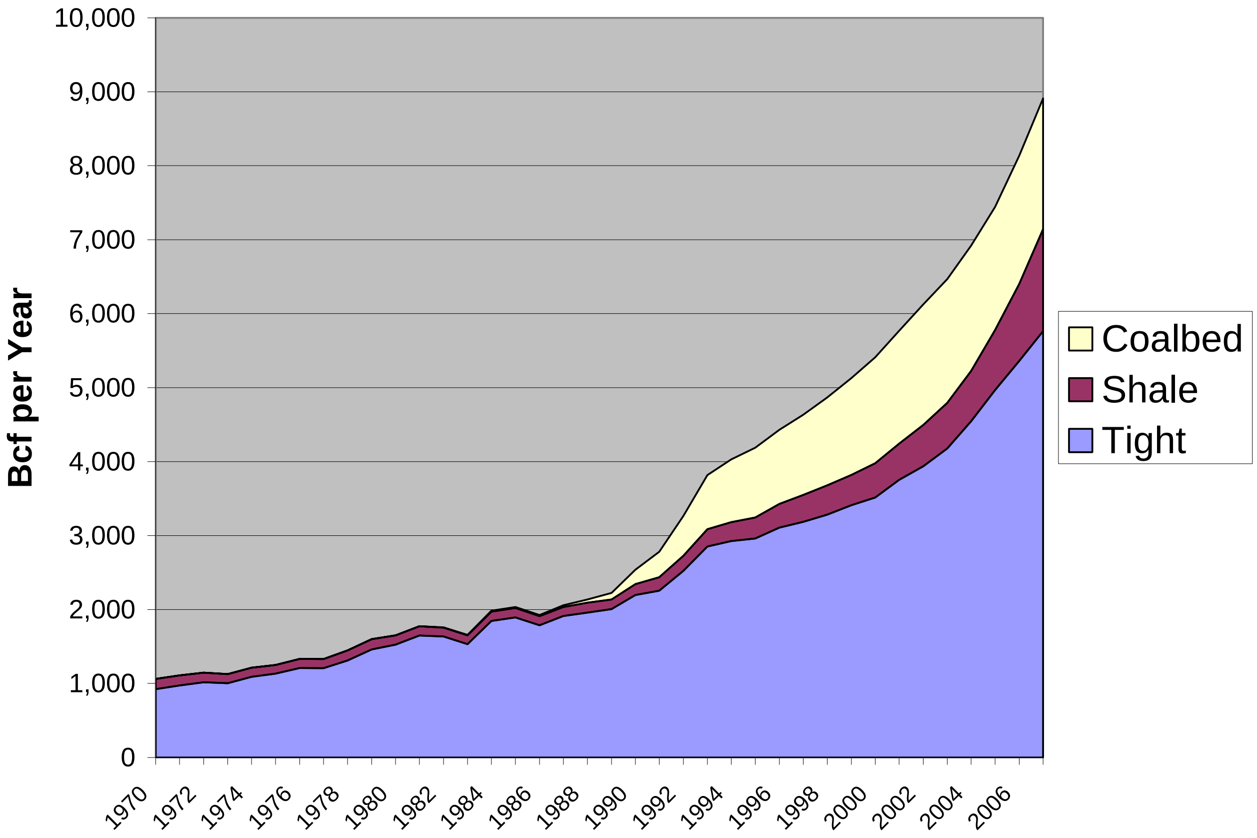
- **Natural Gas**
  - *Availability, Economics, and Production Potential of North American Unconventional Natural Gas Supplies –* **November 2008**
  - *Natural Gas Pipeline and Storage Infrastructure Projections Through 2030 –* **October 2009**
- **CO_2**
  - *Developing a Pipeline Infrastructure for CO2 Capture and Storage: Issues and Challenges –* **February 2009**

Unconventional Gas Supplies

- Driver of future North American natural gas production.
  - Changes in production (location or volume) drive infrastructure needs.
- Definition
  - Relative to conventional supplies - Unconventional natural gas resources are lower in resource concentration, are more dispersed, and require well stimulation or other technologies to produce.
- Most common types:
  - Tight (sandstone or carbonate)
  - Shale
  - Coal bed methane

Historical U.S. Unconventional Gas Production

Strong Production Growth since the Mid-1990s



Total U.S. Natural Gas Reserves / Resource

Trillion Cubic Feet
EIA Form-23 Reports

Year	Starting Reserves	Production	Net Reserve Additions	Ending Reserves
2000	158	19	29	168
2001	168	19	26	175
2002	175	19	22	178
2003	178	19	22	181
2004	181	19	22	184
2005	184	18	30	196
2006	196	18	23	201
2007	201	19	44	226

Total U.S. reserves are increasing each year.

