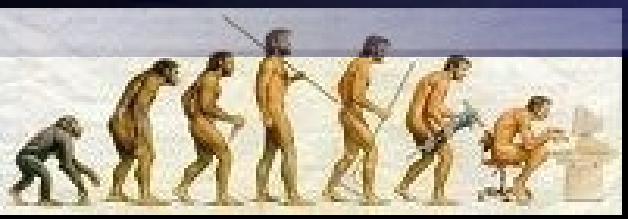
Domestic Natural Gas and Its Role in Building the Nation's Energy Future

AGIA
The Alaska Gasline Inducement Act



Dr. Mark Myers
May 12, 2009

The Human Effect

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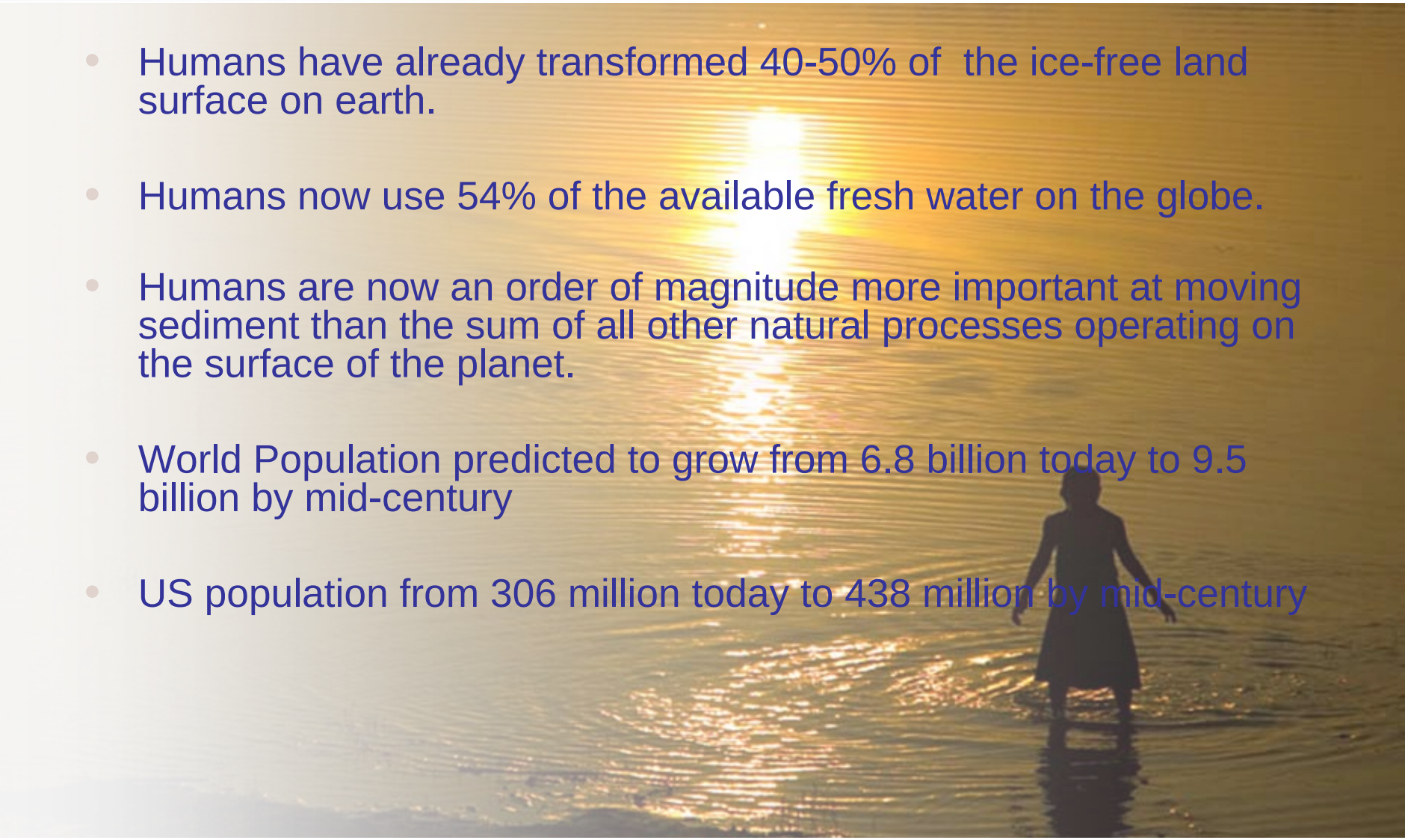

- Humans have already transformed 40-50% of the ice-free land surface on earth.
- Humans now use 54% of the available fresh water on the globe.
- Humans are now an order of magnitude more important at moving sediment than the sum of all other natural processes operating on the surface of the planet.
- World Population predicted to grow from 6.8 billion today to 9.5 billion by mid-century
- US population from 306 million today to 438 million by mid-century

Increased Demands on Resources – Globally, Nationally and Locally

- **Energy**
- **Minerals**
- **Water**
- **Agriculture**
- **Recreation**
- **Preserved natural habitat**

Sustaining Our Environment While Meeting the Future Resource Needs Requires Long Term Strategic Choices

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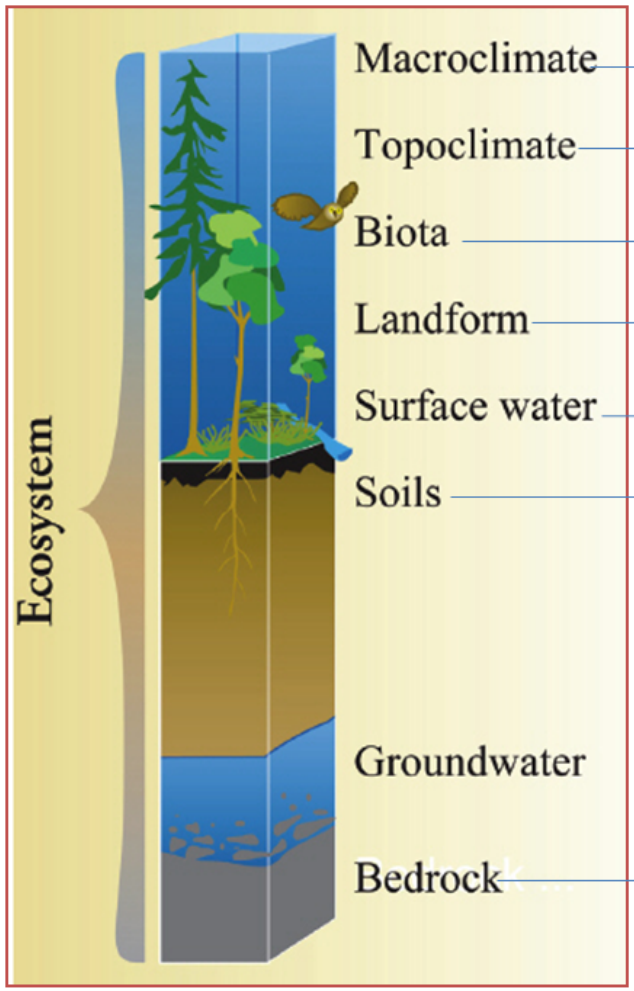

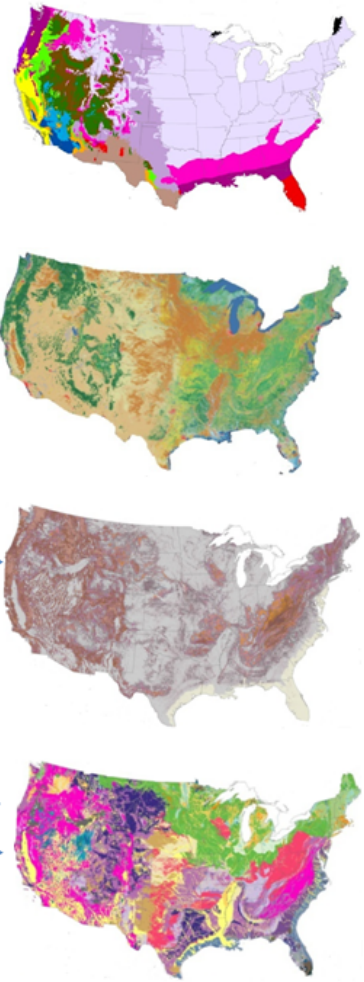

No Free Lunch: All New Sources of Energy Have Their Own Unique Environmental Challenges: Biomass/Water

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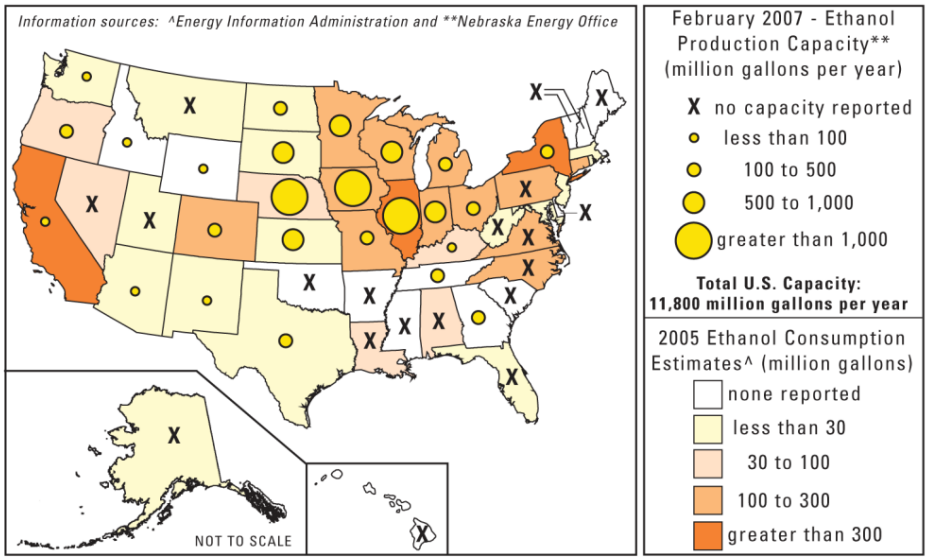
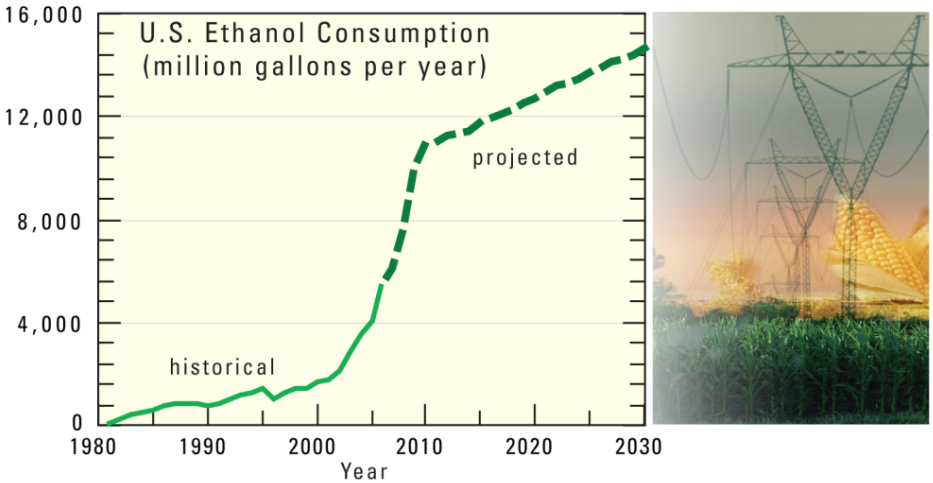
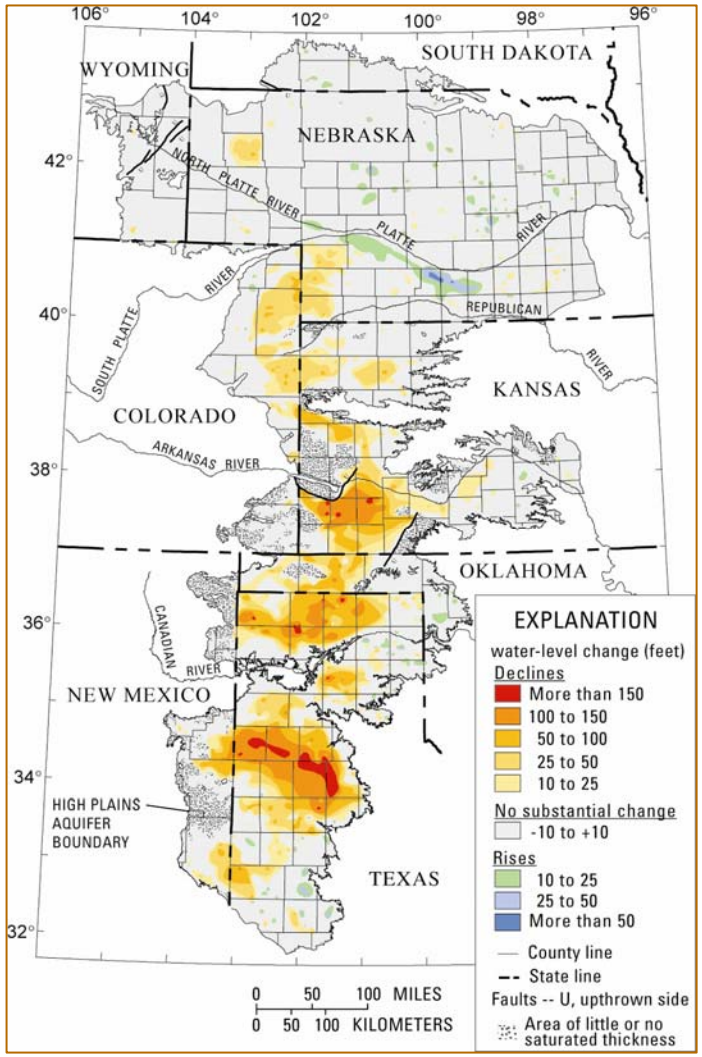
USGS/EIA







Competing Demands For Land, Water and Energy Will Challenge Regulators and Policy Makers

