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# The Economics and Market Impacts of Unconventional Gas in Europe

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A Realistic Balanced Perspective on  
European Unconventional Gas Developments  
**A North American Perspective**

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**Atlantic Council**

**1101 15<sup>th</sup> St NW, 11<sup>th</sup> Floor  
Washington, DC**

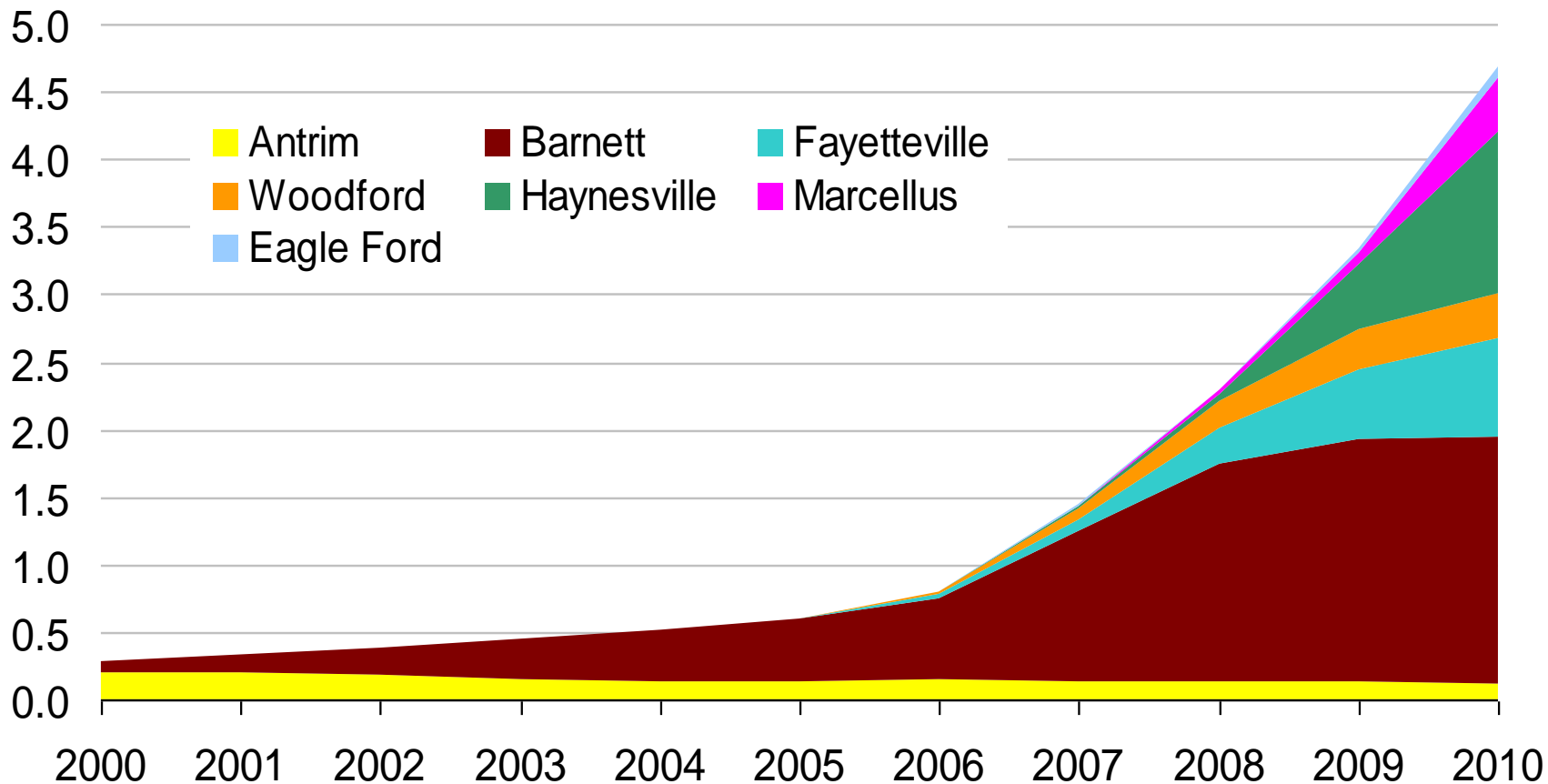


**U.S. Energy Information Administration**  
Independent Statistics and Analysis

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# Over the last decade, U.S. shale gas production has increased 14-fold

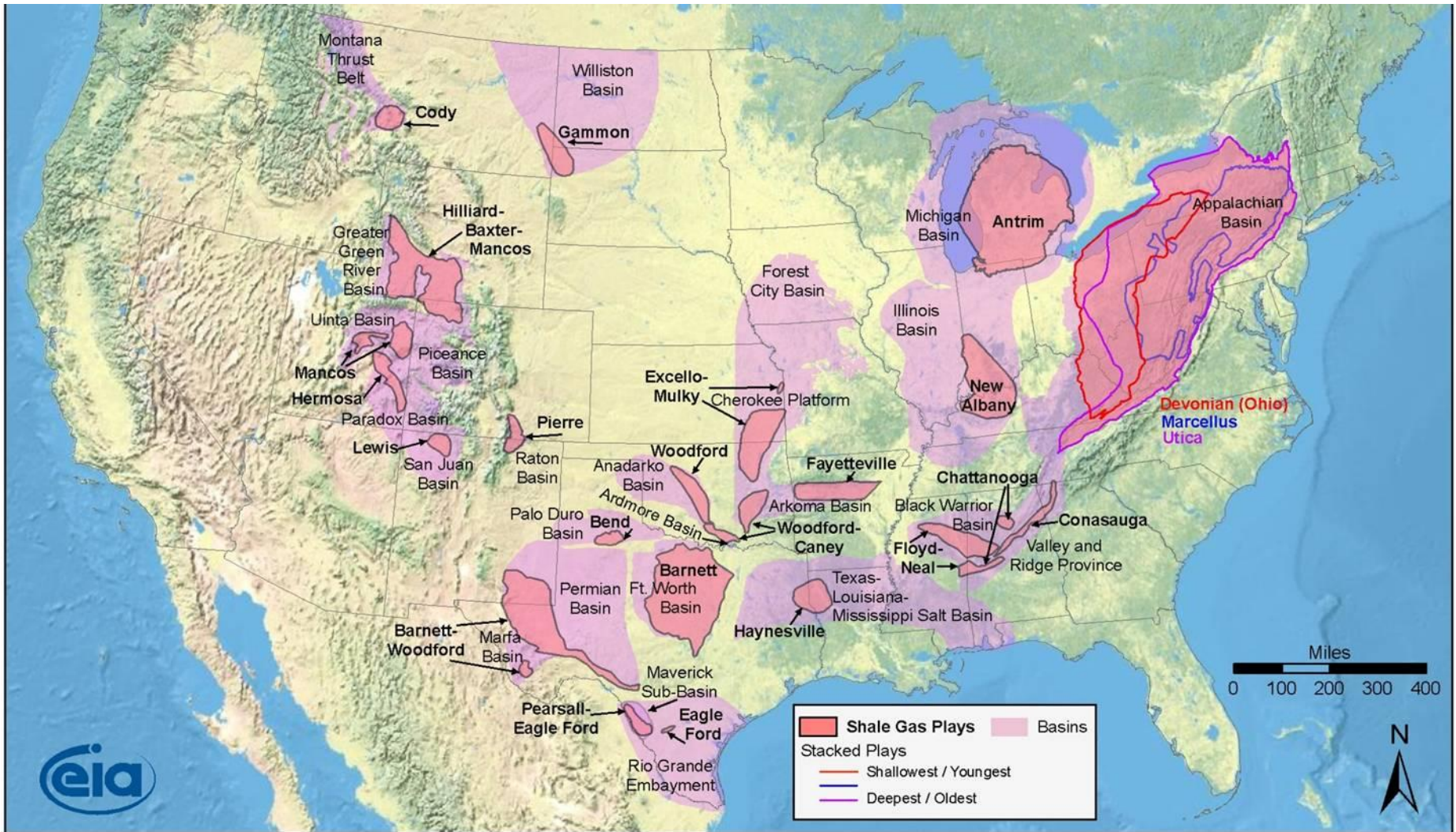
annual shale gas production  
trillion cubic feet