	Proven Reserves	Unproved Plus Discovered Undeveloped	Total Remaining Resources	Shale Assessment*
Alaska	8.2	294.4	302.6	0.0
West Coast Onshore	3.1	26.5	29.6	0.3
Great Basin	1.0	3.7	4.7	0.0
Rockies	59.5	235.0	294.5	15.7
West Texas	21.4	133.3	154.7	92.2
Gulf Coast Onshore	44.6	257.1	301.6	90.0
Mid-continent	28.3	234.2	262.5	168.2
Eastern Interior	19.7	331.6	351.2	262.4
Gulf of Mexico	17.7	299.7	317.4	0.0
U.S. Atlantic Offshore	0.0	39.0	39.0	0.0
U.S. Pacific Offshore	0.9	24.0	24.0	0.0
WCSB	56.9	316.0	372.9	166.2
Arctic Canada	0.0	71.0	71.0	0.0
Eastern Canada Onshore	0.5	12.8	13.3	7.0
Eastern Canada Offshore	0.5	83.0	83.5	0.0
Western British Columbia	0.0	10.9	10.9	0.0
US	204.4	1,878.4	2,082.8	628.8
Canada	57.9	493.6	551.5	173.2
North America	262.3	2,372.0	2,634.3	802.0

*Portion of total resource

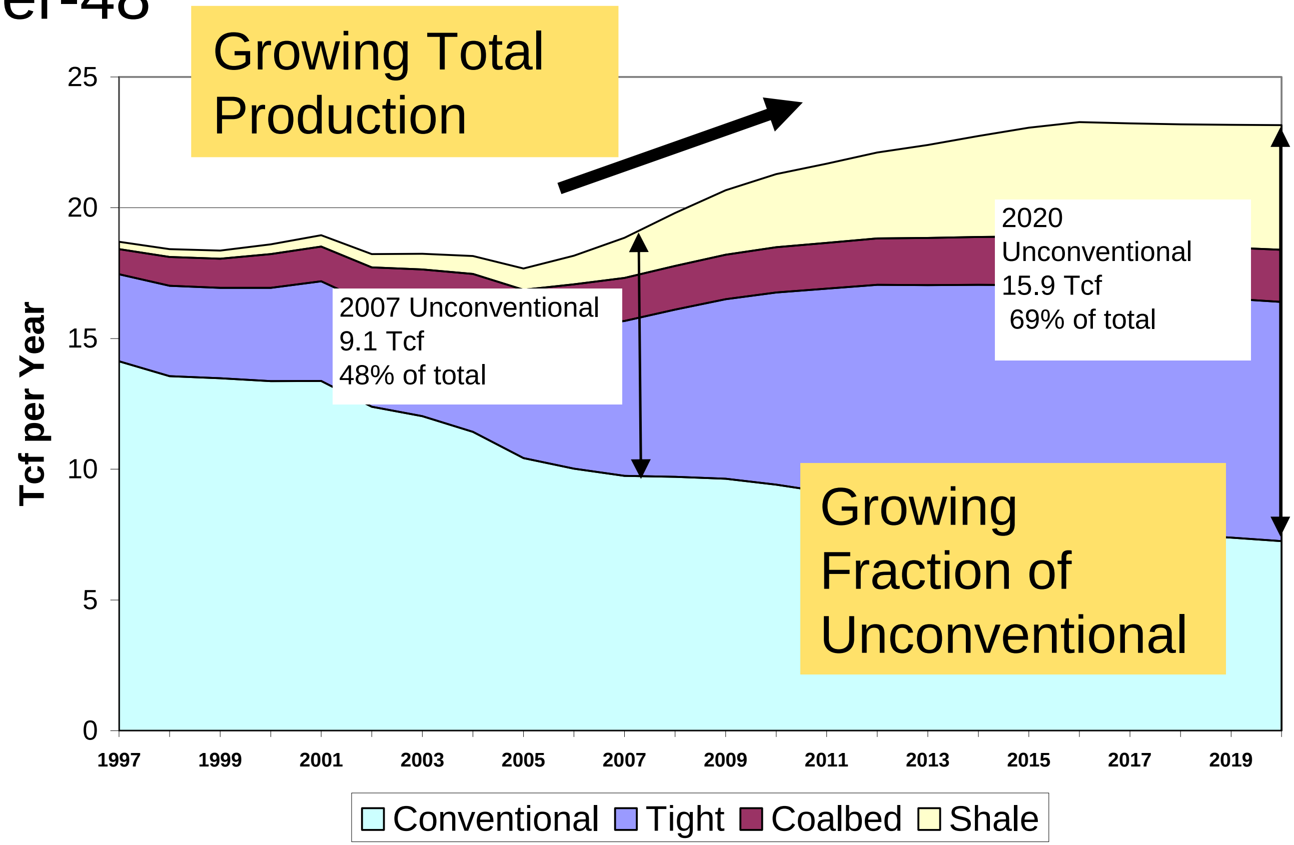
There is a lot of natural gas remaining.