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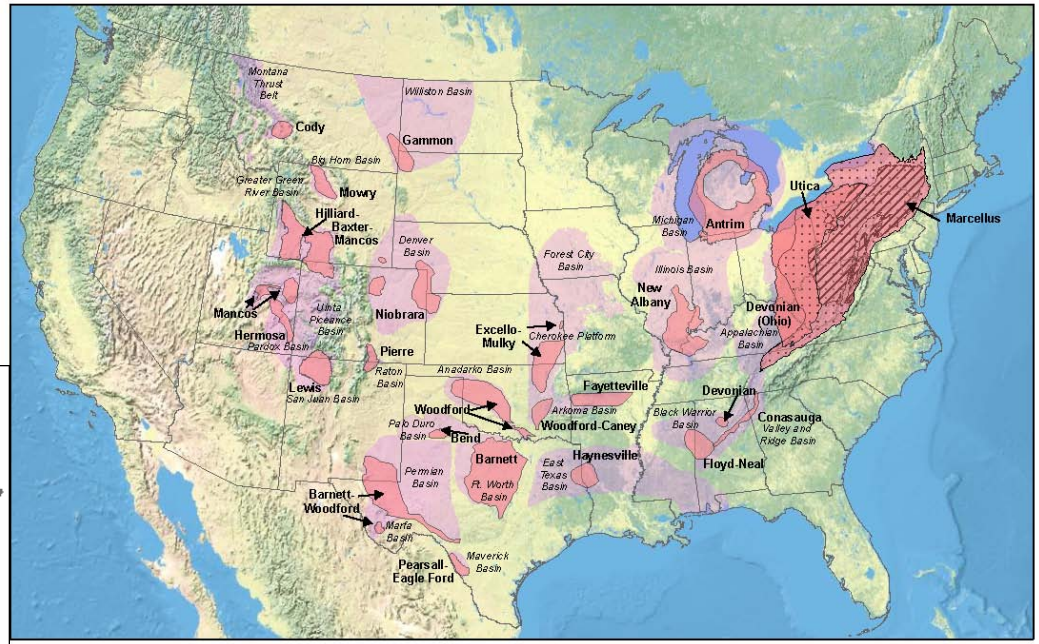


United States Shale Gas Plays

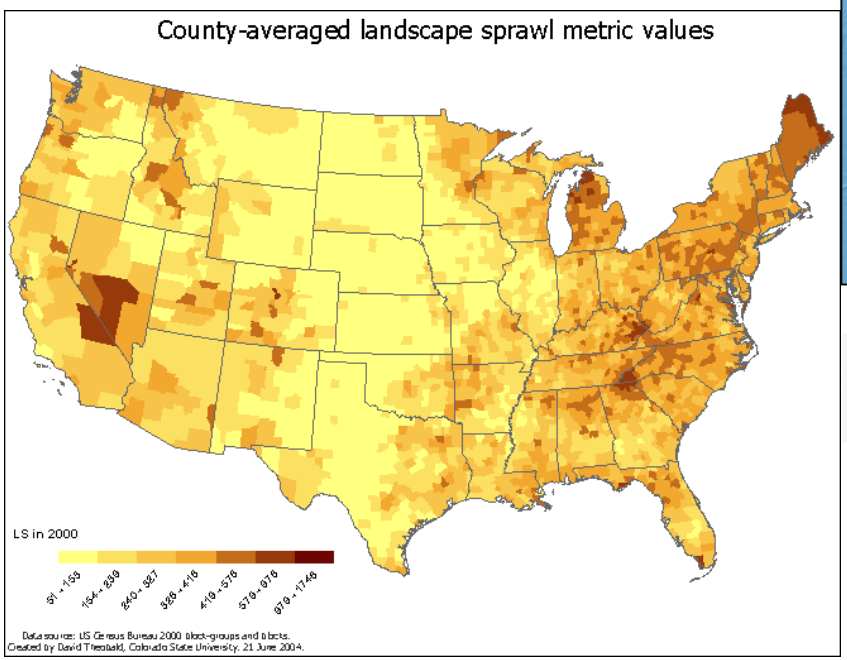
www.eia.doe.gov
Energy Information Administration
Office of Oil and Gas

Shale Gas Plays
Basins

Stacked Appalachian Plays
Marcellus
Utica
Devonian (OH shale)

November 2008
Miles
0 150 300 600

N



The Effects of a Changing Climate Adds Additional Challenges To Resource Management

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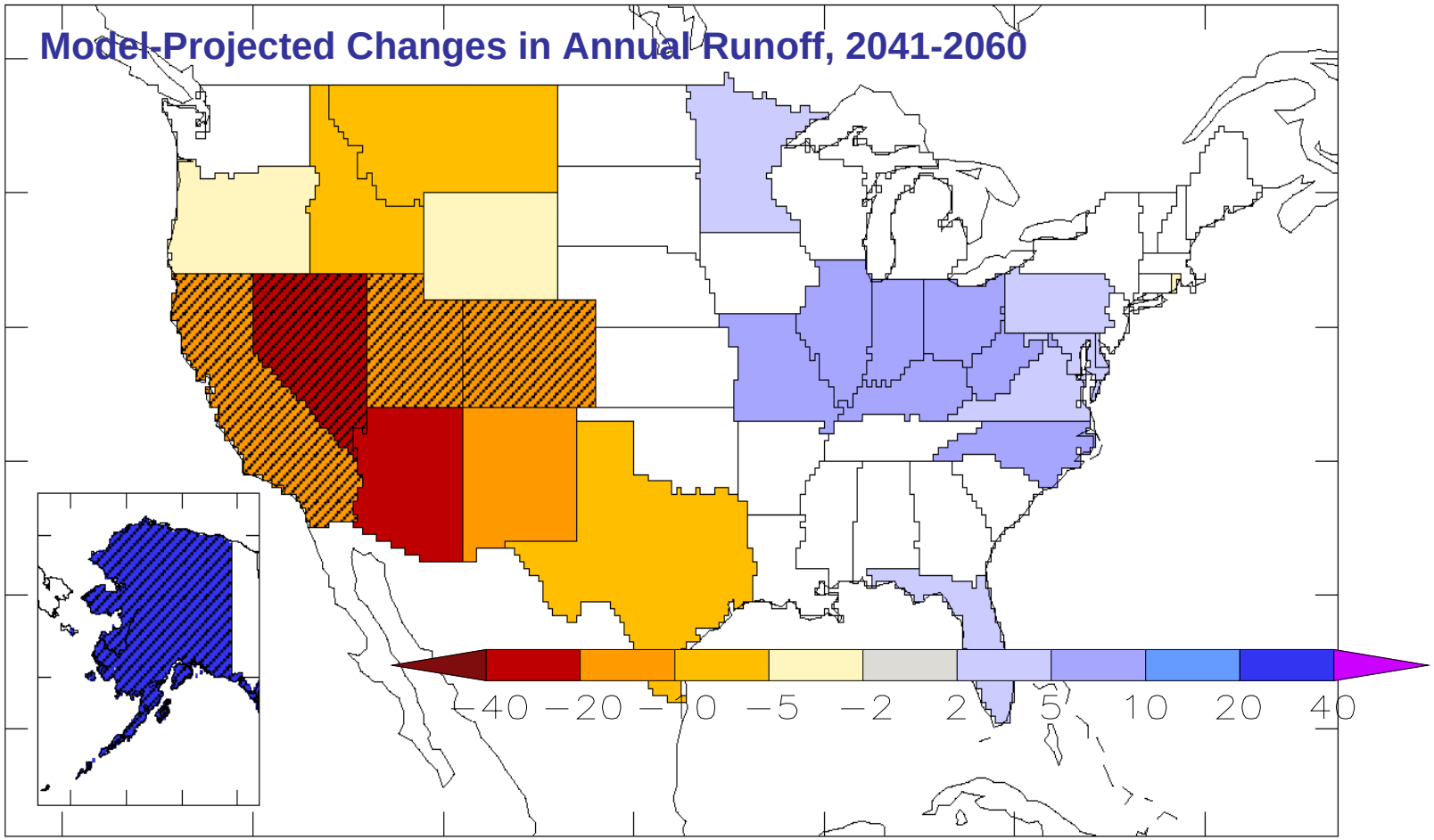
Model-Projected Changes in Annual Runoff, 2041-2060



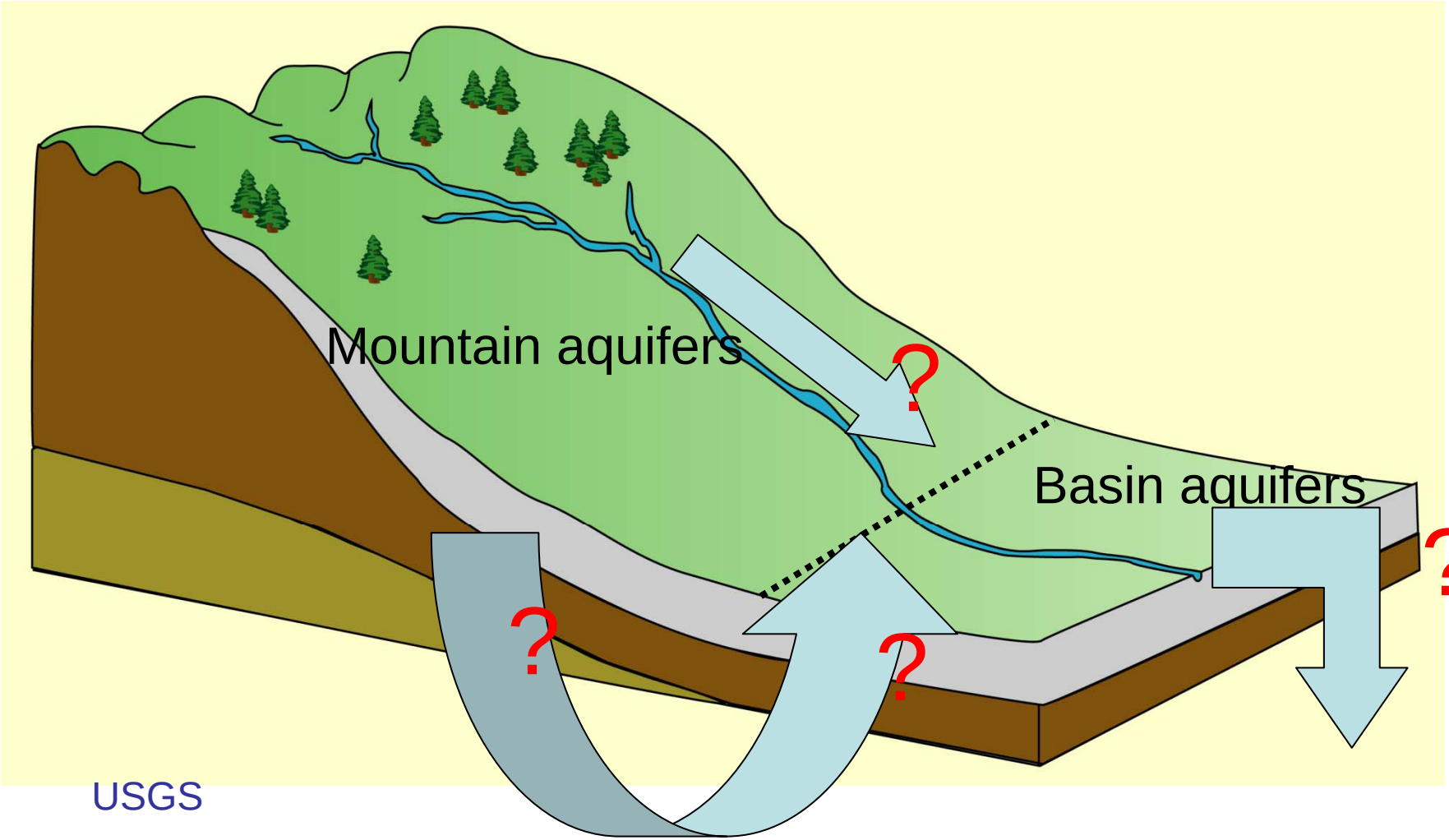
Percentage change relative to 1900-1970 baseline. Any color indicates that >66% of models agree on sign of change; diagonal hatching indicates >90% agreement.

(After Milly, P.C.D., K.A. Dunne, A.V. Vecchia, Global pattern of trends in streamflow and water availability in a changing climate, *Nature*, 438, 347-350, 2005.)

With mountain recharge at risk,

Groundwater inputs to upland streams at risk…

Recharge to basin aquifers across mountain fronts may also change.



USGS

The Energy Mix for the United States

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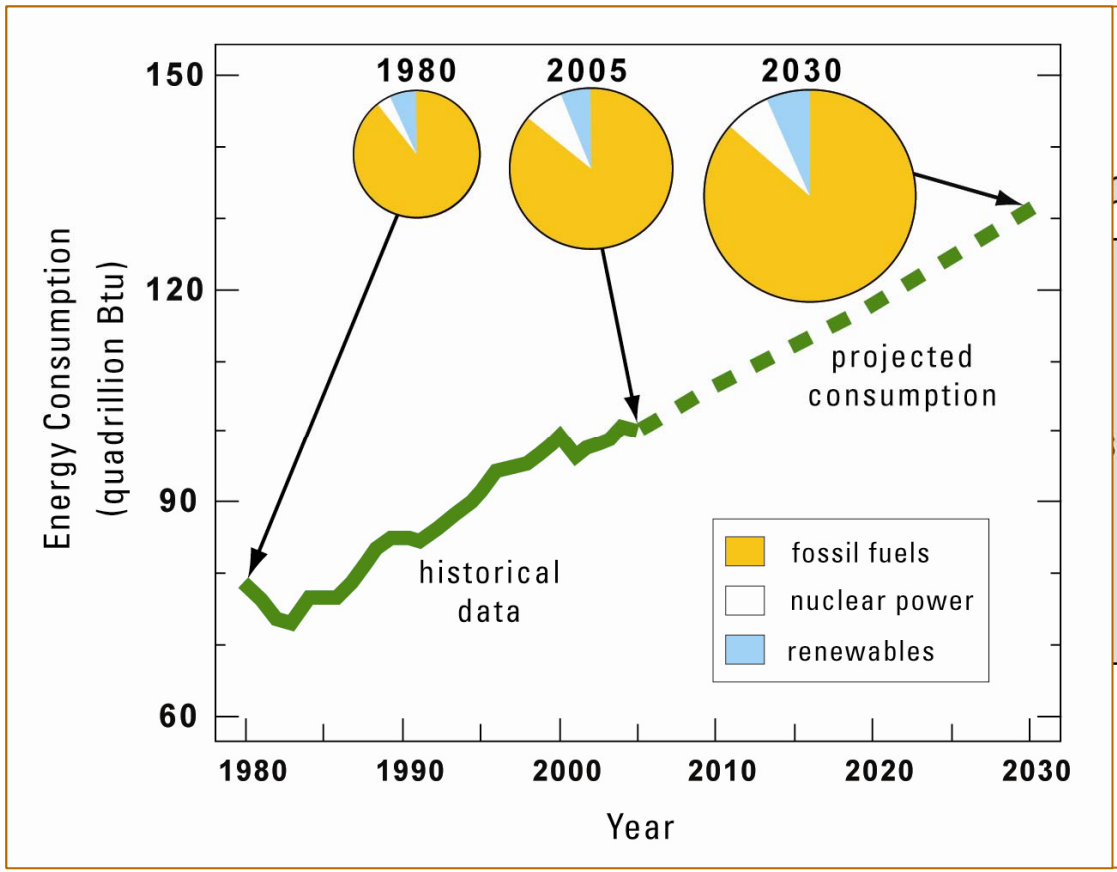