Source: EIA, Lippman Consulting (2010 estimated)



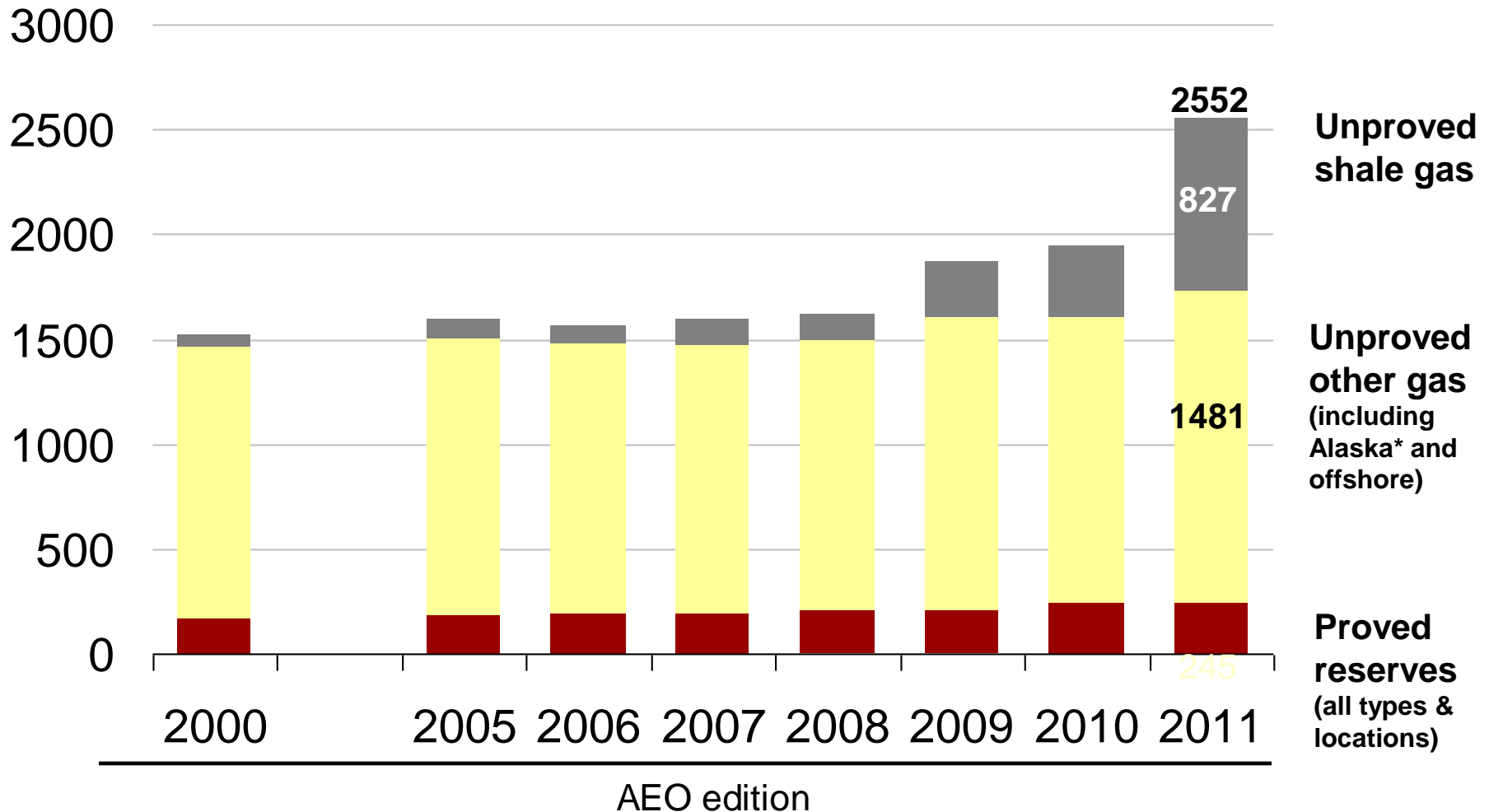
# Success in the Barnett prompted companies to look at other shale formations in the U.S.



Source: Energy Information Administration based on data from various published studies.

# Shale gas has been the primary source of recent growth in U.S. technically recoverable natural gas resources

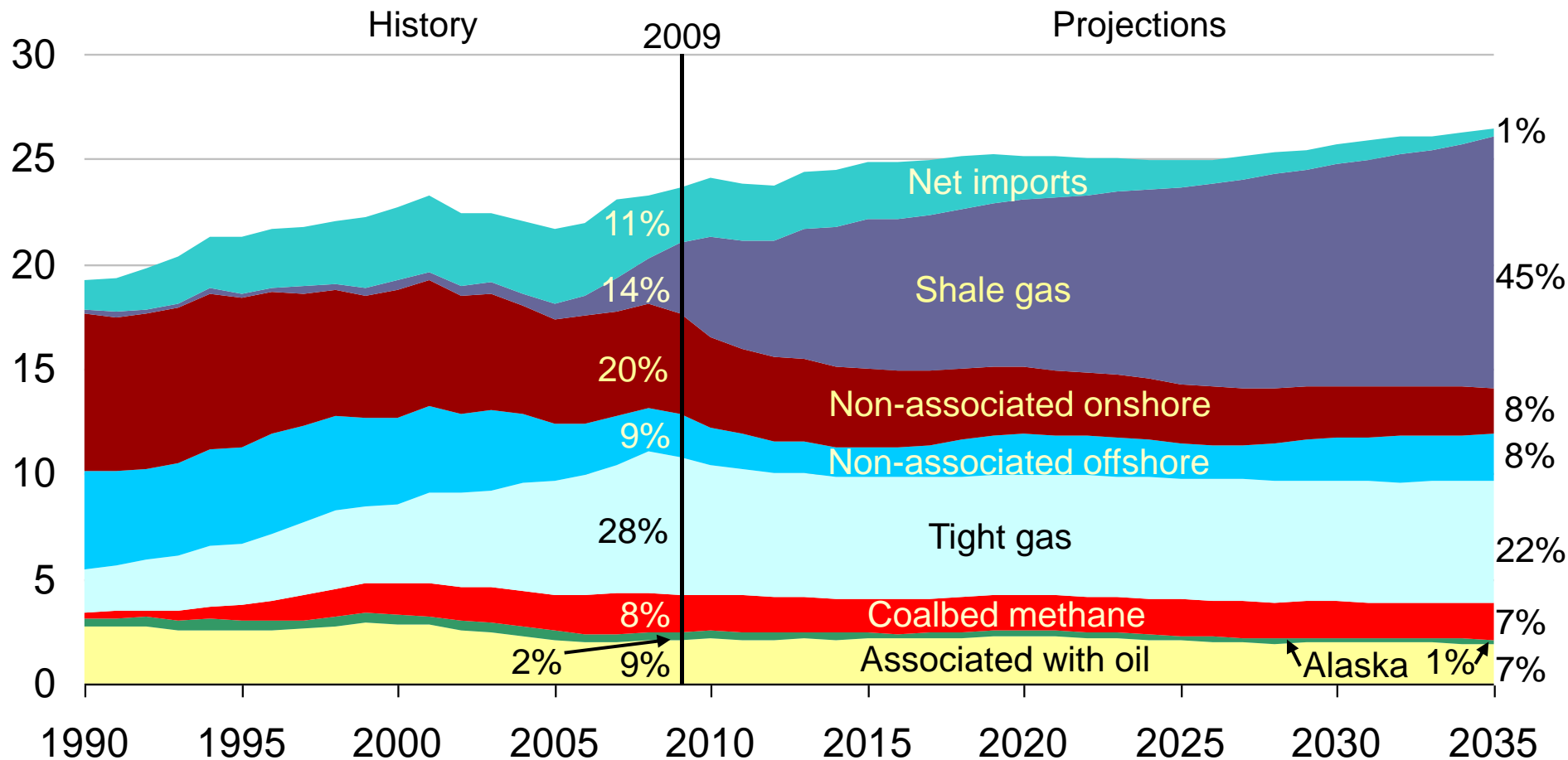
U.S. dry gas resources  
trillion cubic feet



\* Alaska resource estimates prior to AEO2009 reflect resources from the North Slope that were not included in previously published documentation.