100 years of current production

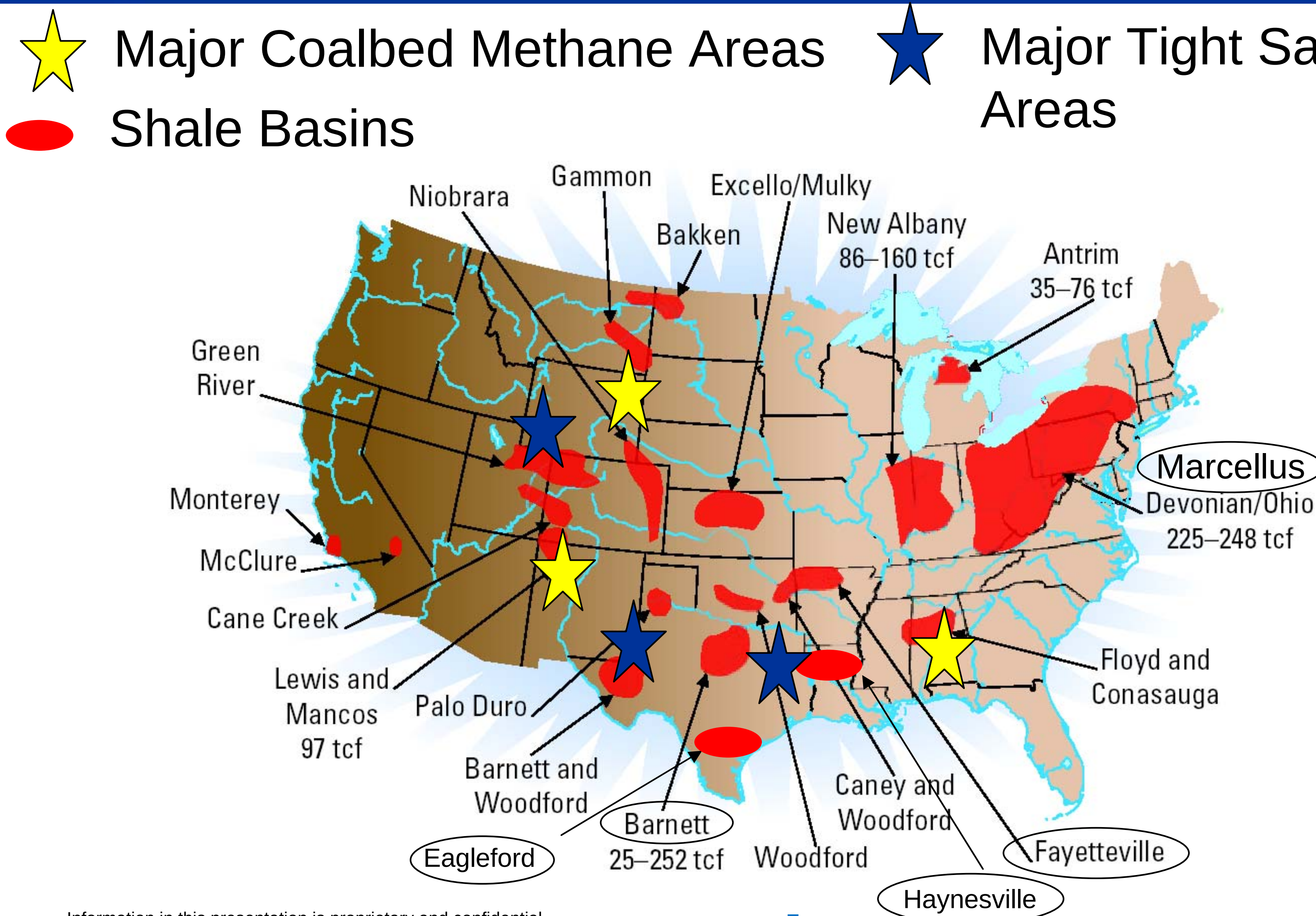
Unconventional Fraction of U.S. Gas Production