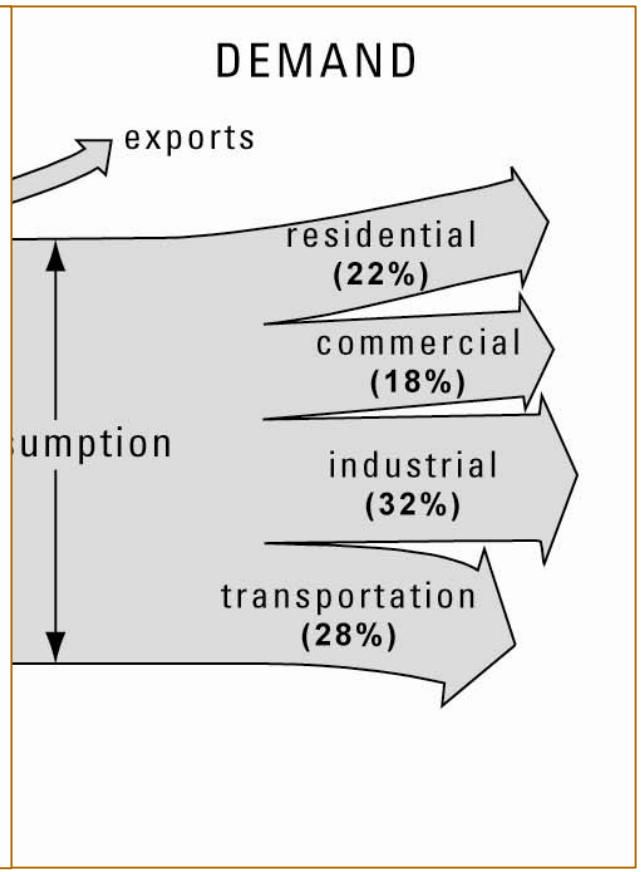

EIA

Large Changes Have Occurred In Fuel Sources

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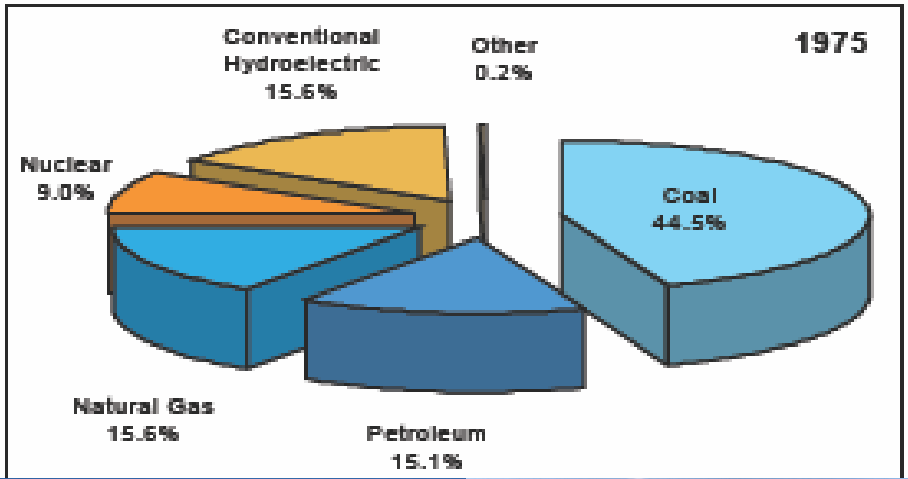
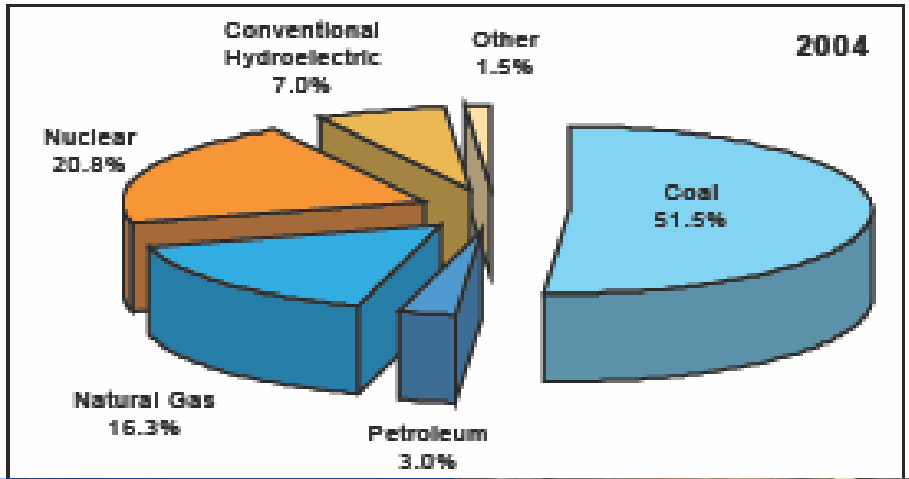
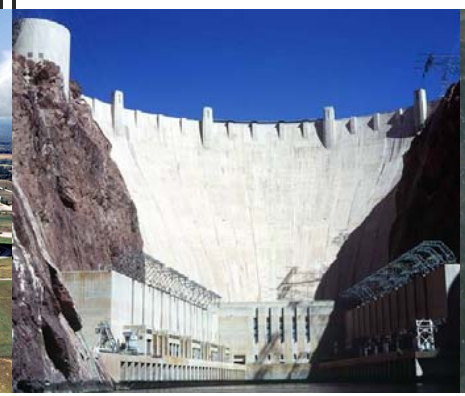
U.S. Electric Power Generation by Fuel Type - Years 1975 and 2004







USGS/EIA

Change in Fuel Type for Electrical Generation Over Three Decades

Natural Gas is America's Resource For Enhancing Economic, Environmental and National Security

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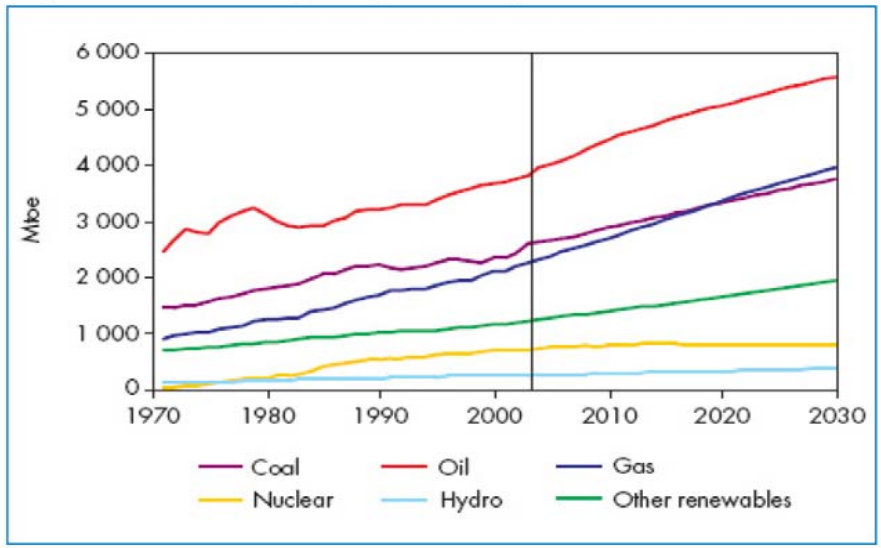
- Global competition for imported energy
- Growing population, long term economic growth heighten worldwide demand
- Environmental consequences of development, extraction, and use of other resources

World Energy Consumption by Source



IEA

Petroleum and the USA Today

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- How have things changed recently?
  - Global economic downturn with associated rapid decline in oil and gas prices and drilling
  - Rapid expansion of unconventional gas supplies in USA
  - Policy shift limiting access to federal lands for non-renewable energy production?
  - Increased likelihood of carbon regulation
  - First authoritative Arctic oil and gas assessment

U.S. Gas Well Drilling down 45% in Last Year

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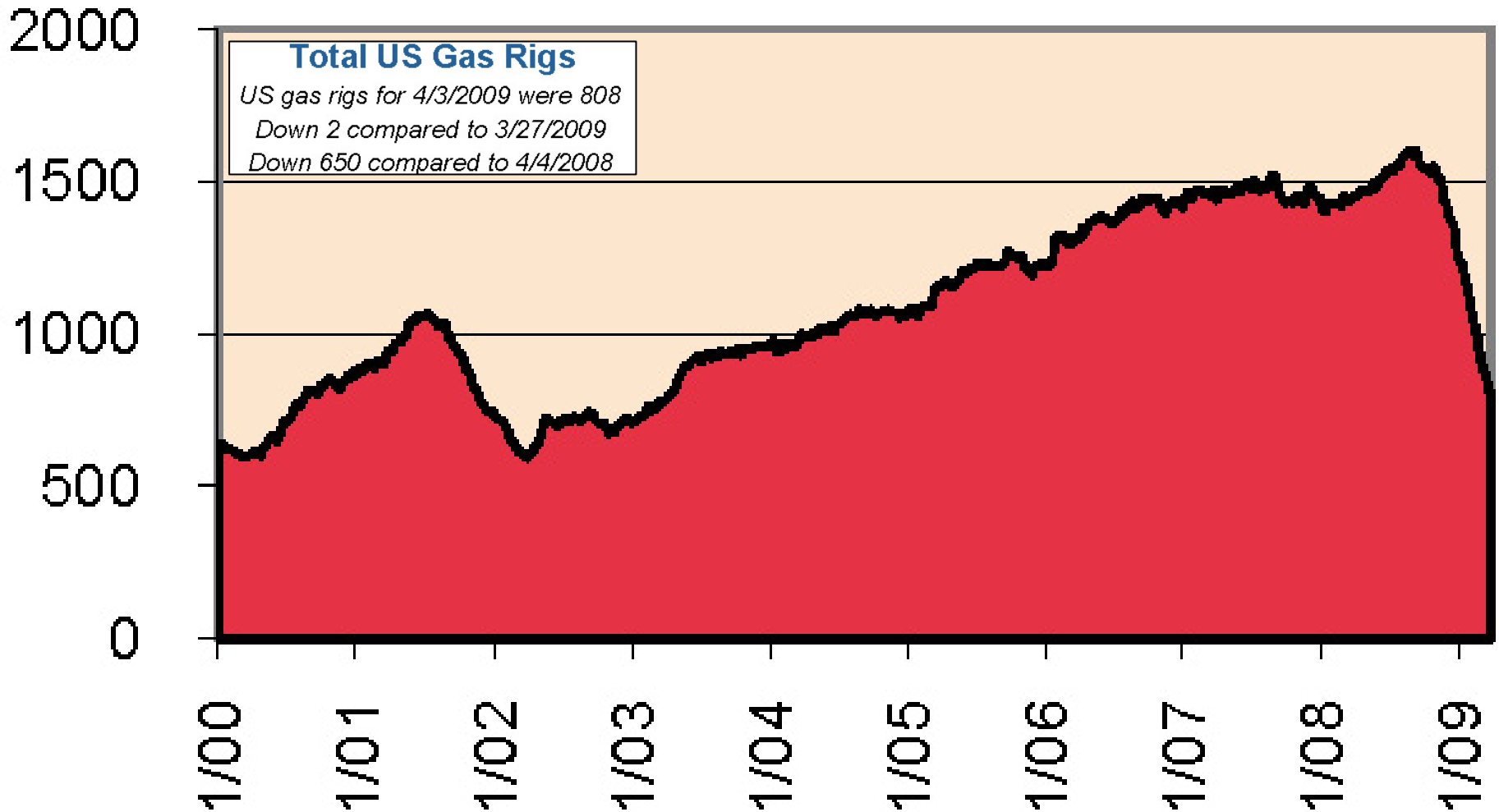

Source: Baker Hughes

Domestic Production Increasing Due in Large Part to Unconventional Gas

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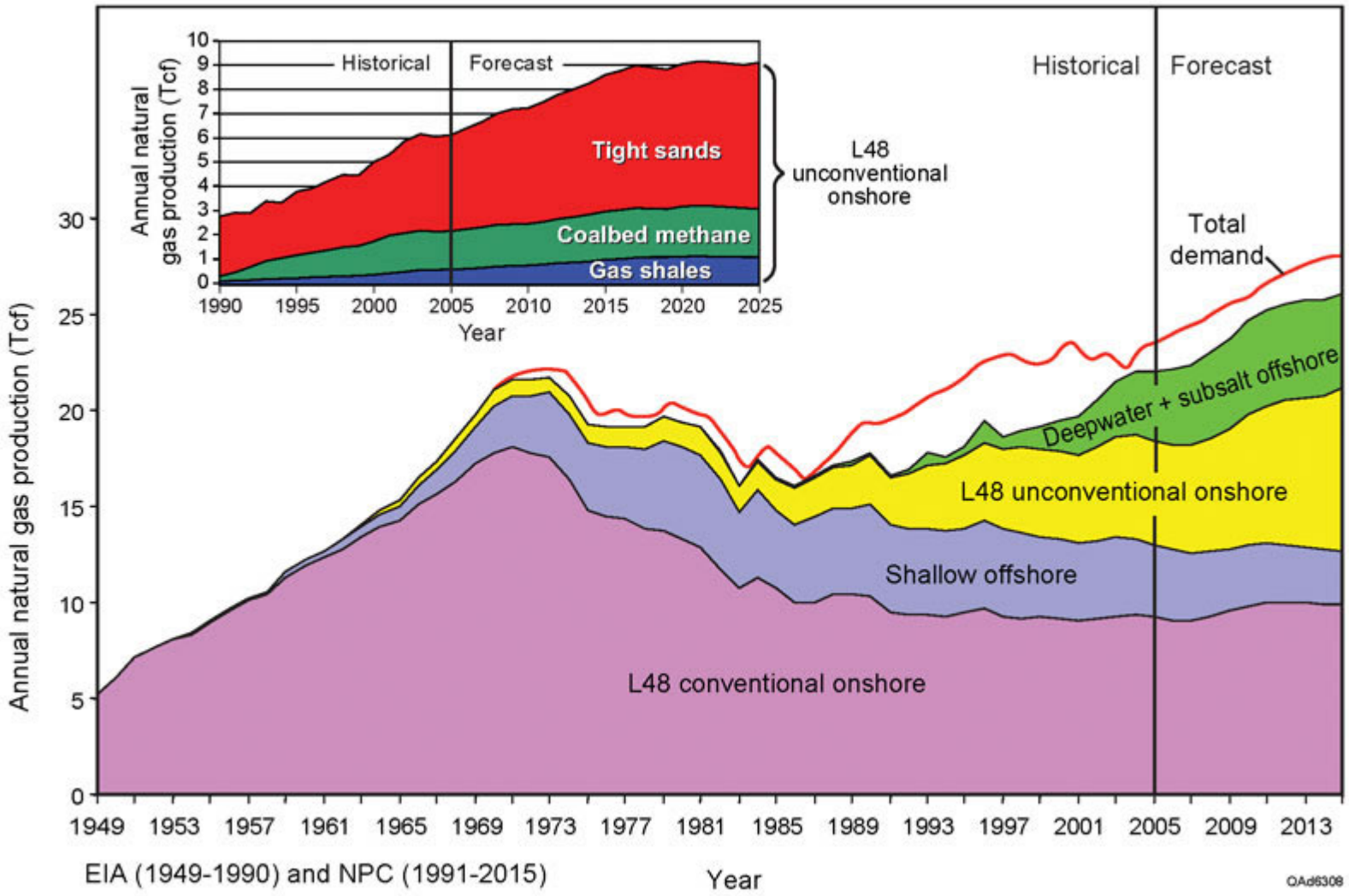