# Shale gas offsets declines in other U.S. supply to meet consumption growth and lower import needs

U.S. dry gas  
trillion cubic feet per year

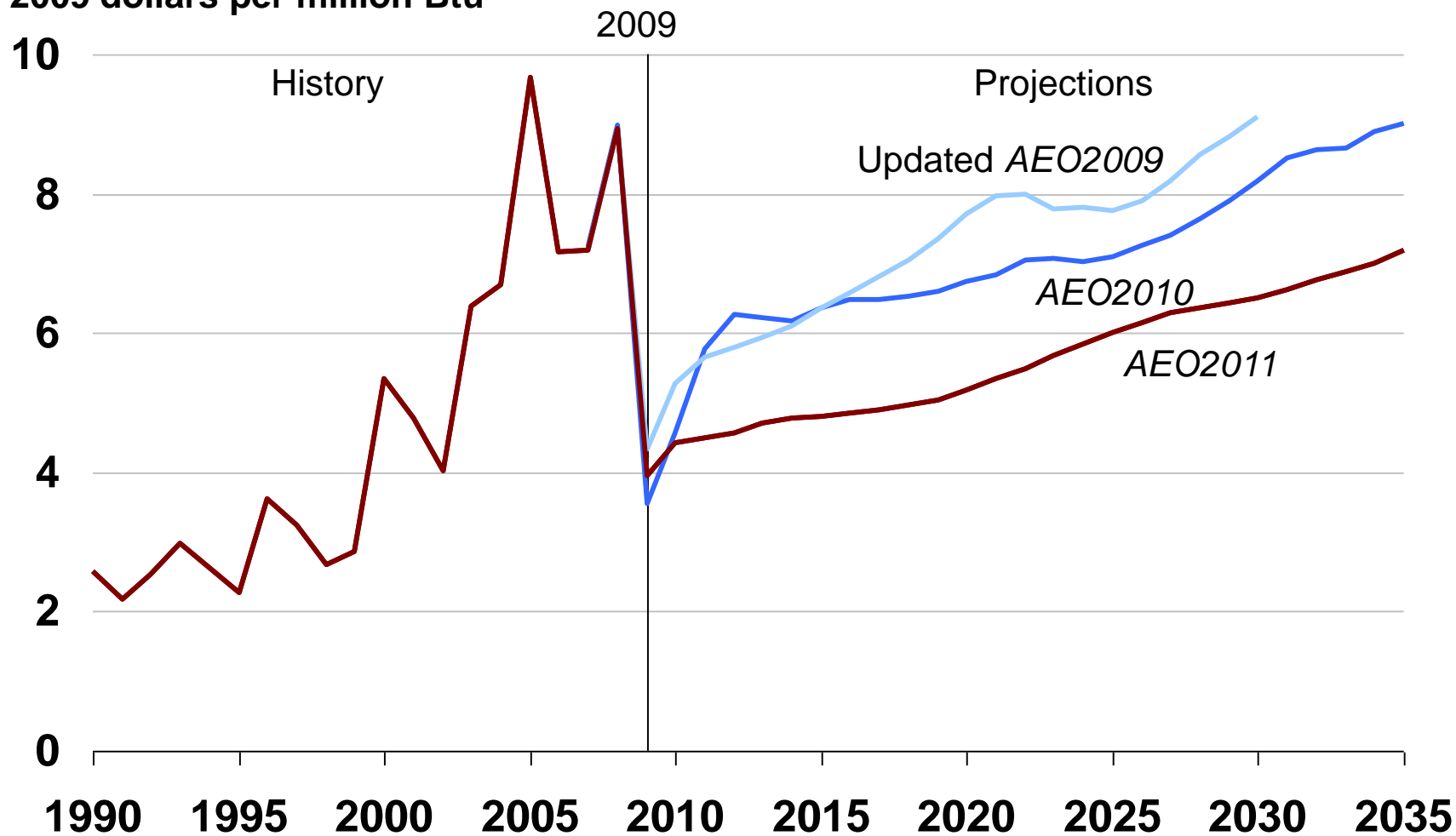


Source: EIA, Annual Energy Outlook 2011



# Natural gas price projections are significantly lower than past years due to an expanded shale gas resource base

natural gas spot price (Henry Hub)  
2009 dollars per million Btu



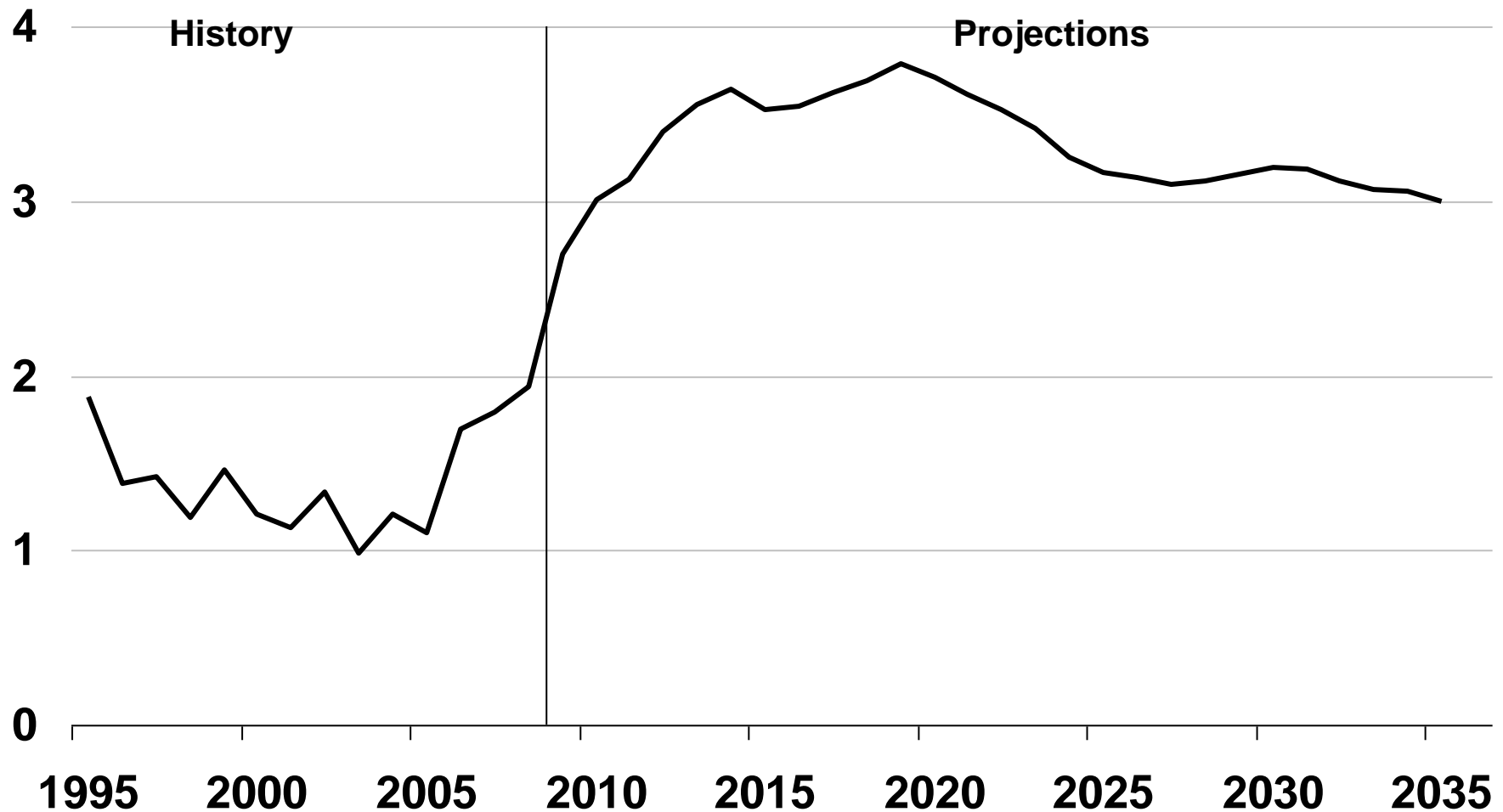


# Natural gas price projections are significantly lower than past AEOs

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- **Price Determination:** In the *AEO2011*, the price of crude oil impacts the cost to explore and develop domestic natural gas, but does not directly impact natural gas pricing. Analysis conducted prior to 2006 had demonstrated that crude oil prices directly influenced the natural gas price determination.
- **Shale Resources:** Increased application of advanced technologies (namely horizontal drilling and hydraulic fracturing) has opened the potential for production from additional shale resources allowing for a continued divergence in oil and natural gas prices.