Unconventional production growth projected to continue

U.S. Lower-48



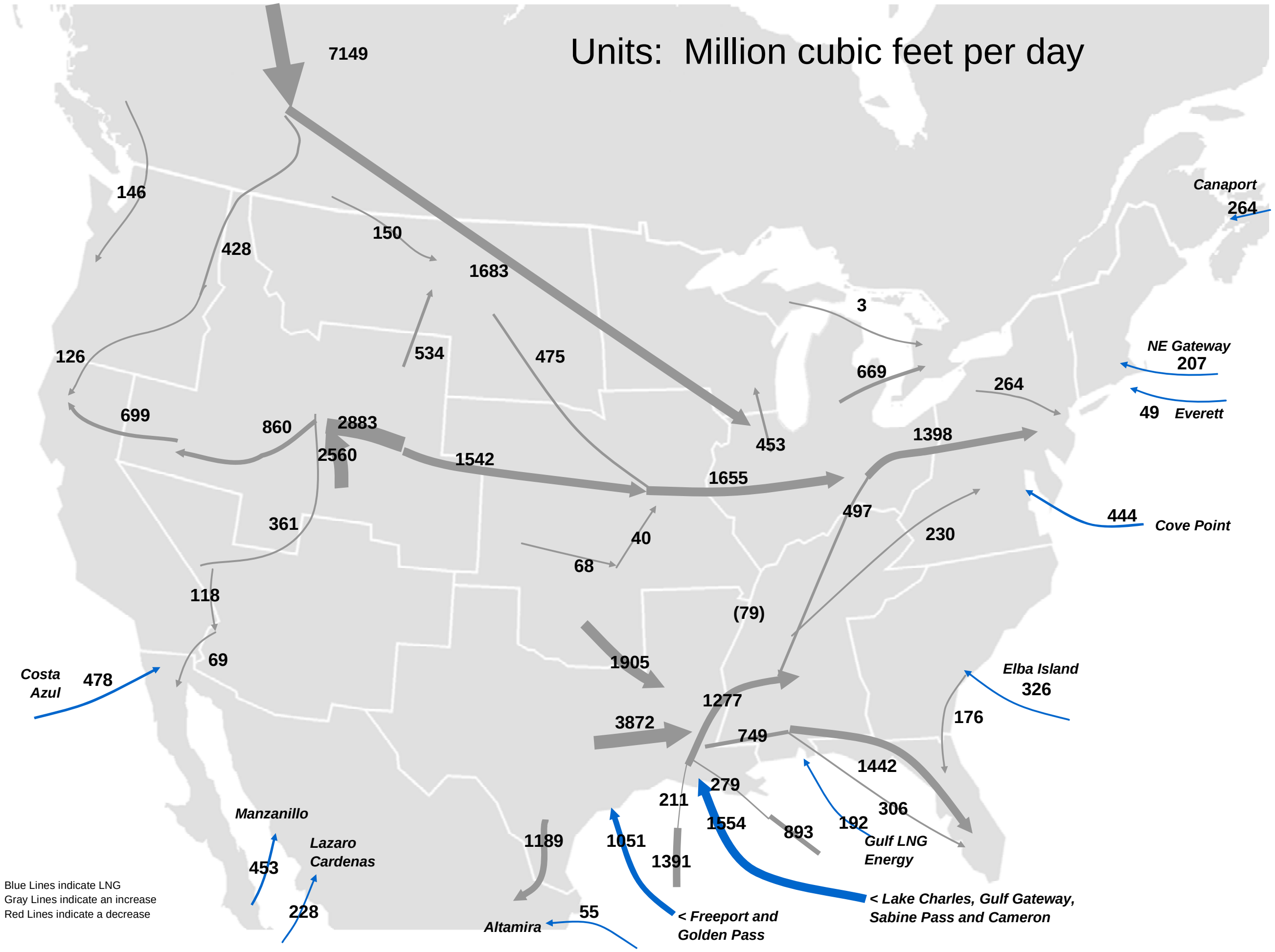
Unconventional Resources are Widespread



Increases in Interregional Flow, 2008 to 2030

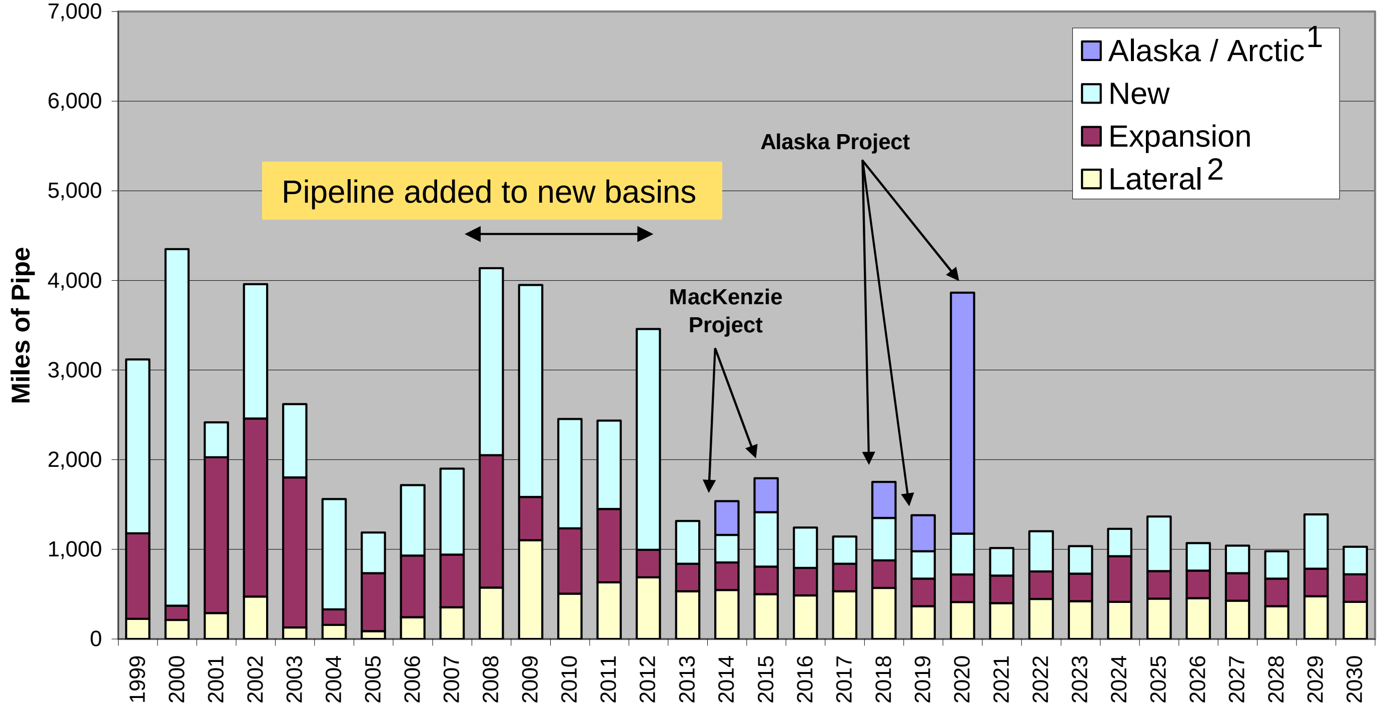
INGAA Base Case – Infrastructure Report

- Increases in interregional flow mainly driven by shifting gas supply locations.
- New pipeline infrastructure will be needed to make the incremental transport possible.