*More Recent EIA Price Forecasts for Gas Predict **Higher** Long-term Prices for Natural Gas in the U.S.*

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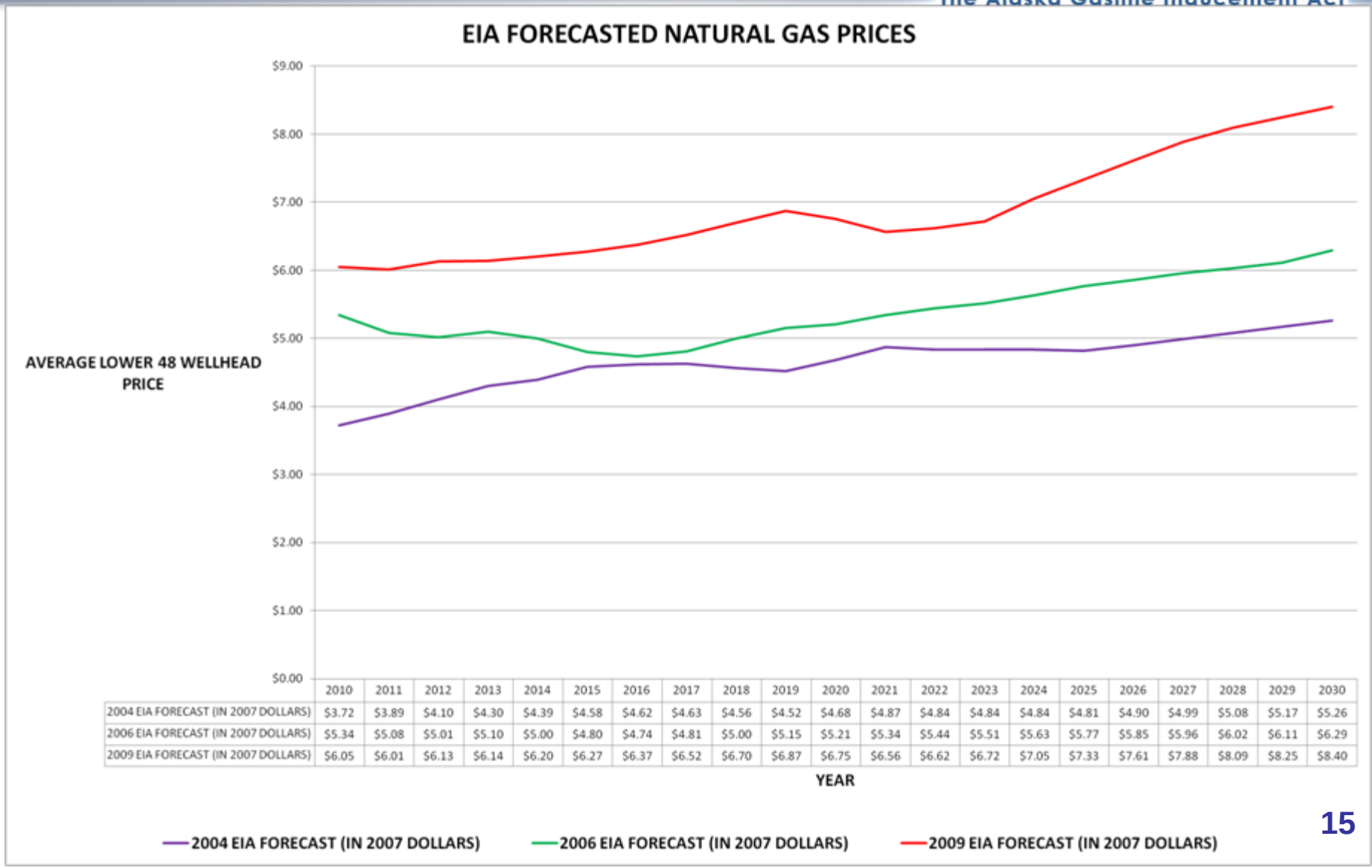

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
2004 EIA FORECAST (IN 2007 DOLLARS)	$3.72	$3.89	$4.10	$4.30	$4.39	$4.58	$4.62	$4.63	$4.56	$4.52	$4.68	$4.87	$4.84	$4.84	$4.84	$4.81	$4.90	$4.99	$5.08	$5.17	$5.26
2006 EIA FORECAST (IN 2007 DOLLARS)	$5.34	$5.08	$5.01	$5.10	$5.00	$4.80	$4.74	$4.81	$5.00	$5.15	$5.21	$5.34	$5.44	$5.51	$5.63	$5.77	$5.85	$5.96	$6.02	$6.11	$6.29
2009 EIA FORECAST (IN 2007 DOLLARS)	$6.05	$6.01	$6.13	$6.14	$6.20	$6.27	$6.37	$6.52	$6.70	$6.87	$6.75	$6.56	$6.62	$6.72	$7.05	$7.33	$7.61	$7.88	$8.09	$8.25	$8.40

2009 EIA Forecasts for Natural Gas Prices Accounts for Growth of Unconventional Gas Resources

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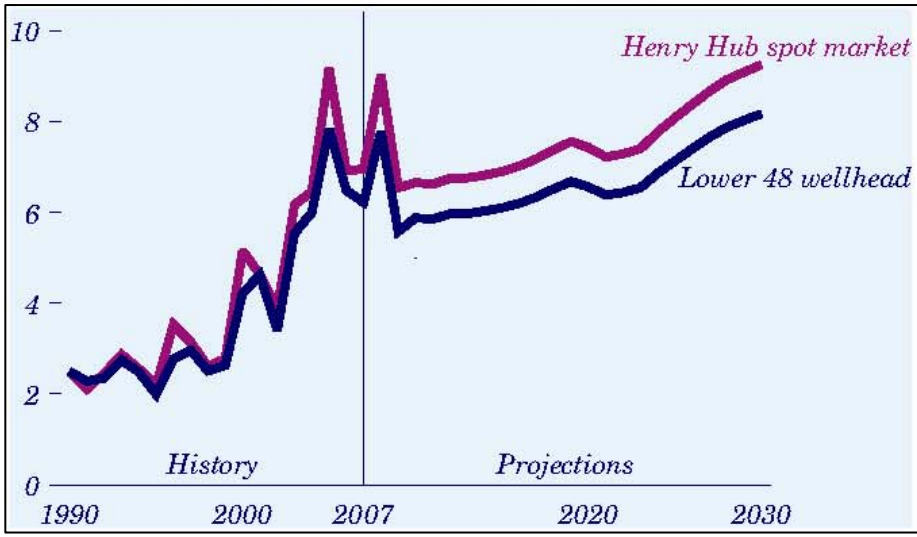
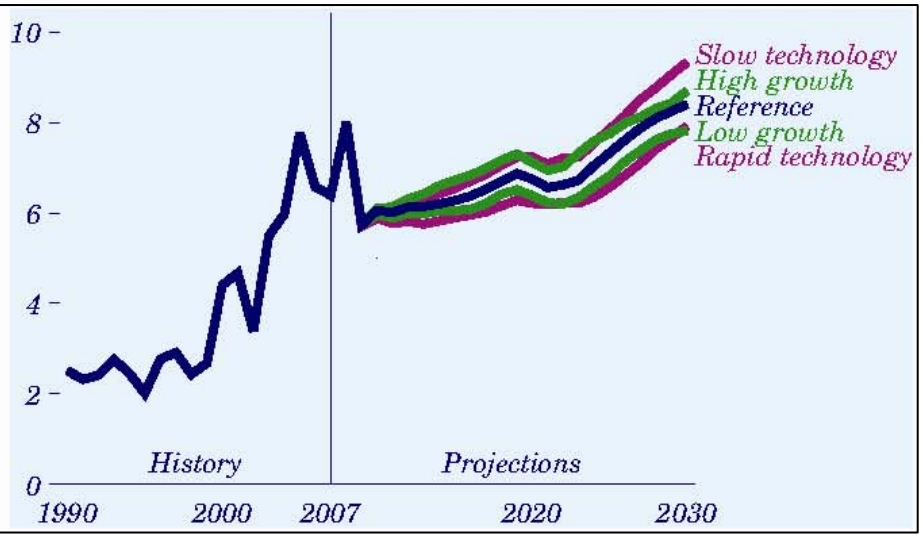


Lower 48 wellhead and Henry Hub Spot market prices for natural gas, 1990-2030 (2007 dollars per million Btu)



Lower 48 wellhead natural gas prices in five cases, 1990-2030 (2007 dollars per thousand cubic feet)

Source: EIA Annual Energy Outlook 2009

Both Lower 48 Unconventional and Alaska North Slope Gas are Needed for America's Future

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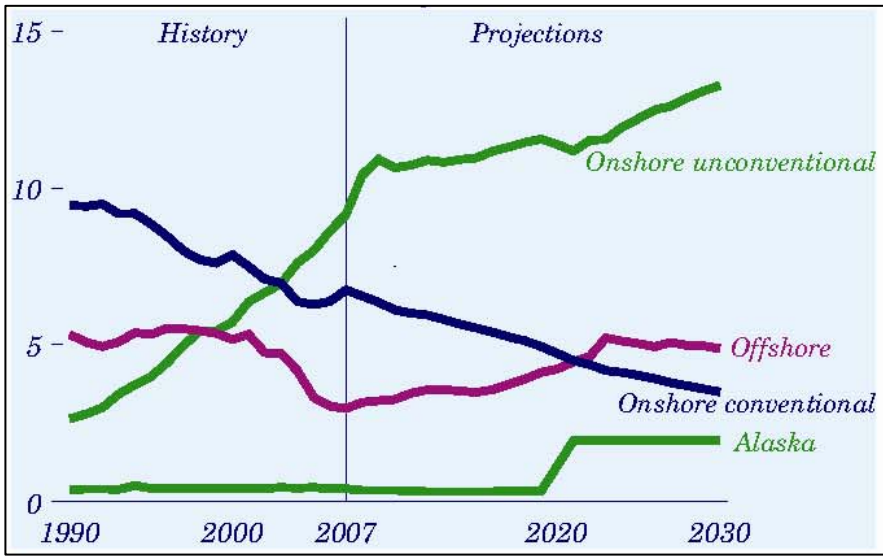
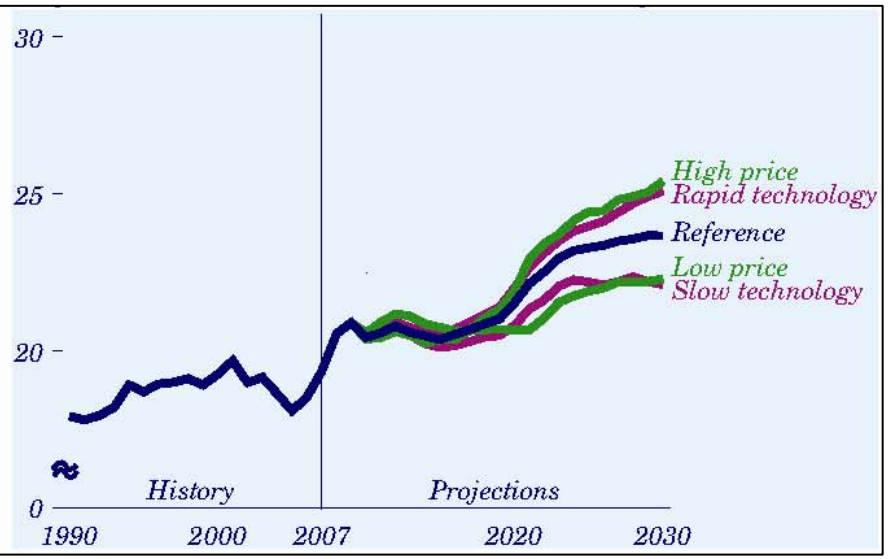


Natural gas production by source, (1990-2030 9trillion cubic feet)



Total U.S. natural gas production in five cases, 1990-2030 (trillion cubic feet)

Source: EIA Annual Energy Outlook 2009

Liquid Natural Gas (LNG) Imports Current and Forecast Volumes

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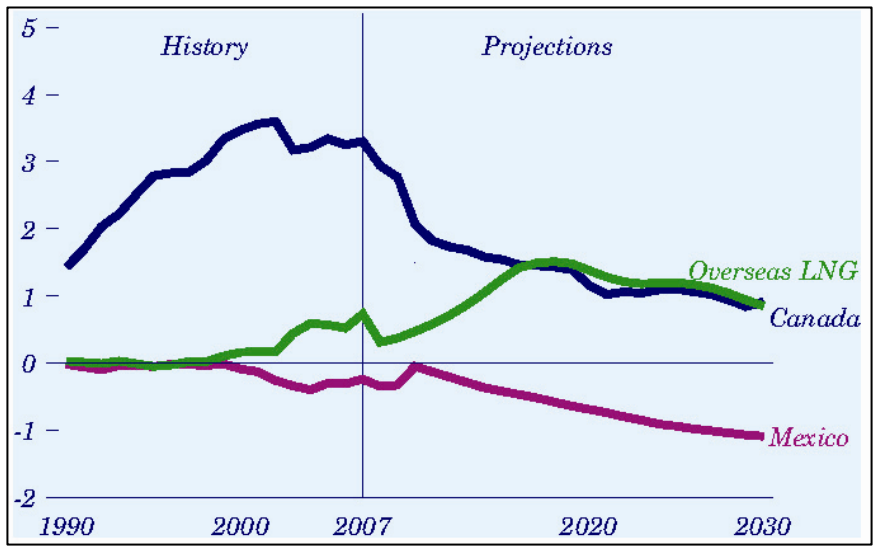
LNG import volumes have experienced little net change since the legislature approved the AGIA license