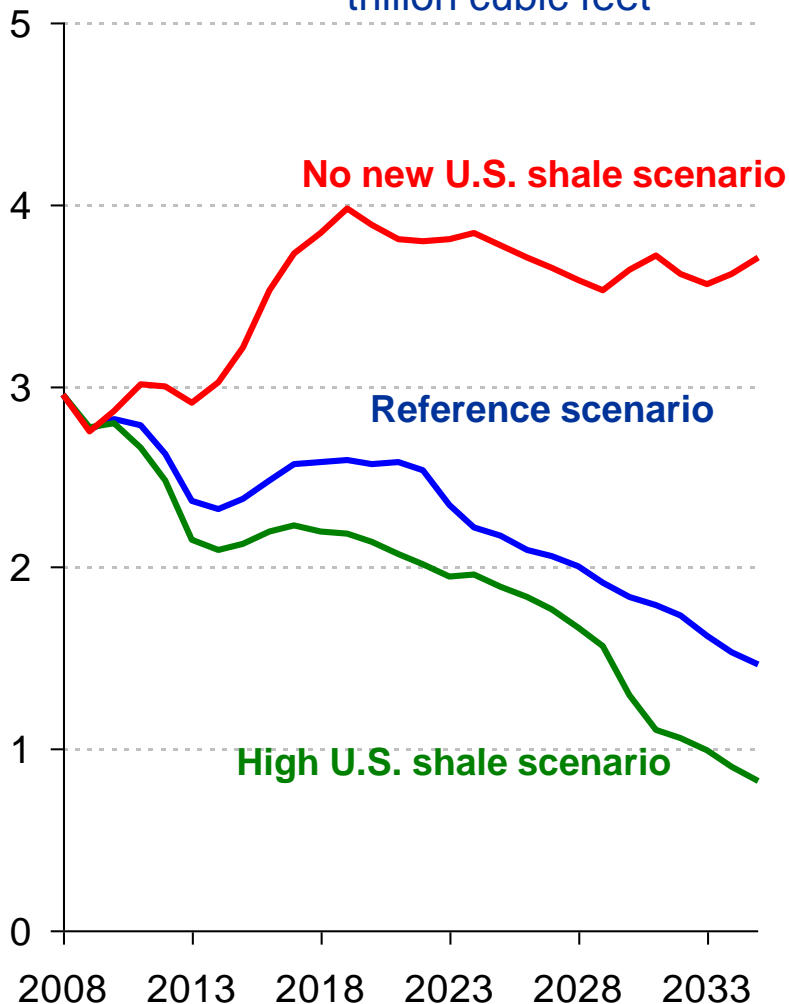
# Ratio of low-sulfur light crude oil prices to natural gas prices on an energy-equivalent basis, 1995-2035





# Shale gas production significantly affects projected U.S. gas imports, and could have similar effects in other gas importing countries

total U.S. natural gas imports  
trillion cubic feet



## Two alternate scenarios

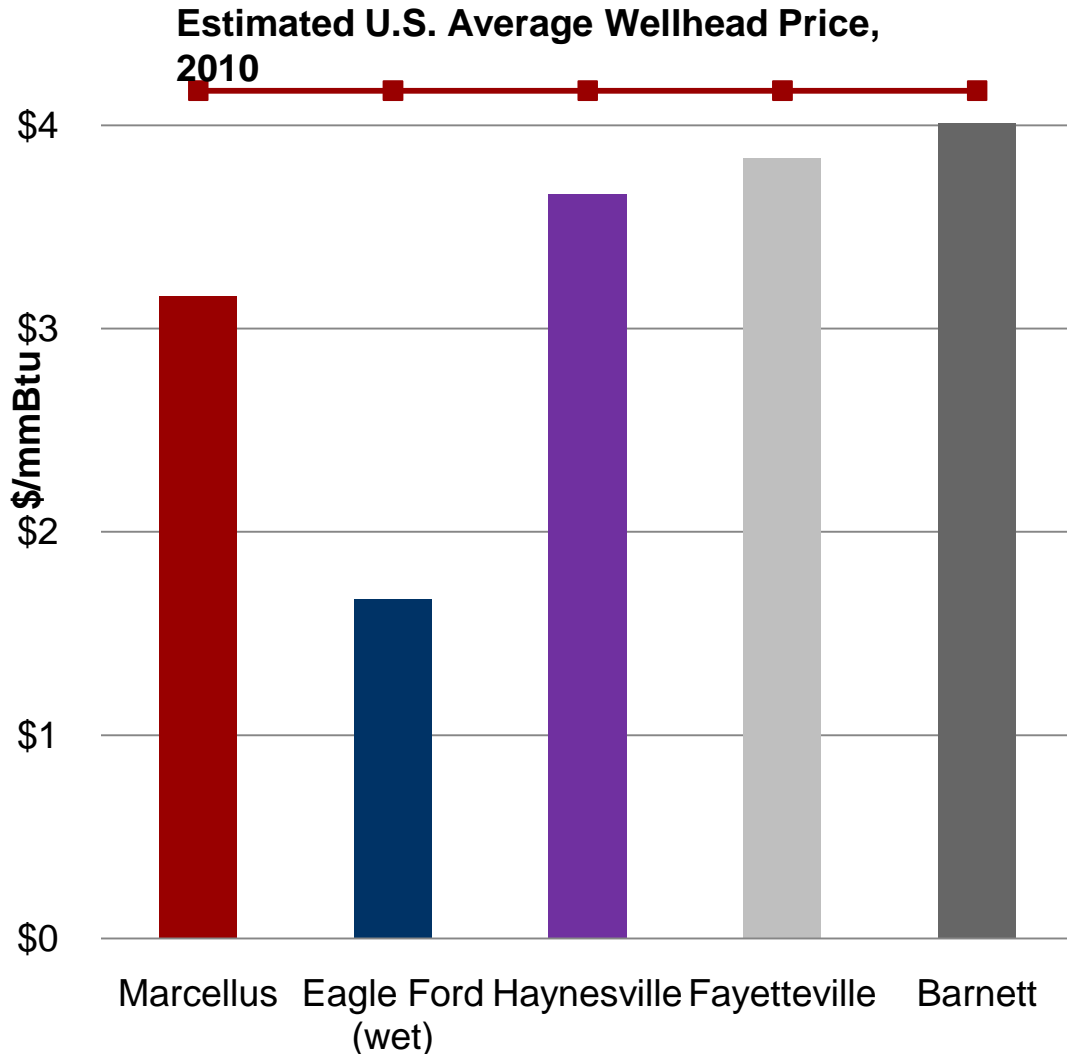
**No new U.S. shale scenario** allows no new onshore, lower 48 shale drilling after 2009

• **High U.S. shale scenario** increases unproved shale gas resources from 347 tcf to 652 tcf

### 2035 Results

Projection	Reference	No New Shale	High Shale Resource
Henry Hub price (\$2008/mmbtu)	\$8.88	\$10.37	\$7.62
Total U.S. gas production (tcf)	23.3	19.1	25.9
Alaska pipeline start year	2023	2020	2030
Net U.S. gas imports (tcf)	1.5	3.7	0.8
Total U.S. gas consumption (tcf)	24.9	22.9	26.8

# Bentek breakeven costs of major U.S. shale plays



BENTEK calculates breakeven cost by collecting production data for key operators in shale basins with assumptions for each play.