Base Case Miles of New Pipeline

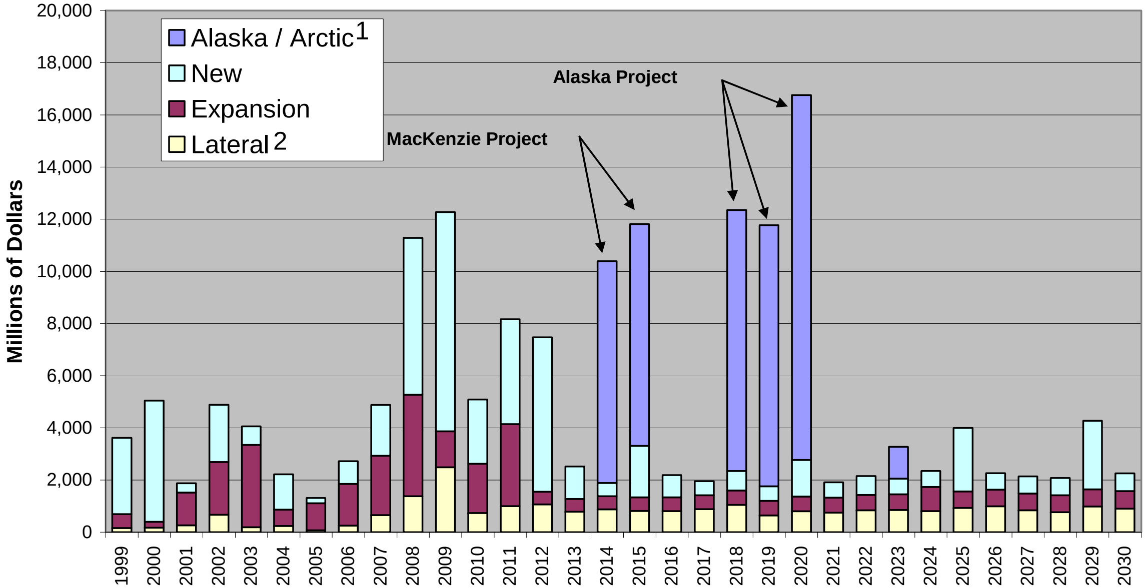
Pipeline Mileage Added Each Year



- From 2009 through 2030, about 1,700 miles of gas transmission pipeline will be added each year. These additions are fairly consistent with recent levels.
- Construction of laterals will likely account for a greater share of the incremental mileage in the future. Much of the new pipeline in the future is likely to rely on and add to recently built projects.
- Arctic projects and associated downstream pipes account for 5,000 miles of new pipeline.

Capital Expenditures for New Pipeline Capacity

Million Dollars (Nominal$) Spent Each Year, Including the Cost of Compression



[1] Includes cost of downstream expansions on existing corridors in the U.S. and Canada in addition to the cost of arctic Canada and Alaska frontier projects.

[2] Lateral is defined as a spur off the main transmission line, normally used to connect production, storage, power plants, LNG terminals or isolated demand centers.

- From 2009 through 2030, the annual expenditures will average about $6 billion.
  - Somewhat above recent expenditures that have averaged $4 to $5 billion per year.
- Arctic pipeline projects will account for 30 to 40 percent of the total expenditures over the period.
  - Without the Arctic projects, expenditures would only average $3 to $5 billion per year, more closely aligning with recent averages.

Summary of Pipeline and Storage Development
From 2009 Through 2030

Base Case

U.S. and Canada Gas Market Growth (Trillion Cubic Feet)	+4.9 (+18%)
Interregional Gas Transport Capability (Billion Cubic Feet Per Day)	+25 (+20%)
Storage Working Gas Capacity (Billion Cubic Feet)	+453 (+10%)
Added Pipeline Mileage	37,700 Total Miles *1,700 Miles Per Year*
Added Horsepower of Compression for Pipelines	8.1 Million HP *370,000 HP Per Year*
Capital Expenditures for New Pipeline and Storage Capacity	~ $135 Billion *~ $6 Billion Per Year*