Total US LNG Import Volumes

July 2008: 31,019 mmcf

December 2008: 30,708 mmcf



Net U.S. imports of natural gas by source, 1990-2030 (trillion cubic feet)

Source: EIA Annual Energy Outlook 2009

Domestic Natural Gas: Critical Bridge to a Sustainable Future

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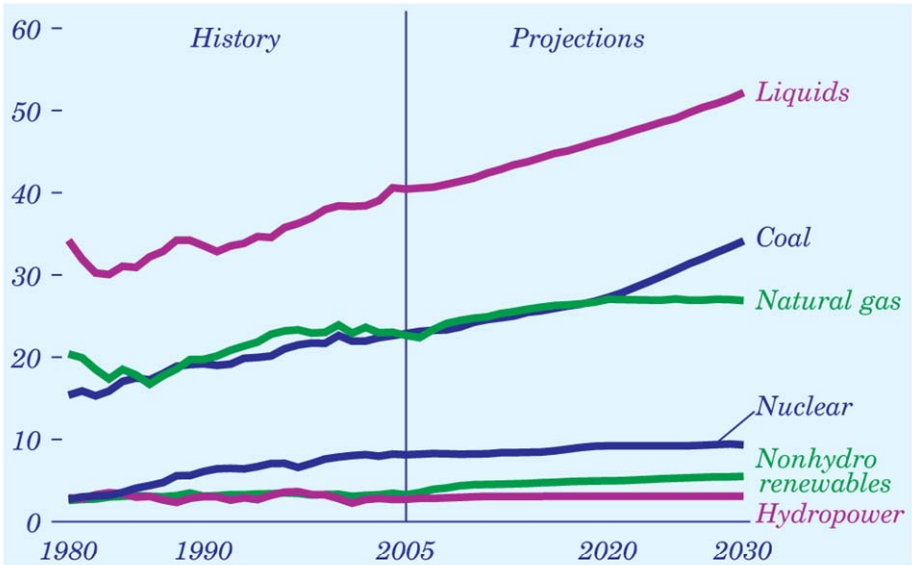
United States Energy Consumption by Fuel



EIA

Carbon Emissions

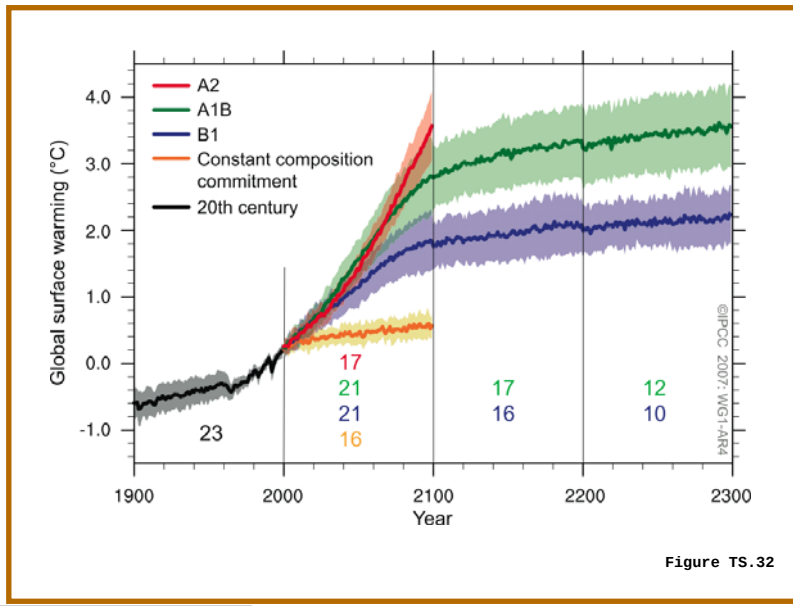
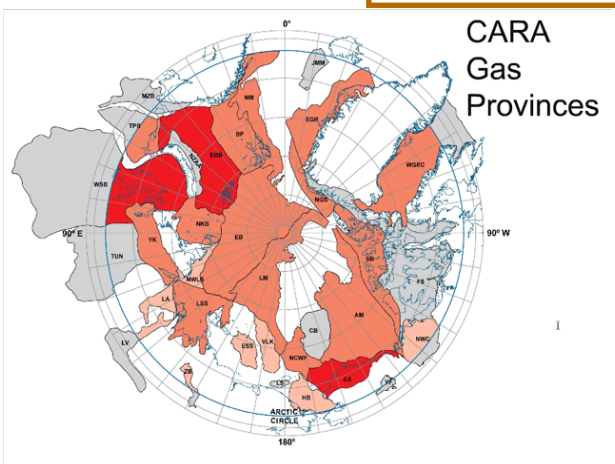


Figure TS.32

USGS

IPCC 2007: WG1-AR4



Impact of Carbon Regulation on Natural Gas Demand

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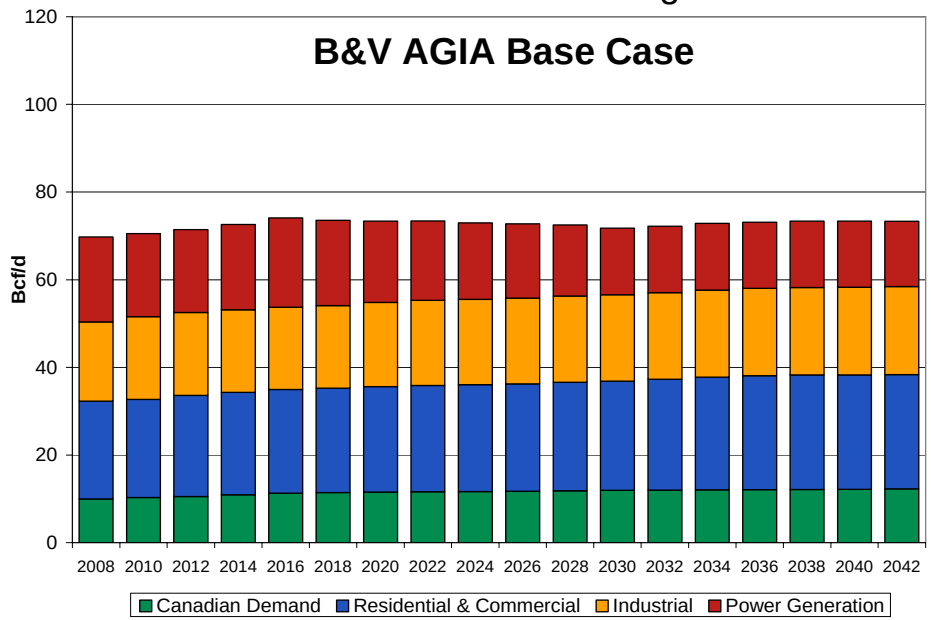
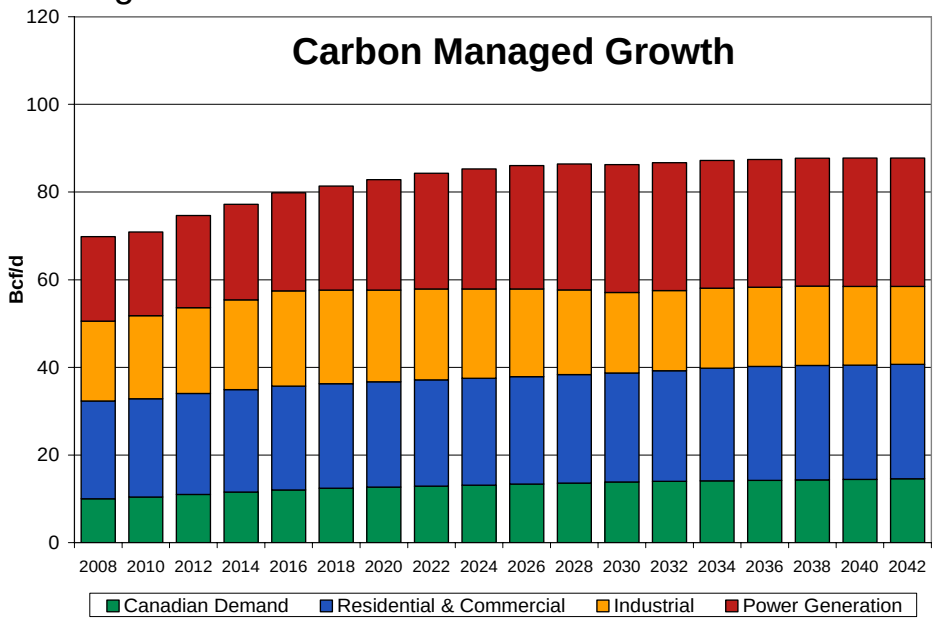
In a Carbon Managed Growth case, demand is 14 Bcf/d more than the B&V AGIA Base Case

- Policies and legislations designed to curb Green House Gas could reduce dispatch and construction of coal-fired generation facilities in favor of natural gas fired facilities, resulting in demand increase from the power sector in the US
- All resources, including renewables, nuclear and IGCC with CCS and gas fired combined cycles are all needed to meet electric demand growth. Gas demand from the power sector will grow from 19 Bcf/d in 2008 to 29 Bcf/d by 2030, with a CAGR of 2%
- Total demand in US lower 48 states is 12.1 Bcf/d higher than BV's AGIA Base Case by 2042. Canada demand is 2.3 Bcf/d higher in the Carbon Managed Growth case





Source: Black & Veatch Analysis

Multiple Different Sources of Natural Gas will be Needed to Meet Lower 48 Demand Growth

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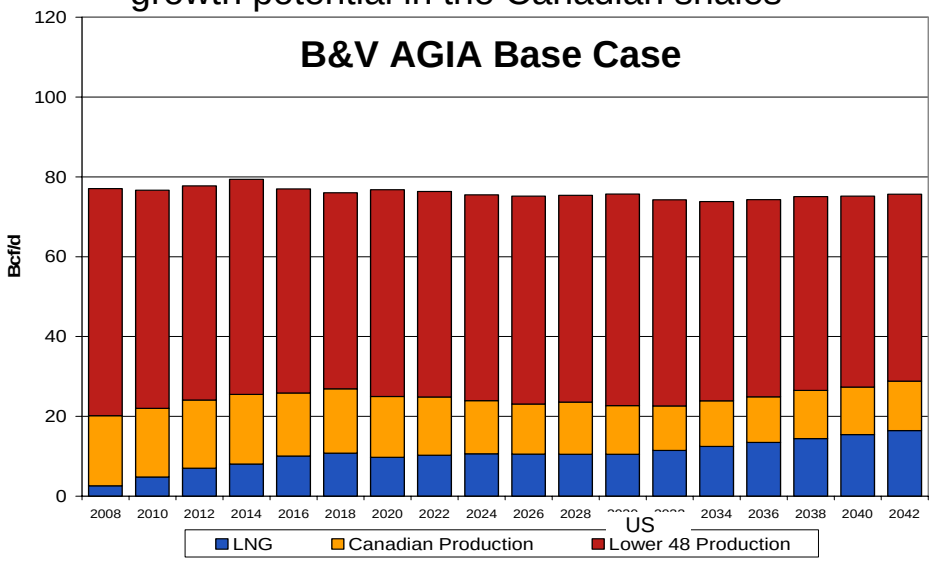
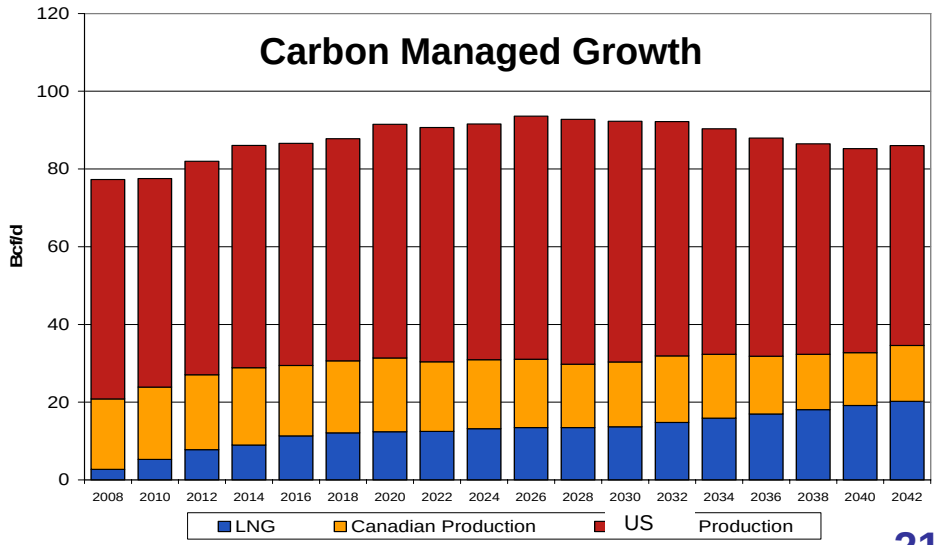
Additional LNG imports and more unconventional productions from the US is necessary in order to meet the lower 48 demand growth

- Additional LNG imports will be needed to meet the demand growth; 6.4 Bcf/d by 2042 in the Carbon Managed Growth scenario
- US Production will average 58.3 Bcf/d from 2022-2042 in the Carbon Managed Growth case, which will be 7.8 Bcf/d higher than the B&V AGIA Base Case. Recent developments in shale discoveries in Haynesville and Marcellus indicate greater production potentials from these unconventional resources. The production growth can be considered as a proxy.
- Canadian production continues to decline in both cases. In the Carbon Managed Growth case, Canadian production is 3.7 Bcf/d higher than in the B&V AGIA Base Case, which may approximately reflect the growth potential in the Canadian shales