Costs include drilling, completion, initial production rates, operating costs, taxes, decline rates, gathering, transportation and royalties.

Does not include exploration and acreage costs.

Utilizes well-head gas price and liquids assumptions with before-tax IRR of 10 percent.

Breakeven costs can vary significantly within basins.

Source: BENTEK LLC, Production Monitors, January 2011



# Considerable shale formation heterogeneity

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“Serving as source, trap and seal, shale beds have characteristics that vary not only from region to region but also within specific plays and fields. In fact, there often are significant well-to-well variations in gas production within a single field.... Where there is large variability in production from well to well, it clearly tends to challenge any assumption that shales and their indigenous hydrocarbons are simple and consistent.”

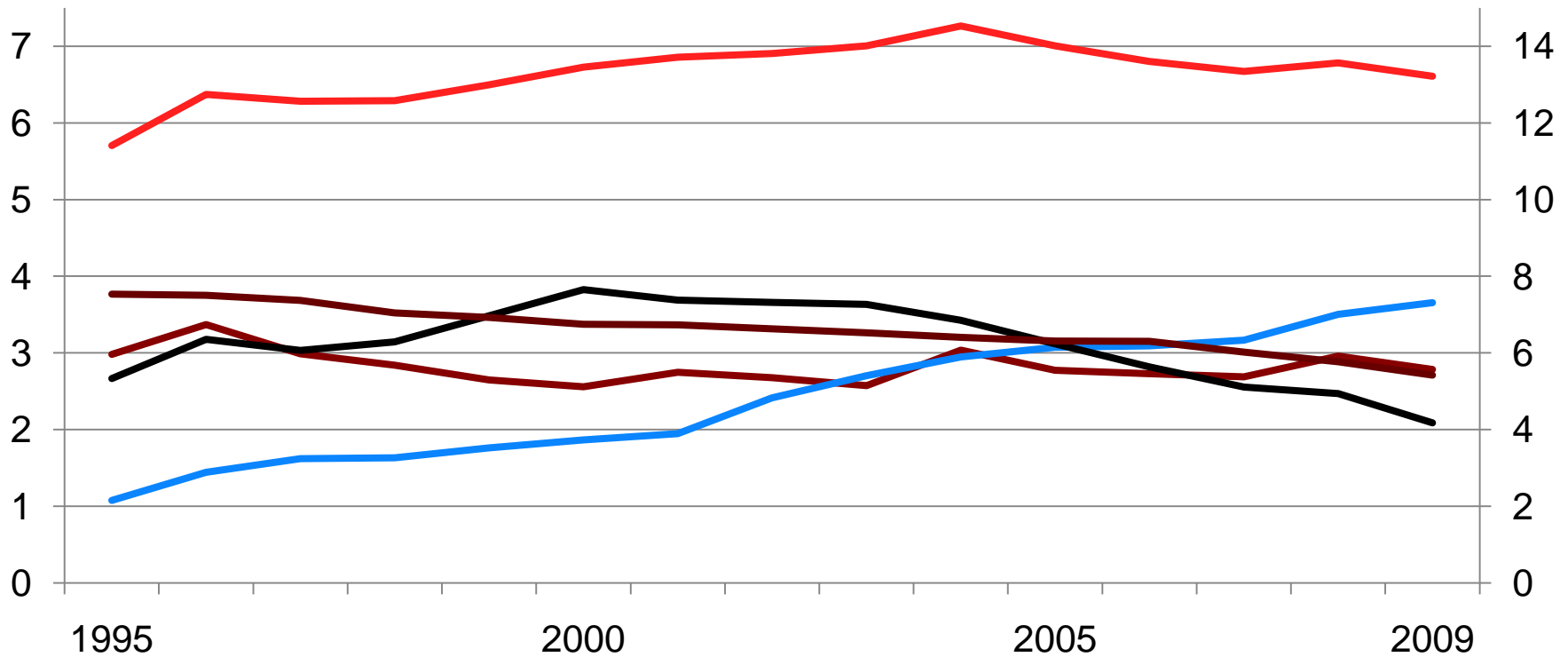
**Source: American Association of Petroleum Geologists, Explorer Magazine, “Shales – Similar, Yet So Different,” by Louise S. Durham, September 2010, pages 28, 33.**

# Considerable shale formation heterogeneity



- Barnett shale gas wells exhibit significant variability regarding initial gas production rates.
- This variability in initial gas production rates has a profound impact on rates of return.
- Some parties have estimated that potentially up to 25 percent of the Barnett wells are unprofitable under certain circumstances.

# Outside of Norway, European natural gas production is declining (Tcf)



— Netherlands  
— United Kingdom

— Norway  
— Rest of Europe

# Partial list of companies active in European shale gas

## FRANCE

Total  
GDF Suez  
Elixir Petroleum  
eCORP  
Eagle Energy  
YCI Energy  
Bridgeoil Ltd  
Diamoco Energy  
Schuepbach LLC  
Dale Gas Partners  
Mouvoil Sa

## POLAND

PGNiG  
Talisman Energy  
Marathon Oil  
Chevron  
Exxon Mobil  
Realm Energy Int.  
San Leon Energy  
UKRAINE  
Total & EuroGas  
Exxon Mobil  
Marathon Oil

## GERMANY

Exxon Mobil  
Realm Energy  
BNK Petroleum  
3Legs Resources  
ROMANIA  
EastWest Resource  
BULGARIA  
Direct Petroleum  
Park Place Energy  
Integrity Towers  
Chevron

## UK

Cuadrilla Resource  
Island Gas  
Celtique Energy  
Eden Energy  
Eurenergy

## AUSTRIA

OMV Exploration

## NETHERLAND

Cuadrilla Resource  
TAQA UAE

## Foreign investment in U.S. shale plays

Foreign Partner	Domestic Partner	Shale Play	Deal Amt (\$bn)	Year
Reliance	Pioneer	Eagle Ford	1.32	2010
Reliance	Atlas	Marcellus	1.70	2010
Reliance	Carrizo	Marcellus	0.39	2010
StatoilHydro	Chesapeake	Marcellus	3.38	2009
Total	Chesapeake	Barnett	2.25	2009
CNOOC	Chesapeake	Eagle Ford	1.08	2010
British Gas	EXCO	Marcellus	0.95	2010
British Gas	EXCO	Haynesville	1.30	2009
Mitsui	Anadarko	Marcellus	1.40	2010
<b>Total</b>			<b>13.77</b>	

Source: EIA, from trade press reports  
As of October, 2010





# Summary

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- The impact of shale gas production technology on the U.S. energy outlook has occurred rapidly and is still evolving.
- At the U.S. Henry Hub, natural gas prices are expected to rise from about \$4.40 per MMBtu to \$7.20 per MMBtu between 2009 and 2035.
  - Shale gas production expands from 3.3 TCF in 2009 to 12 TCF by 2035, or from about 4% to 45% of supply.
  - Coalbed methane production remains relatively flat, with a supply share of about 8%.
- There has been significant interest and direct investment in U.S. shale gas companies by non-U.S. companies and the majors.

# Summary (continued)

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- Some have estimated breakeven costs, under certain conditions, that suggest lower breakeven costs for shale gas. However, future costs may be influenced by
  - Actual geology encountered,
  - Increased drilling activity,
  - Competition for rigs and crews as shale gas production begins in other countries, and
  - (Re)Convergence of crude oil and natural gas markets.
- The EIA is working with others, including ARI, to assess below-ground and above-ground factors that would affect the potential for shale gas production in other countries.