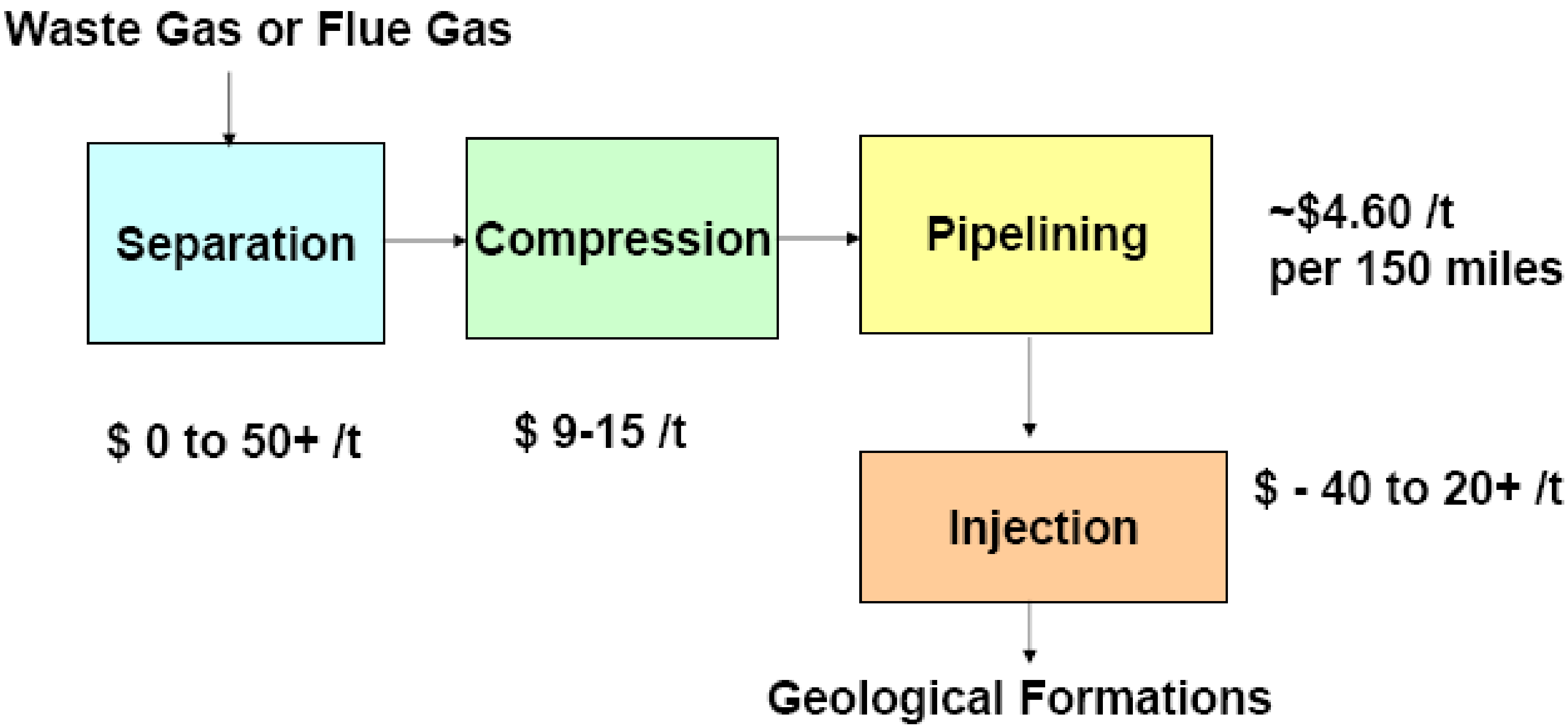
Other Midstream Development
From 2009 Through 2030

Base Case

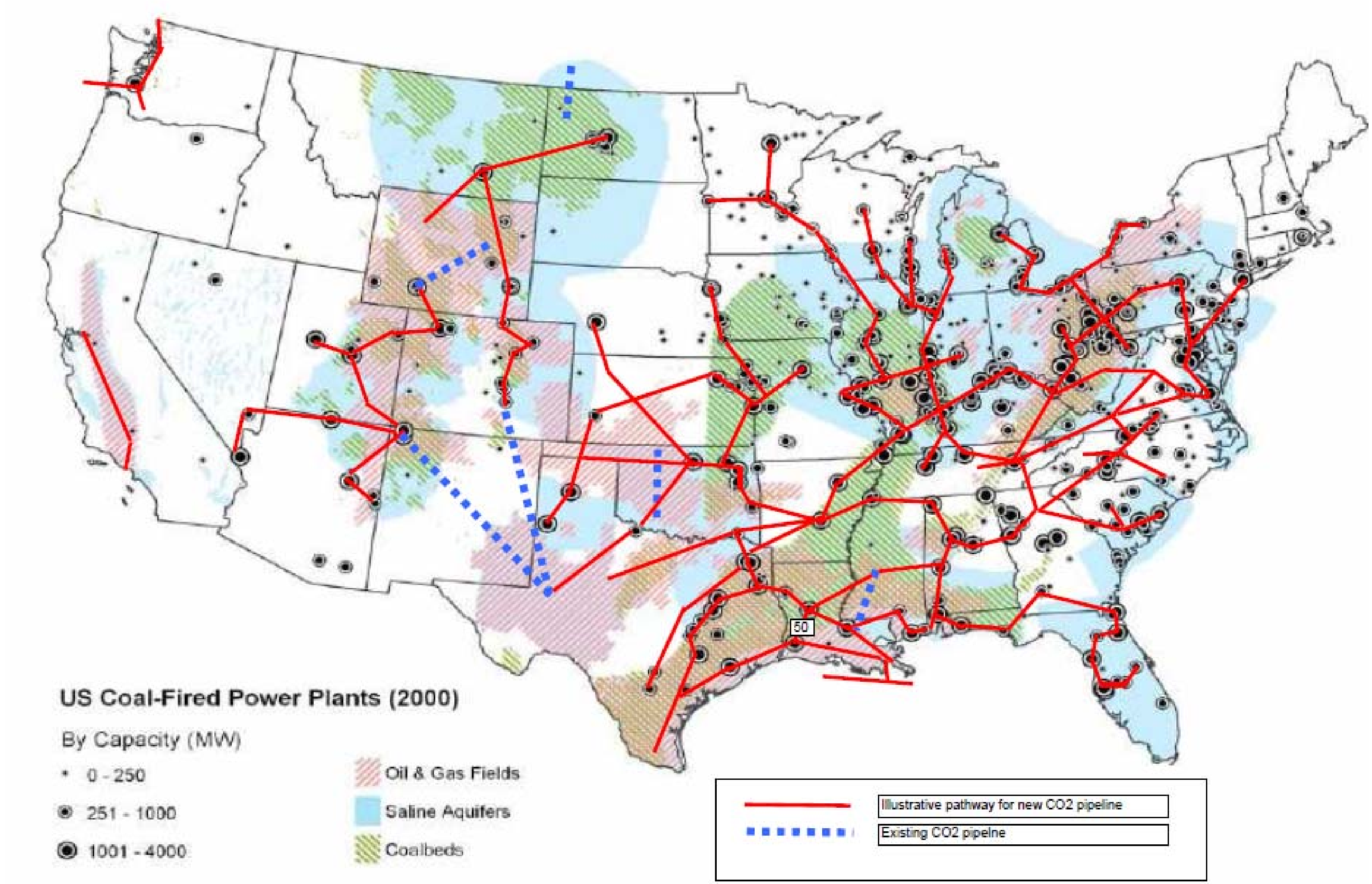
Gathering Line Mileage	+18,200 miles	$13.8 Billion
Gas Processing Capacity	+15.6 Bcfd	$10.1 Billion
LNG Import Capacity	+3.0 Bcfd	$1.5 Billion