Source: Black & Veatch Analysis

Impact of Carbon Regulation on AECO Price Forecasts

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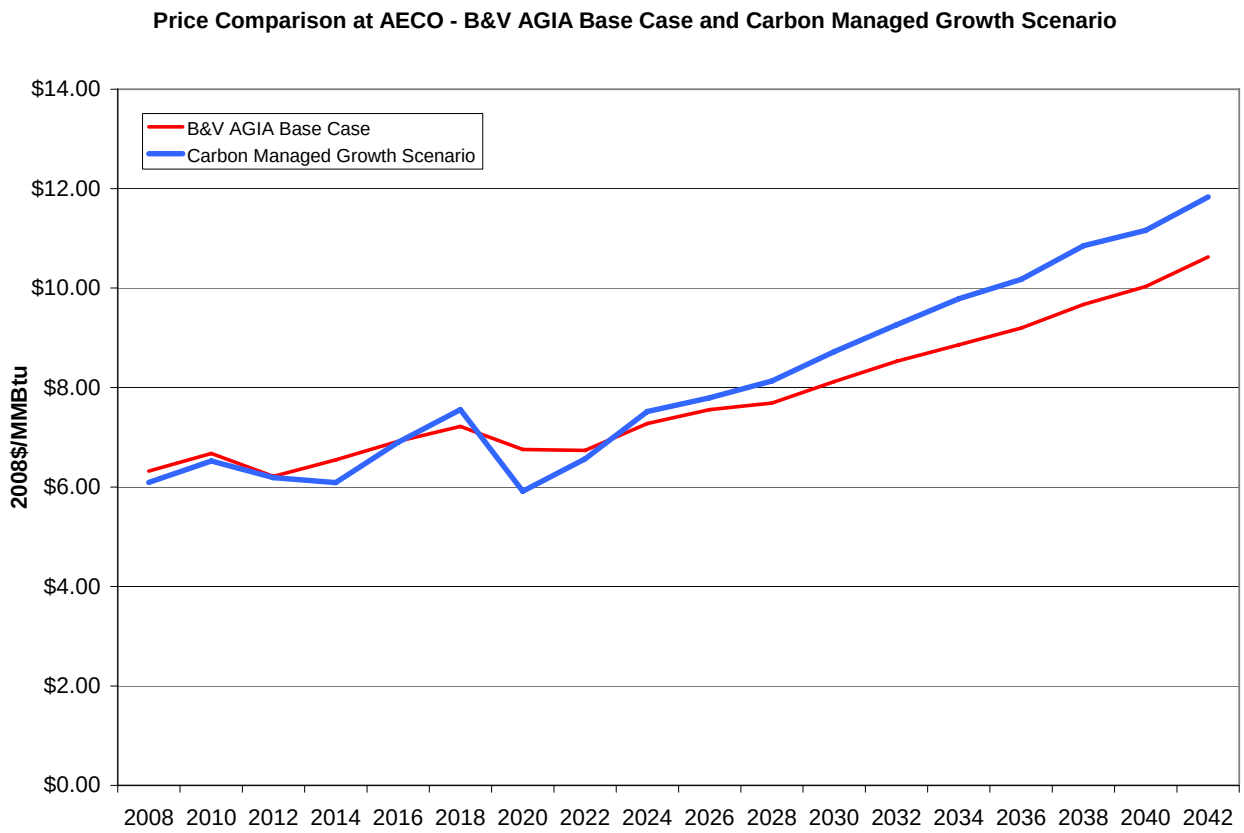
- The Carbon Managed Growth case has sufficient supplies from North America to meet the high demand from both unconventional production and slightly higher additional LNG volumes
- North American gas price is projected to have a higher price path than in the AGIA base case



Source: Black & Veatch Analysis

Route of Proposed Alaska Natural Gas Pipeline

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Estimated Break-Even Costs for Lower 48 Shale Gas and Alaska North Slope Onshore Gas

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- Onshore North Slope Gas (at AECO Hub)

  $3.00 - $4.25

  (USGS, AGIA Finding)
- Lower 48 Shale Gas (NYMEX)

  Lowest - $4.20

  Medium - $6.64

  Highest - $11.50

  (Bank of America)
- Today's lower drilling and steel costs and future technological development enhance economics of BOTH

Source: Bank of America, USGS and AGIA Finding

Arctic Alaska and Russia at the Top

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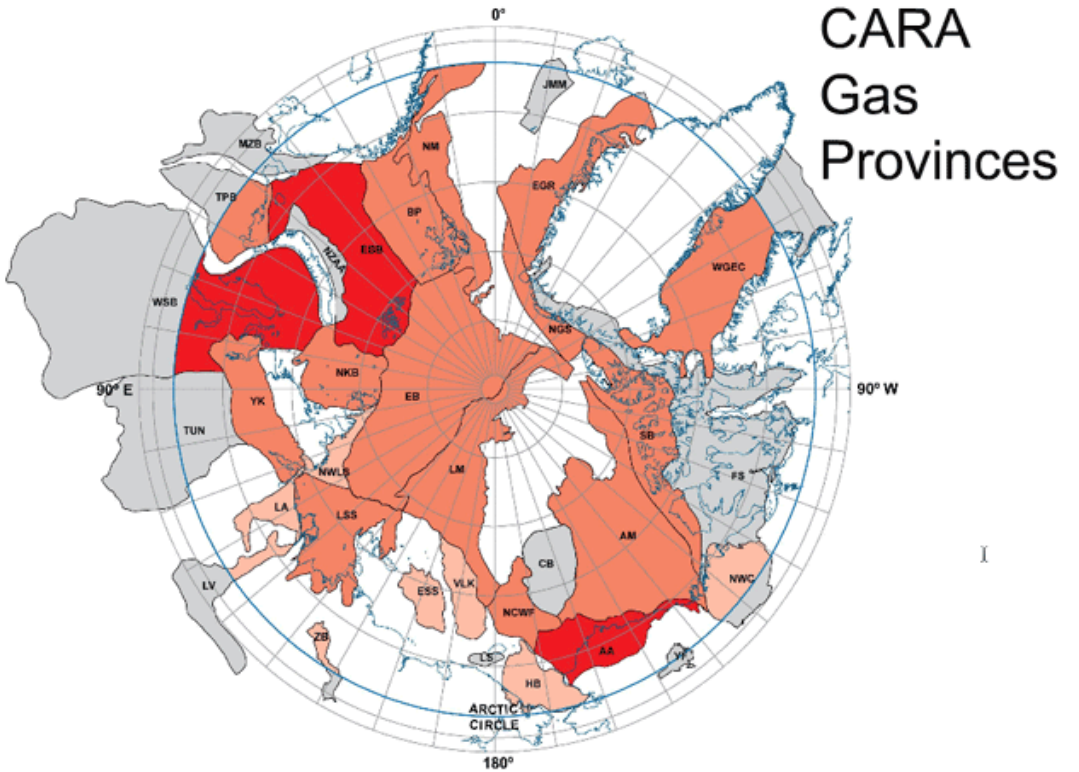
UNDISCOVERED GAS
(trillion cubic feet)

- >100
- 6–100
- <6
- Area not quantitatively assessed
- Area of low petroleum potential



Province Code	Province	Oil (MMBO)	Total Gas (BCFG)	NGL (MMBNGL)	BOE (MMBOE)
WSB	West Siberian Basin	[illegible]	[illegible]	[illegible]	132,571.66
AA	Arctic Alaska	29,960.94	221,397.60	5,904.97	72,765.52
EBB	East Barents Basin	7,406.49	317,557.97	1,428.28	61,755.10
EGR	East Greenland Rift Basins	8,902.13	86,180.06	8,121.57	31,387.04
YK	Yenisey-Khatanga Basin	5,583.74	99,964.26	2,675.15	24,919.61
AM	Amerasia Basin	9,723.58	56,891.21	541.69	19,747.14
WGEC	West Greenland-East Canada	7,274.40	51,818.16	1,152.59	17,063.35
[illegible]	[illegible]a Shelf	3,115.57	32,562.84	867.16	9,409.87
[illegible]	[illegible]n Margin	1,437.29	32,281.01	504.73	7,322.19
[illegible]	[illegible]latform	2,055.51	26,218.67	278.71	6,704.00
[illegible]	[illegible]asin	1,342.15	19,475.43	520.26	5,108.31
[illegible]	[illegible] Basins and Platforms	1,807.26	14,973.58	390.22	4,693.07
[illegible]	[illegible]chora Basin	1,667.21	9,062.59	202.80	3,380.44
[illegible]	[illegible]enland Sheared Margin	1,349.80	10,207.24	273.09	3,324.09
[illegible]	[illegible]w-Makarov	1,106.78	7,156.25	191.55	2,491.04
[illegible]	[illegible] Basin	851.11	8,596.36	191.20	2,475.04
[illegible]	[illegible]bar Basin	1,912.89	2,106.75	56.41	2,320.43
[illegible]	[illegible]kchi-Wrangel Foreland	85.99	6,065.76	106.57	1,203.52
[illegible]	[illegible]asin	98.03	5,741.87	101.63	1,156.63
[illegible]	[illegible]t Laptev Sea Shelf	172.24	4,488.12	119.63	1,039.90
[illegible]	[illegible]i Basin	376.86	1,335.20	35.66	635.06
[illegible]	[illegible] Basin	47.82	1,505.99	40.14	338.95
[illegible]	[illegible]ian Sea Basin	19.73	618.83	10.91	133.78
[illegible]	[illegible]in	2.47	648.17	11.37	121.87
[illegible]	[illegible]t Canada Interior Basins	23.34	305.34	15.24	89.47
[illegible]	[illegible]asin	NQA	NQA	NQA	NQA
[illegible]	[illegible]mlya Basins and Admiralty	NQA	NQA	NQA	NQA
[illegible]	[illegible] Basin	NQA	NQA	NQA	NQA
[illegible]	[illegible]orderland	NQA	NQA	NQA	NQA
[illegible]	[illegible]s (part of Central Alaska [illegible]ce)	NQA	NQA	NQA	NQA
[illegible]	[illegible]it	NQA	NQA	NQA	NQA
[illegible]	[illegible]n Microcontinent	NQA	NQA	NQA	NQA
[illegible]	[illegible]n Shelf	NQA	NQA	NQA	NQA
		89,983.21	1,668,657.84	44,064.24	412,157.09

Source: USGS Fact Sheet 2008-3049

Undiscovered, Conventional Gas Resources of the U.S.

Alaska resources = 36% of national total

AGIA
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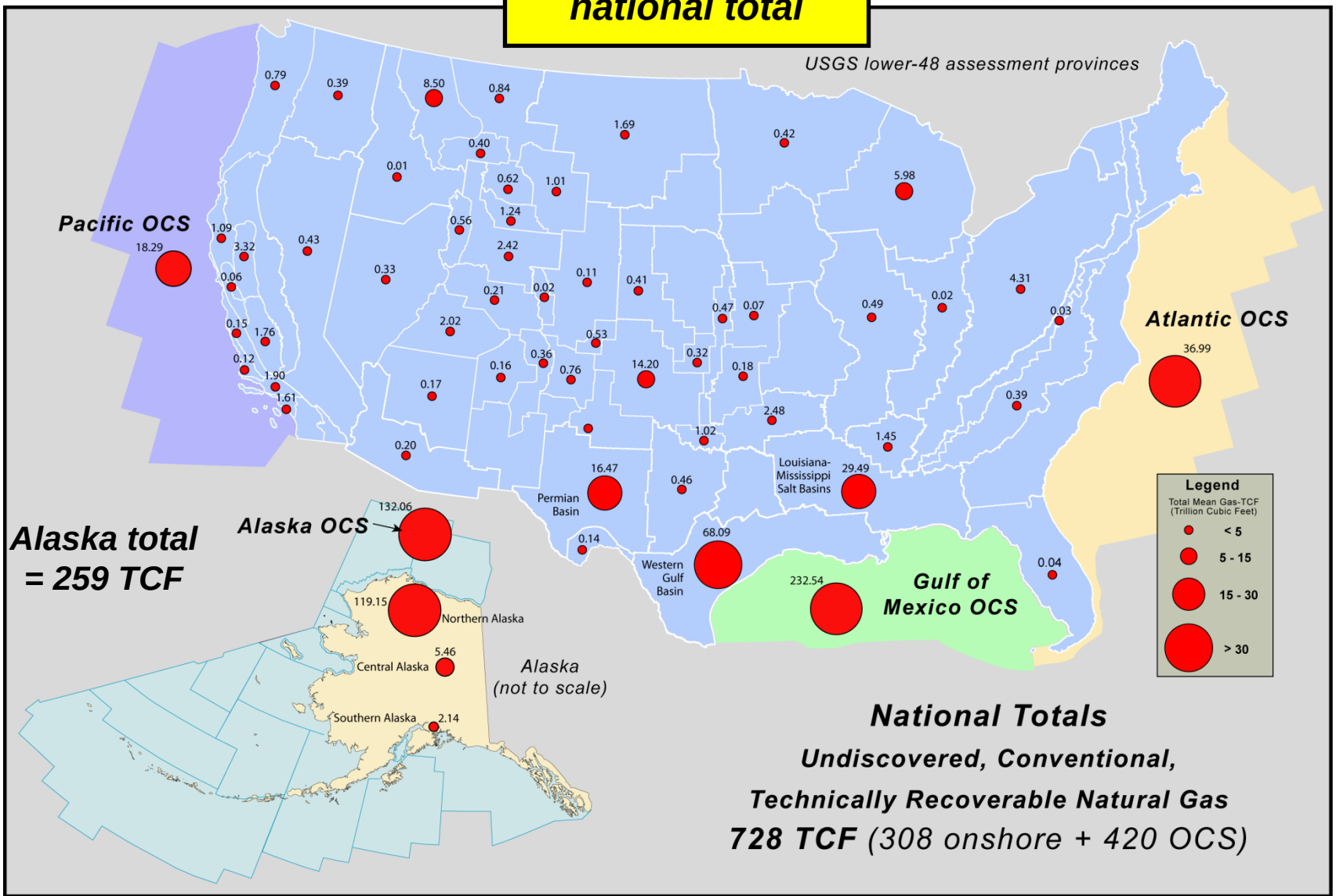