# More Information

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U.S. Energy Information Administration home page [www.eia.gov](http://www.eia.gov)

Short-Term Energy Outlook [www.eia.gov/emeu/steo/pub/contents.html](http://www.eia.gov/emeu/steo/pub/contents.html)

Annual Energy Outlook [www.eia.gov/oiaf/aeo/index.html](http://www.eia.gov/oiaf/aeo/index.html)

International Energy Outlook [www.eia.gov/oiaf/ieo/index.html](http://www.eia.gov/oiaf/ieo/index.html)

Country Analysis Briefs [www.eia.gov/cabs](http://www.eia.gov/cabs)

National Energy Information Center [\(202\) 586-8800](tel:(202)586-8800)

Live expert from 9:00 AM – 5:00 p.m. EST  
Monday – Friday (excluding Federal holidays)

email: [InfoCtr@eia.doe.gov](mailto:InfoCtr@eia.doe.gov)

U.S. Energy Information Administration

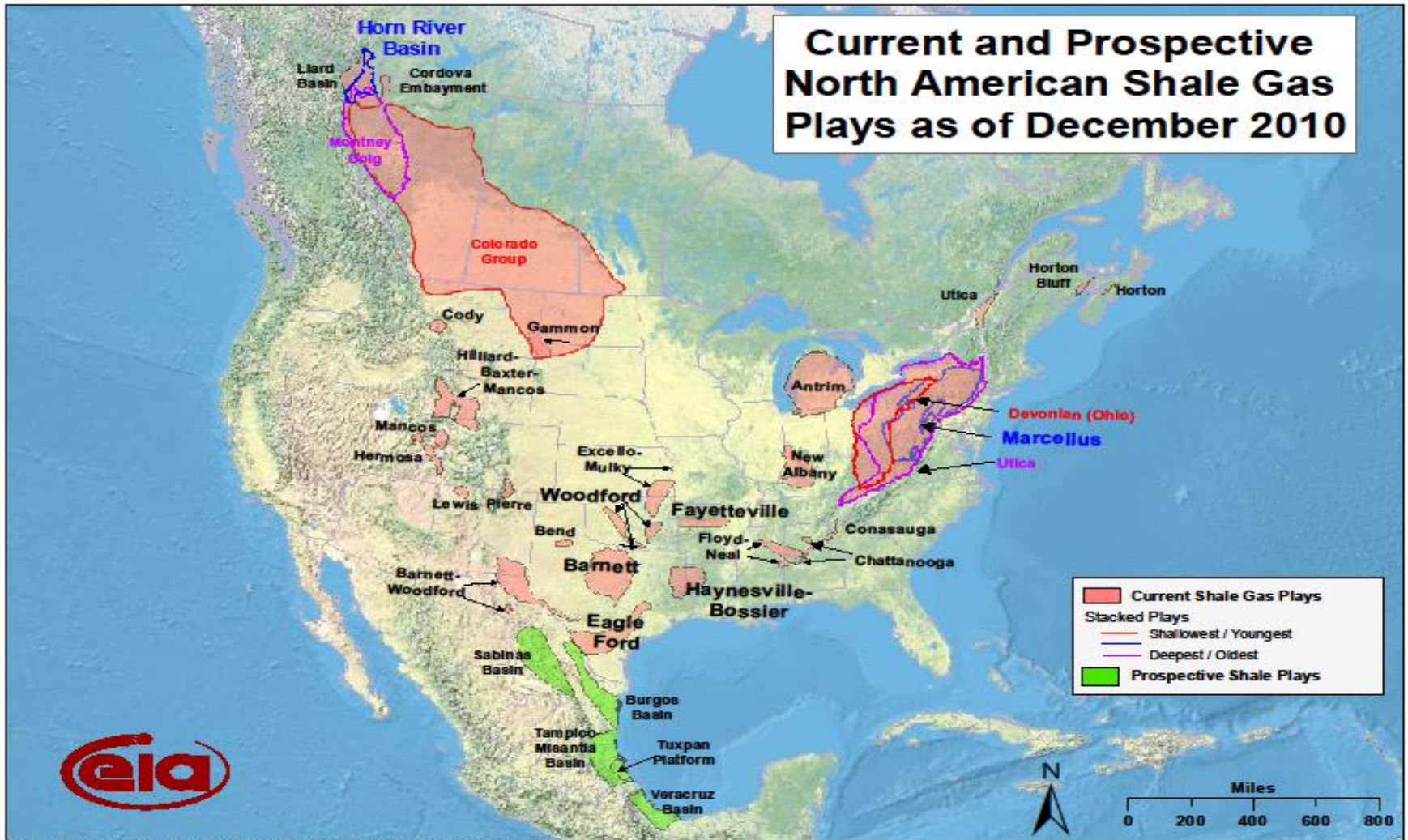
[www.eia.gov](http://www.eia.gov)



# Additional Slides

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# Map of North America shale gas plays



Source: Energy Information Administration based on data from various published studies.  
Updated: December 15, 2010

Source: [www.eia.gov](http://www.eia.gov)

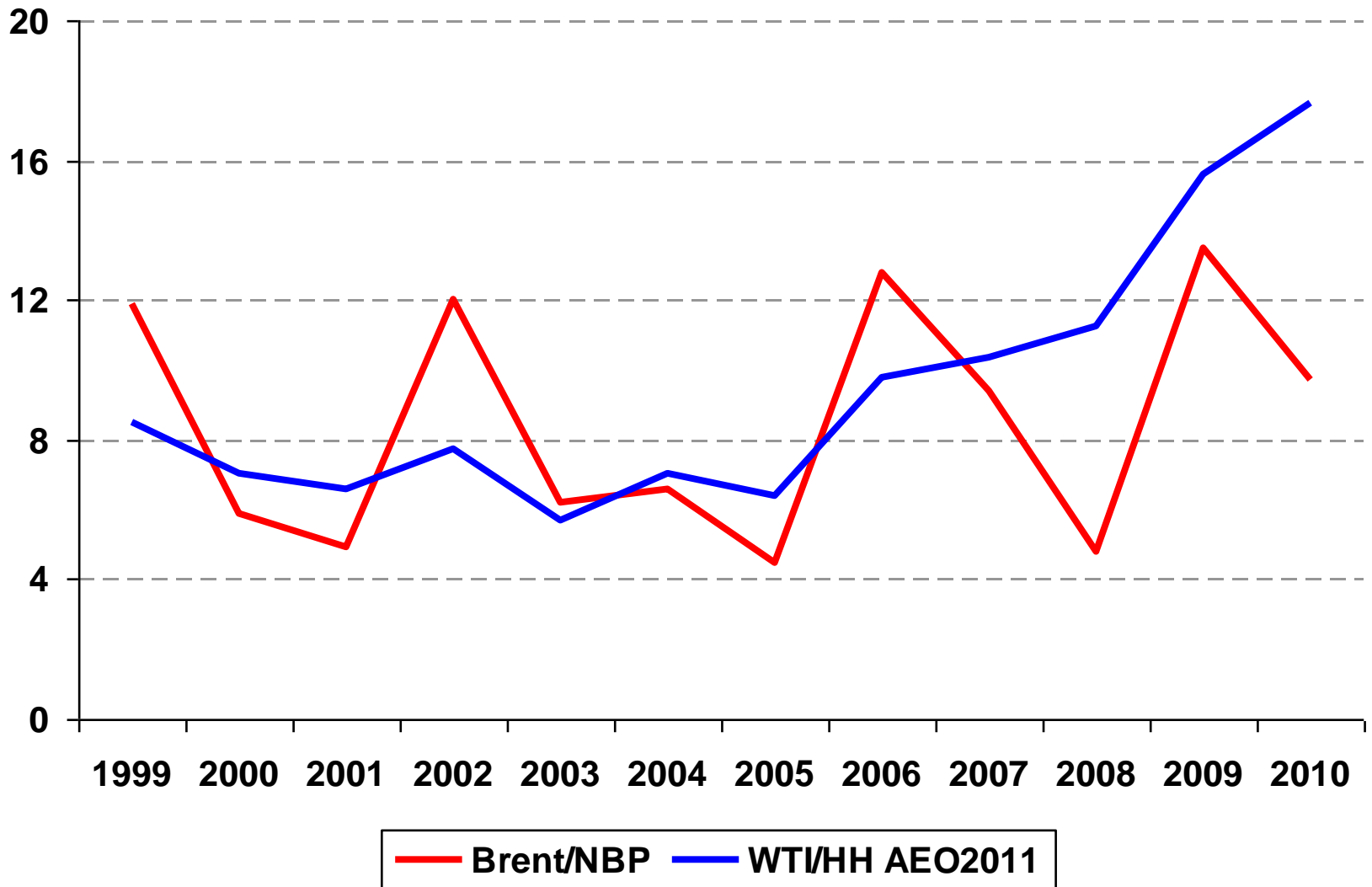
# Natural gas sourced from LNG has increased, at the same time as consumption has declined