Capital Expenditures for All Midstream Infrastructure Development for the INGAA Base Case was $160 Billion from 2009 through 2030.

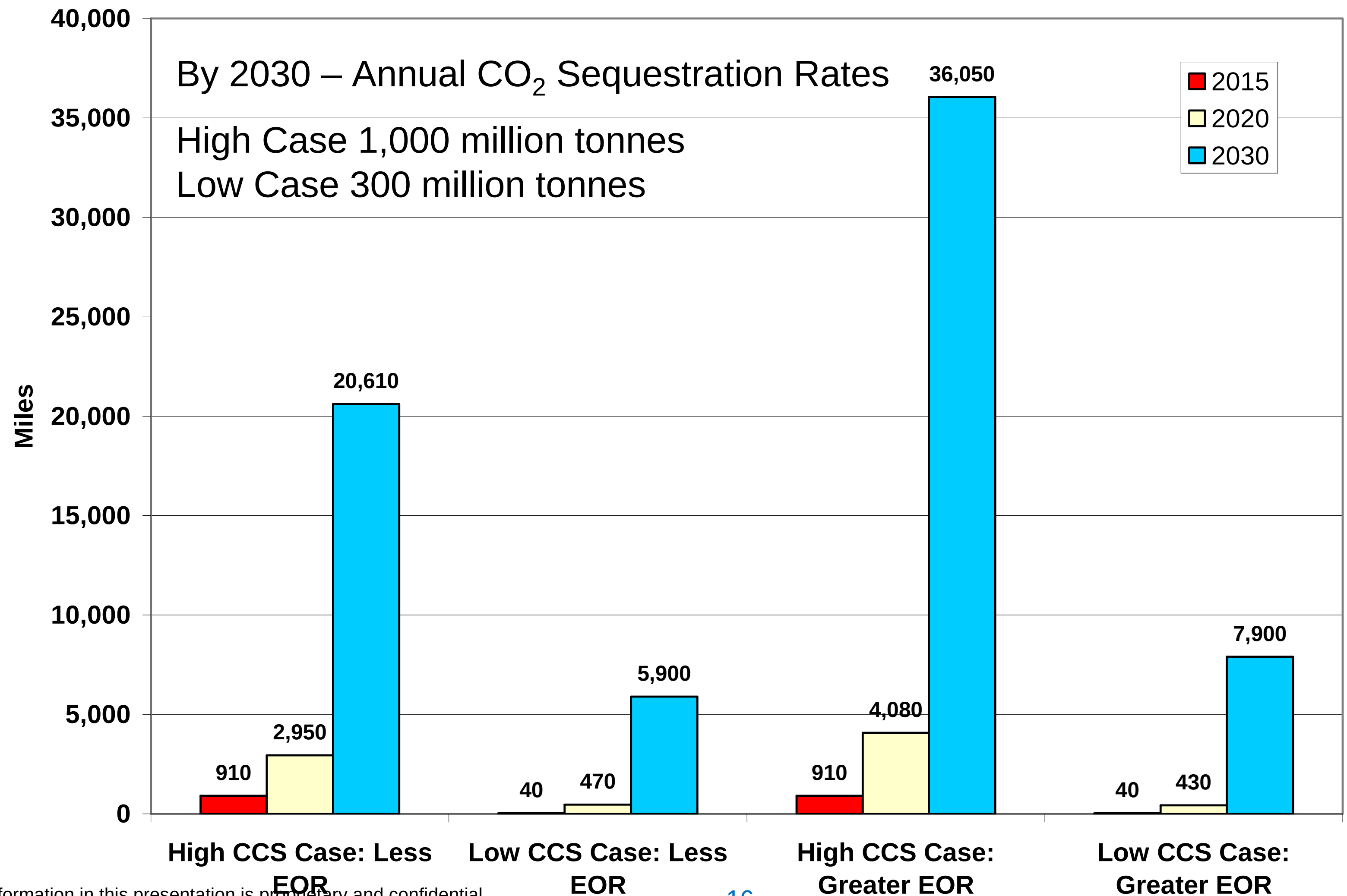
CO_2


Waste Gas or Flue Gas
Separation
Compression
Pipelining
~$4.60 /t
per 150 miles
$ 0 to 50+ /t
$ 9-15 /t
Injection
$ - 40 to 20+ /t
Geological Formations