Wyoming Gas Reserves & Production History

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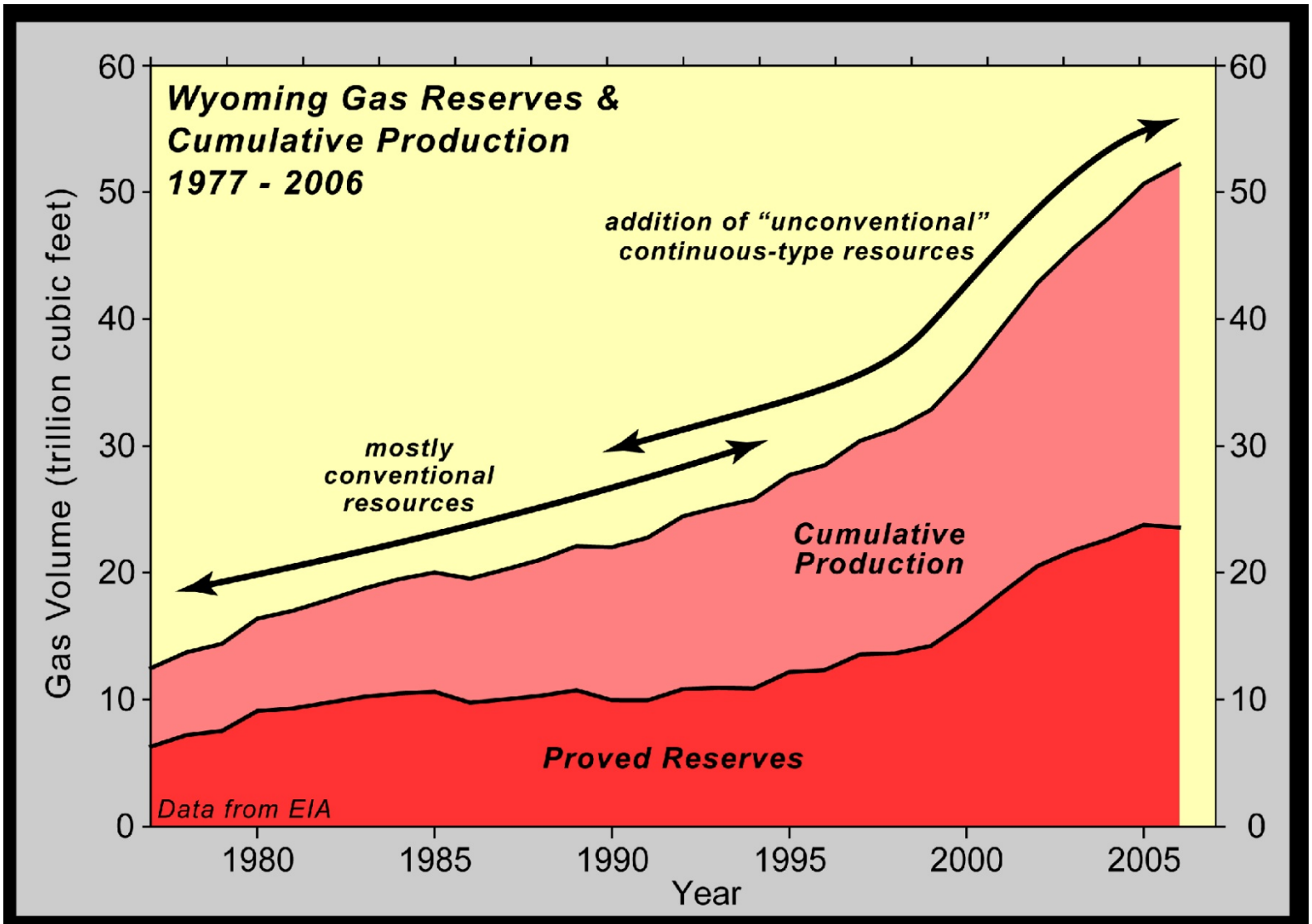
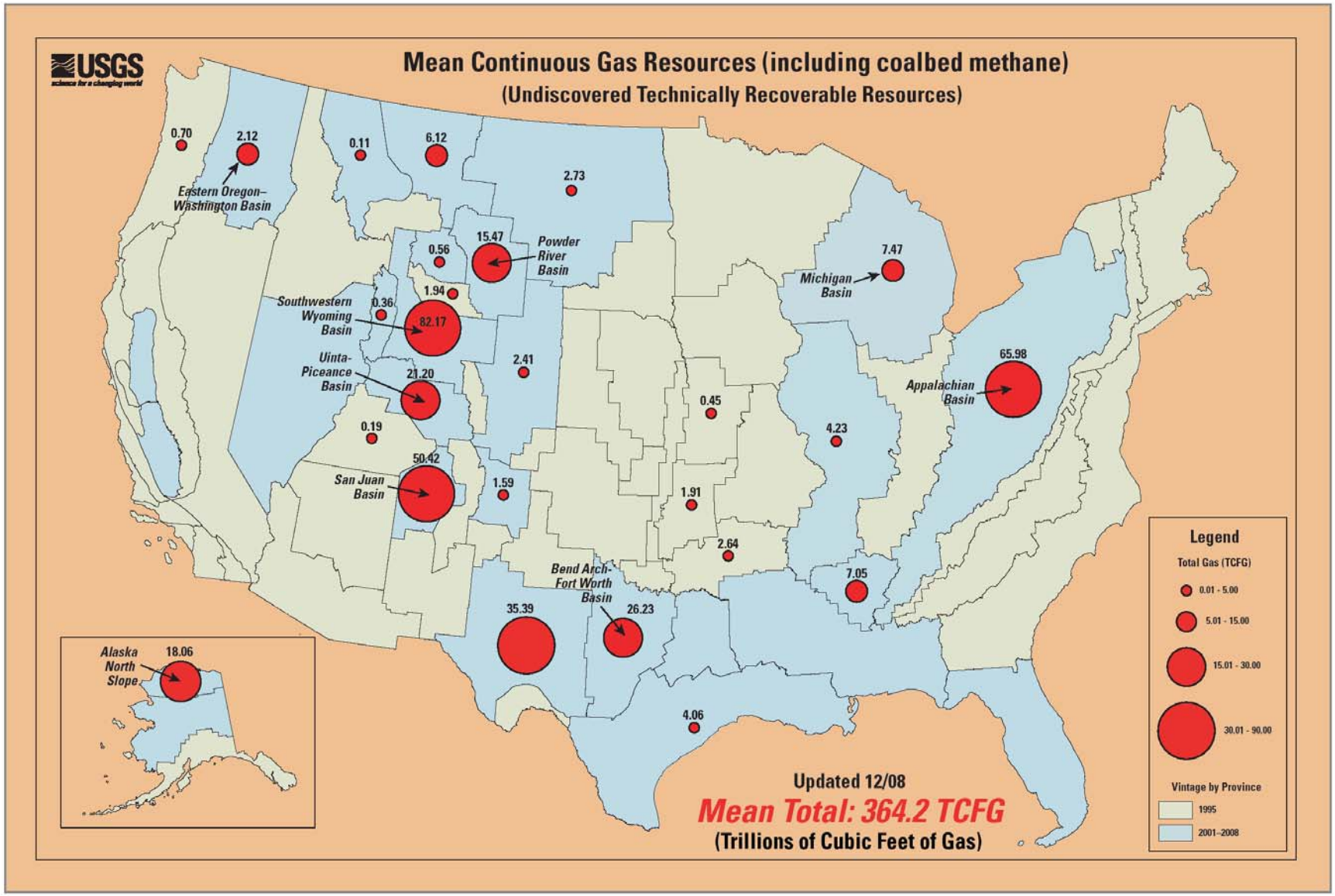
Courtesy of USGS




USGS
Mean Continuous Gas Resources (including coalbed methane)
(Undiscovered Technically Recoverable Resources)
0.70
2.12
Eastern Oregon–
Washington Basin
0.11
6.12
2.73
15.47
Powder
River
Basin
0.56
7.47
Michigan
Basin
1.94
0.36
Southwestern
Wyoming
Basin
82.17
2.41
Uinta-
Piceance
Basin
21.20
65.98
Appalachian
Basin
0.45
0.19
4.23
50.42
San Juan
Basin
1.59
1.91
2.64
Bend Arch-
Fort Worth
Basin
7.05
35.39
26.23
Alaska
North
Slope
18.06
4.06
Updated 12/08
Mean Total: 364.2 TCFG
(Trillions of Cubic Feet of Gas)
Legend
Total Gas (TCFG)
0.01 - 5.00
5.01 - 15.00
15.01 - 30.00
30.01 - 90.00
Vintage by Province
1995
2001–2008

Alaska's North Slope is Very Under-Explored

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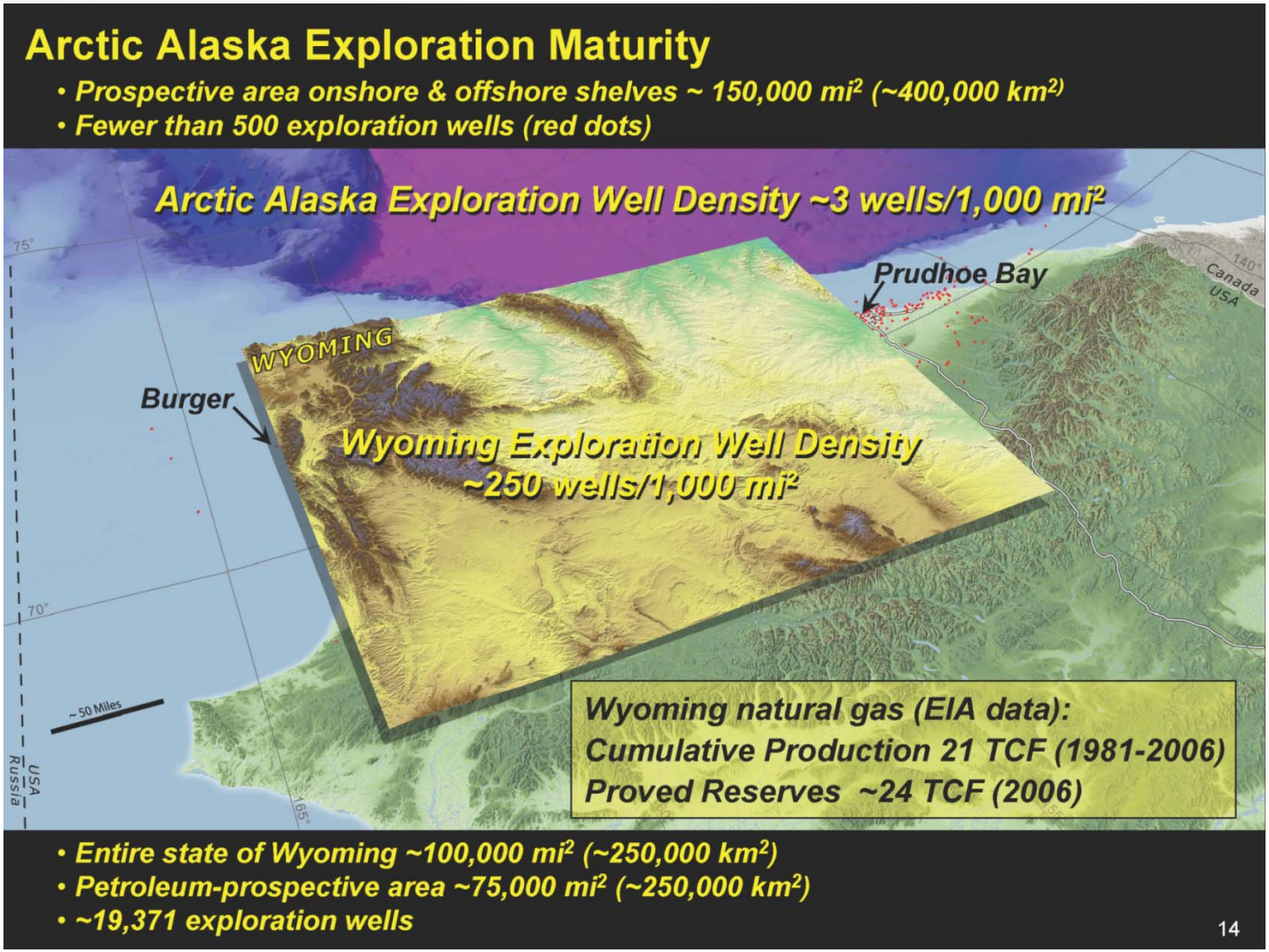

Courtesy of USGS

Alaska's Unconventional Gas Resources (continuous resources)

AGIA
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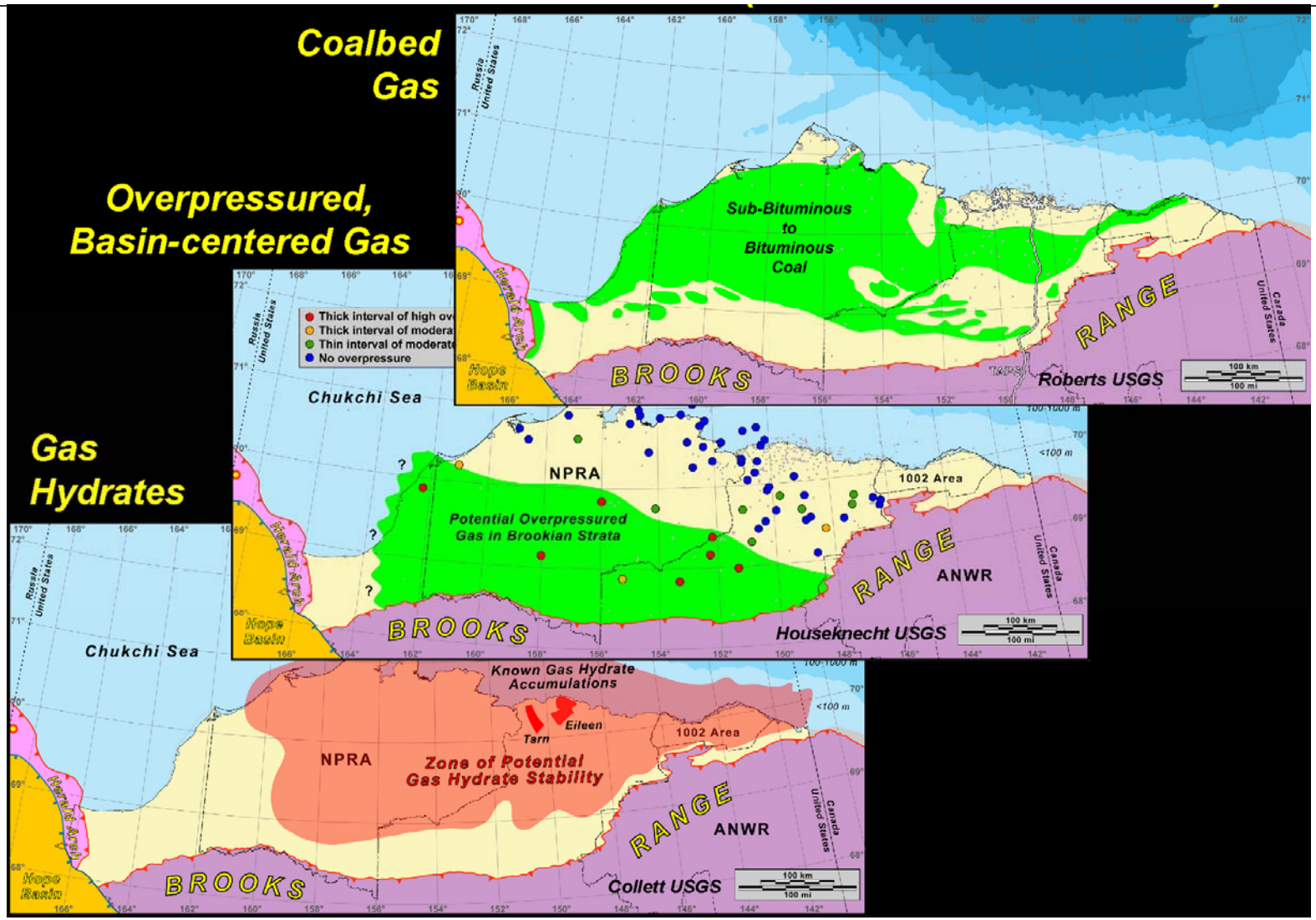

Alaska North Slope Natural Gas Hydrate Assessment Results

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[BCFG, billion cubic feet of gas. MMBNGL, million barrels of natural gas liquids. Results shown are fully risked estimates. F95 represents a 95-percent chance of at least the amount tabulated; other fractiles are defined similarly. Fractiles are additive, assuming perfect positive correlations. NGL, natural gas liquids; TPS, total petroleum system; AU, assessment unit.]