(Tcf)	2005	2006	2007	2008	2009
Europe Consumption	24.39	23.77	24.04	24.37	21.78
UK Consumption	3.38	3.21	3.24	3.35	3.11
Europe LNG imports	1.70	2.00	1.87	1.88	2.43
UK LNG Imports	0.02	0.12	0.05	0.03	0.36
Europe LNG imports as % of total consumption	7.0%	8.4%	7.8%	7.7%	11.1%
UK LNG imports as % of total consumption	0.5%	3.7%	1.5%	1.0%	11.6%



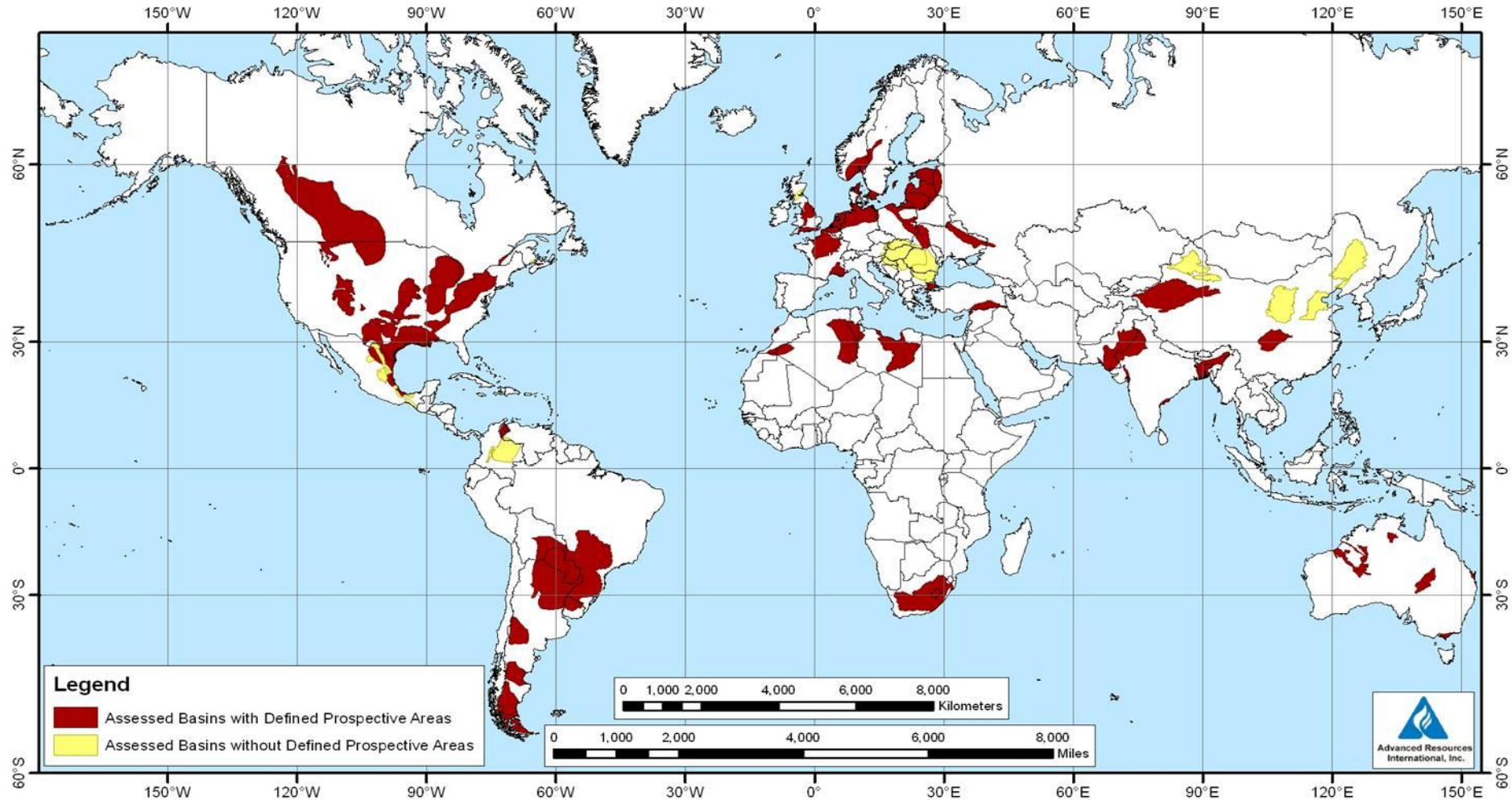
2009 LNG import data from Cedigaz estimates, all other data from EIA