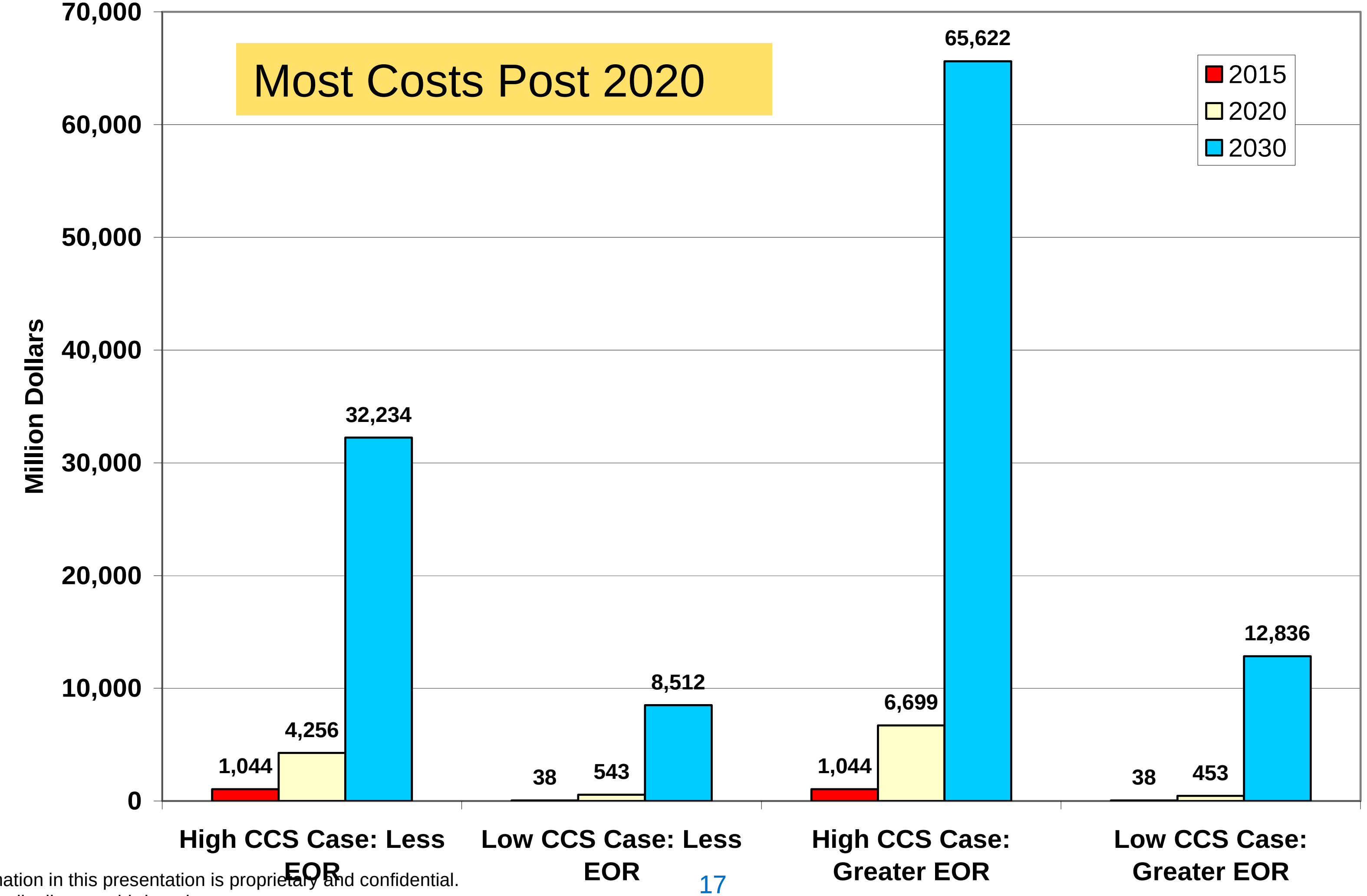
Potential CO_2 Pipeline Network



Pipeline Requirements are between 5,900 and 36,000 Miles



Costs Range between $8.5 and $65.6 billion



Key Issues Identified by Industry and Government Experts

- Liability for performance of both the pipelines and the sequestration reservoirs in short term and long term
  - ensuring pipeline deliverability and the permanence of storage
- Financing of pipeline and sequestration facilities
  - corporate balance sheet financing, to project financing, to hybrid approaches including some public financing
- Siting and right-of-way acquisition
  - whether federal eminent domain is desirable
  - how to address overlapping federal, state, and local siting authorities and processes

Need for a National Approach

- Future CO_2, unlike in EOR applications, will have no economic value outside what a GHG carbon policy (cap and trade or tax) confers on it
  - Creates special challenges for financing
- CO_2 transport and sequestration will be continent wide
  - Involving large investment
  - Requiring standard operating capabilities and rules, e.g., CO_2 quality standards
  - Ensure access and performance
- Future pipelines will be in more heavily populated areas with more siting and construction challenges