Total Petroleum System and Assessment Unit	Field Type	*Total Undiscovered Resources*							
		Gas (BCFG)				*NGL (MMBNGL)*			
		F95	F50	F5	Mean	F95	F50	F5	Mean
Northern Alaska Gas Hydrate TPS									
Sagavanirktok Formation Gas Hydrate AU	*Gas*	6,285	19,490	37,791	20,567	0	0	0	0
Tuluvak-Schrader Bluff-Prince Creek Formations Gas Hydrate AU	*Gas*	8,173	26,532	51,814	28,003	0	0	0	0
Nanushuk Formation Gas Hydrate AU	*Gas*	10,775	35,008	68,226	36,857	0	0	0	0
Total Undiscovered Resources		**25,233**	**81,030**	**157,831**	**85,427**	**0**	**0**	**0**	**0**

Source: USGS Fact Sheet 2008-3073

Natural Gas is America's Resource For Enhancing Economic, Environmental and National Security

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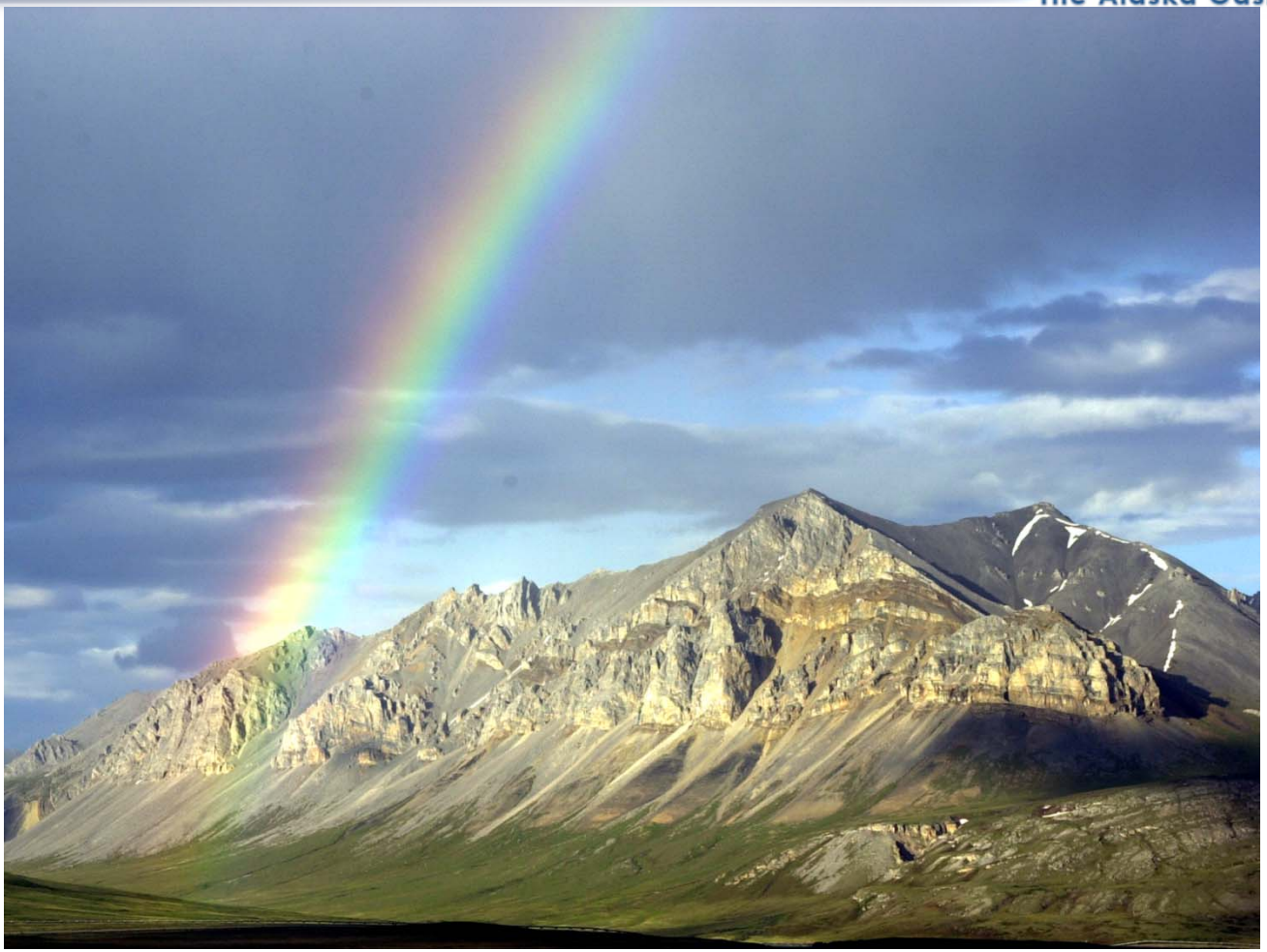

Atigun Gorge North Slope Alaska – Along the Gasline Route

Photo taken by David Houseknecht USGS

Undiscovered Conventional Gas Potential

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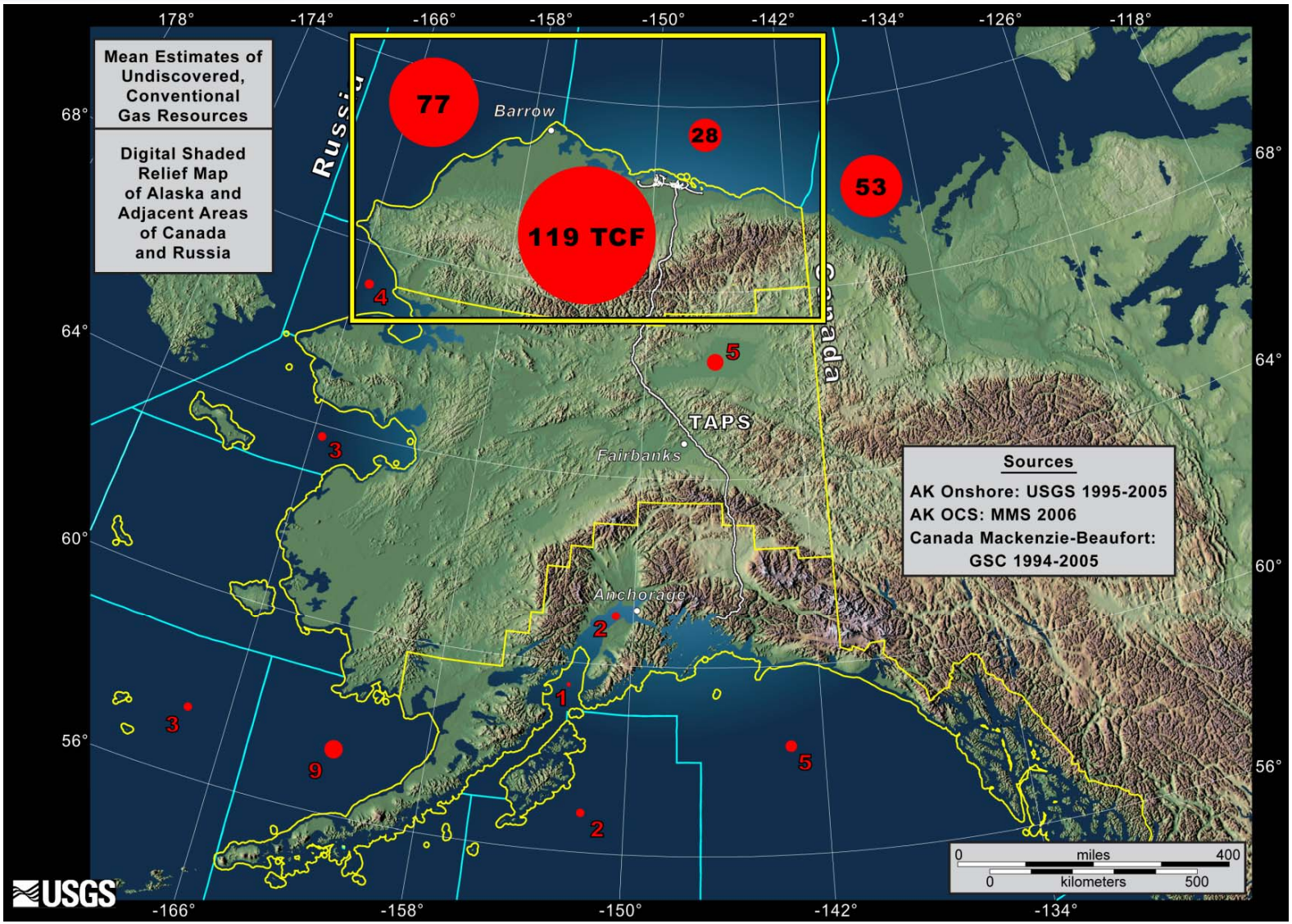

Potential for Undiscovered Petroleum in Arctic Alaska

USGS /MMS

AGIA
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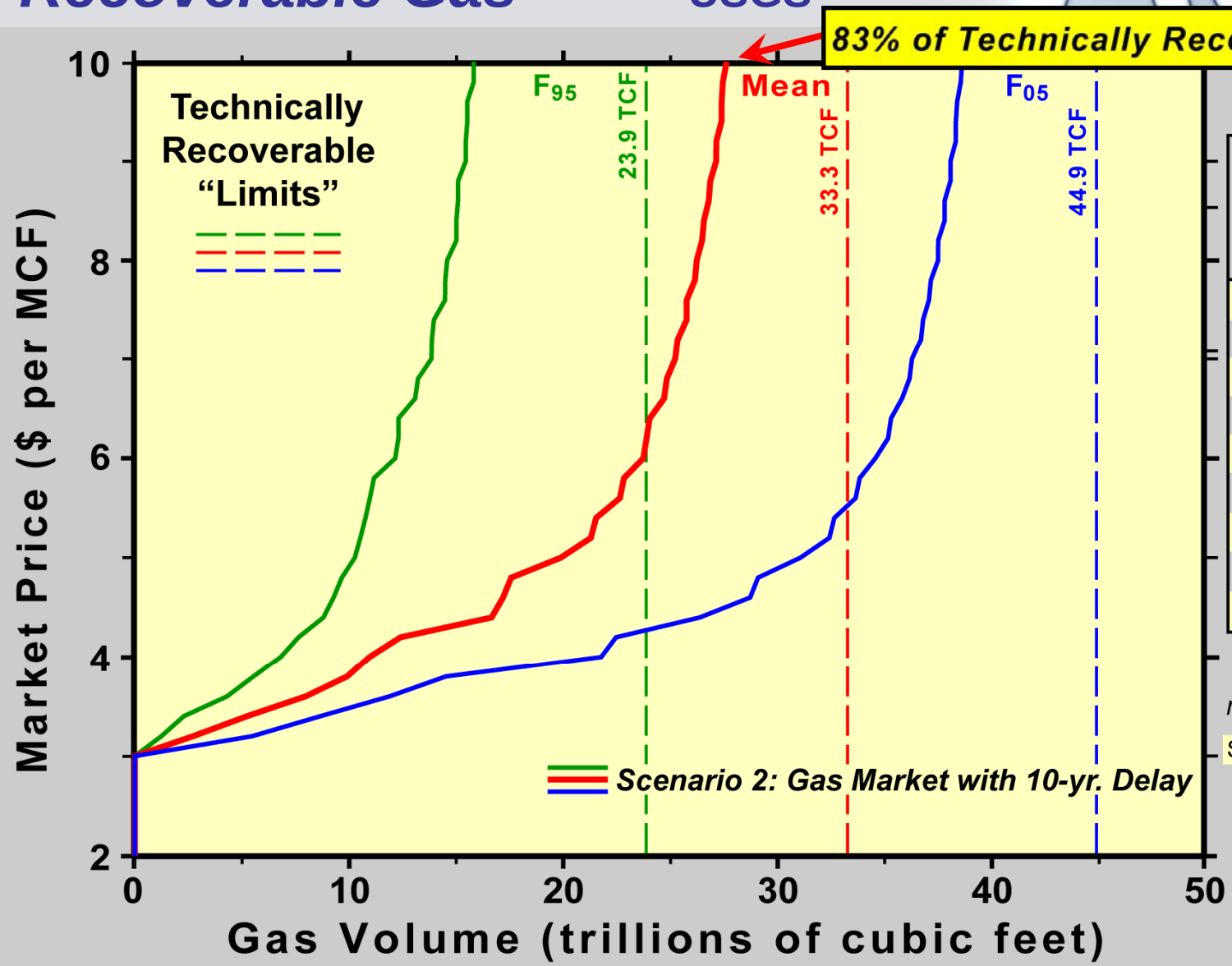
Mean Estimates of Undiscovered, *Conventional* Natural Gas in Arctic Alaska (trillion cubic feet)

	Non-Associated Gas	Associated Gas	Total Gas
Onshore & State Offshore Areas (USGS estimates)			
NPRA	61.35	11.68	73.03
Central North Slope	33.32	4.20	37.52
ANWR, 1002 Area	3.84	4.76	8.60
Subtotal	*98.51*	*20.64*	*119.15*
Federal Offshore Areas (MMS estimates)			
Chukchi Shelf	na	na	76.77
Beaufort Shelf	na	na	27.65
Hope Basin	na	na	3.77
Subtotal	na	na	*108.19*
TOTAL			*227.34*

Central North Slope Economically Recoverable Gas

USGS



Market Price ($/MCF)	Economically Recoverable Gas (trillion cubic feet) Sc. 2
2	0
3	0
4	10.9
5	19.9
6	23.7
7	25.2
8	26.2
9	27.1
10	27.6

Based on mean estimates of technically recoverable oil resources

Scenario 1 - No Gas Market

North Slope Gas Potential

DOE

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Location	Estimate of undiscovered technically recoverable conventional natural gas (Trillion Cubic Feet) Mean	Estimate of economically recoverable* natural gas reserves (Trillion Cubic Feet) Mean
National Petroleum Reserve, Alaska	73.0	31.0
Central North Slope, State Lands	37.5	33.3
ANWR 1002 area	8.6	1.0
TOTAL Onshore Potential	119 TCF	66.3 TCF
Chukchi Sea	76.8	50.0
Beaufort Sea	27.7	21.0
Hope Basin ?	3.8	
TOTAL Offshore Potential	108 TCF	71.0 TCF
TOTAL TCF	227 TCF	137.3

Data Sources: Regional Resource Assessments from the U.S. Geological Survey, http://energy.usgs.gov/alaska/ and Minerals Management Service http://www.mms.gov/alaska/re/reports/2006Asmt/

*NETL This study did not include Hope Basin.