# Oil to Gas Price Ratios

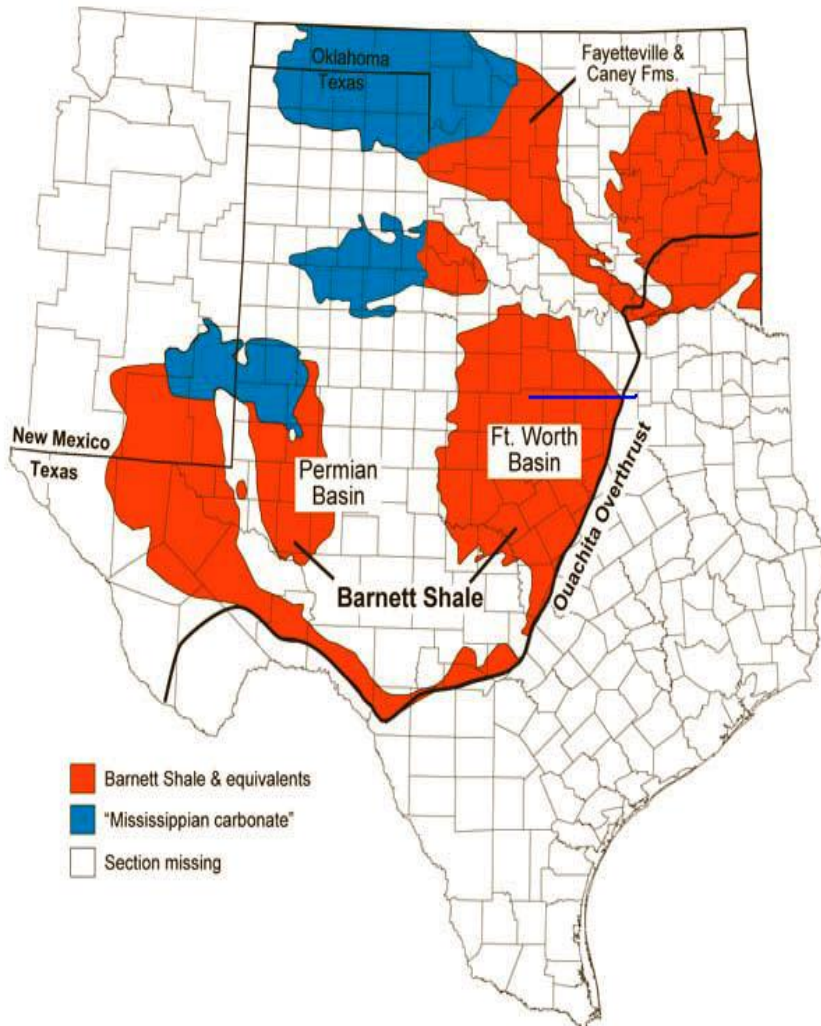




# Current World Shale Gas Prospects



# Portions of the “mature” Barnett shale remain untested

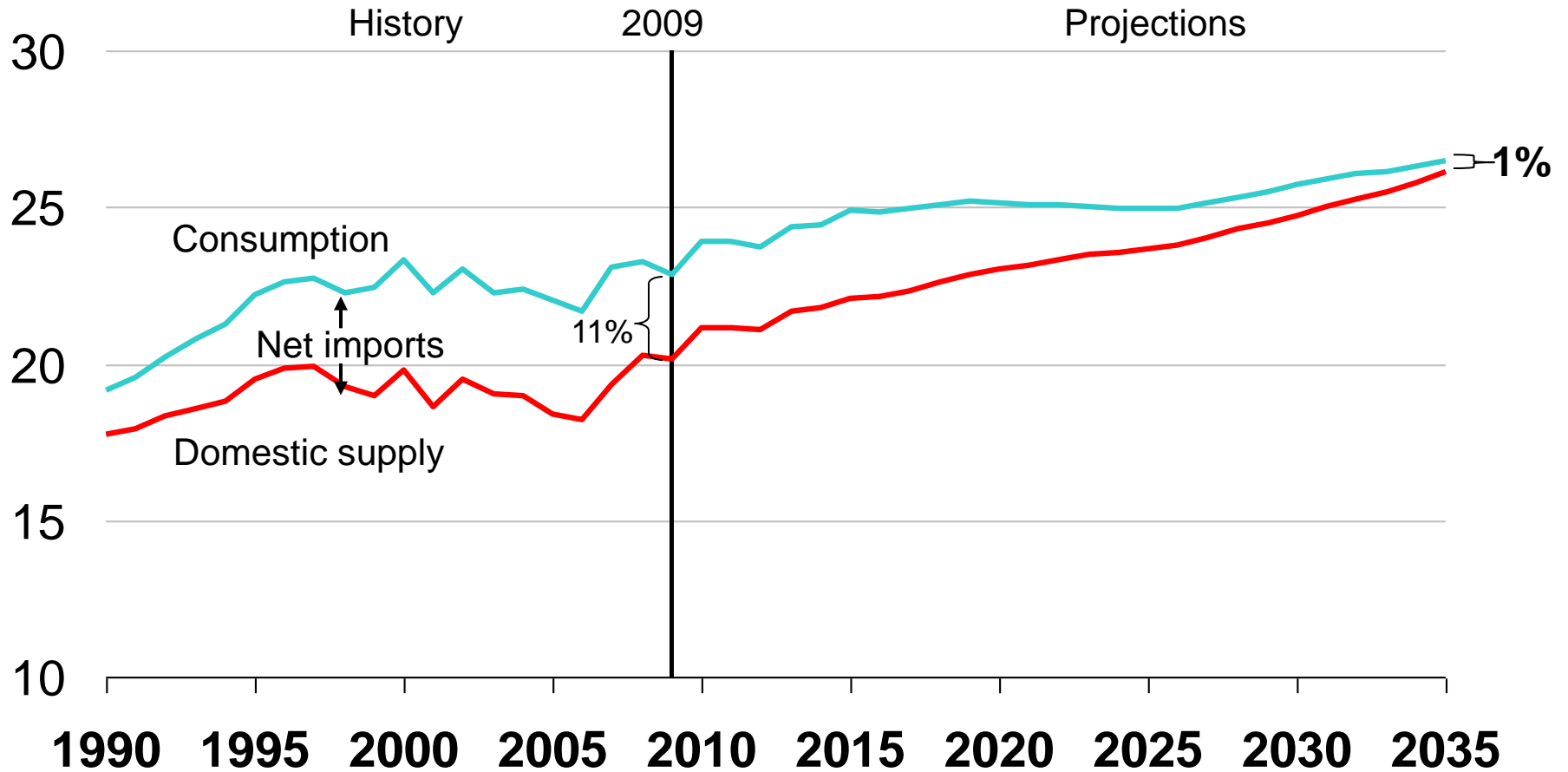


- In north-central Texas, the Barnett shale covers all or part of at least 30 counties. Wells have been drilled in about 23 counties, with most of the wells drilled in 5 or 6 counties.
- The Barnett shale also exists in the Permian Basin in west Texas. Only a few wells have been drilled in the west Texas Barnett, which were deemed to be “disappointing” and so no further drilling has occurred there, but could occur later.

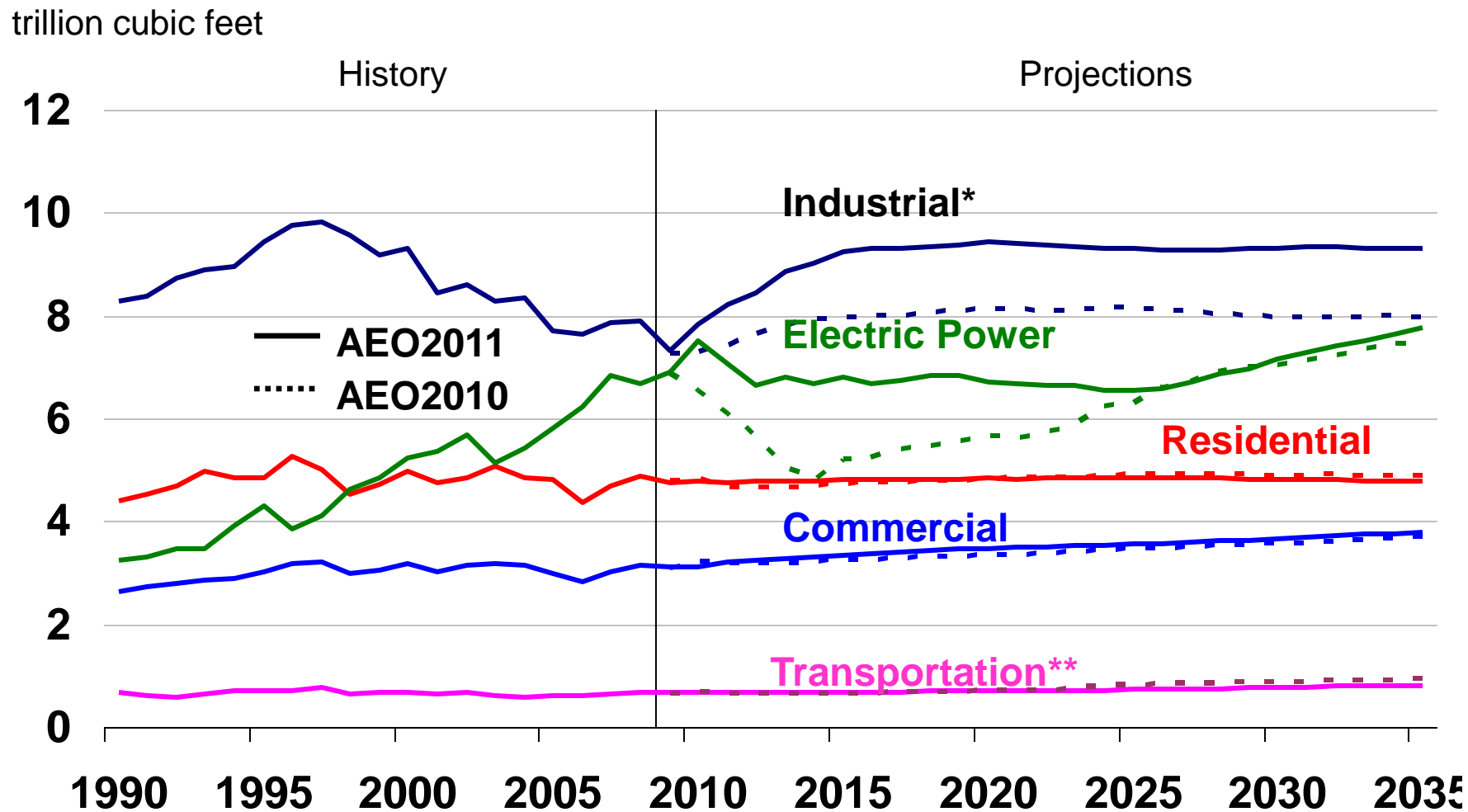
Note regarding map – Shale labeled as “Fayetteville” is actually the Woodford Shale.

# 30% domestic gas production growth outpaces 16% consumption growth, leading to declining imports

U.S. dry gas  
trillion cubic feet per year



# Natural Gas Consumption by Sector: AEO2011 vs AEO2010



\* Includes lease and plant fuel

\*\* Includes pipeline fuel

