



The Outlook for Renewables in a Changing Power and Natural Gas Market

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Summary/Take-Away Points

- **New natural gas supply availability is having considerable impacts on all energy markets today and on longer term, forward-looking basis.**
- **Given the prevalence of natural gas at the margin, this impacts not just retail gas usage, but also power, renewables and environmental valuations.**
- **Lower gas commodity will also drive down gas as a share of total bill and start to move base rate/commodity cost relationships to longer-run averages could have impacts on longer term electricity demand (and RPS requirements).**
- **Gas market changes will impact avoided costs (future looking costs) and have implications for cost-effective energy efficiency and renewable energy requirements.**



Marginal Costs/Avoided Costs

Marginal cost – the change in total cost resulting from an extremely small change in output. Typically thought of in the short run, although long run marginal costs can be important for planning purposes.

Avoided costs – the real world estimate of long run marginal costs where all factors of production (or inputs such as capital/capacity and other variable costs) are variable.

Important in long run resource planning evaluation as well as evaluation of renewable energy resources and energy efficiency measures.



Avoided cost estimates are often a function of:

- 1. Future energy costs (fuel/natural gas driven)**
- 2. Future capacity costs**
- 3. Future natural gas commodity costs (LDC)**
- 4. Future environmental costs**
- 5. Future renewable costs**
- 6. Zero dispatch benefits (use/application varies by state)**

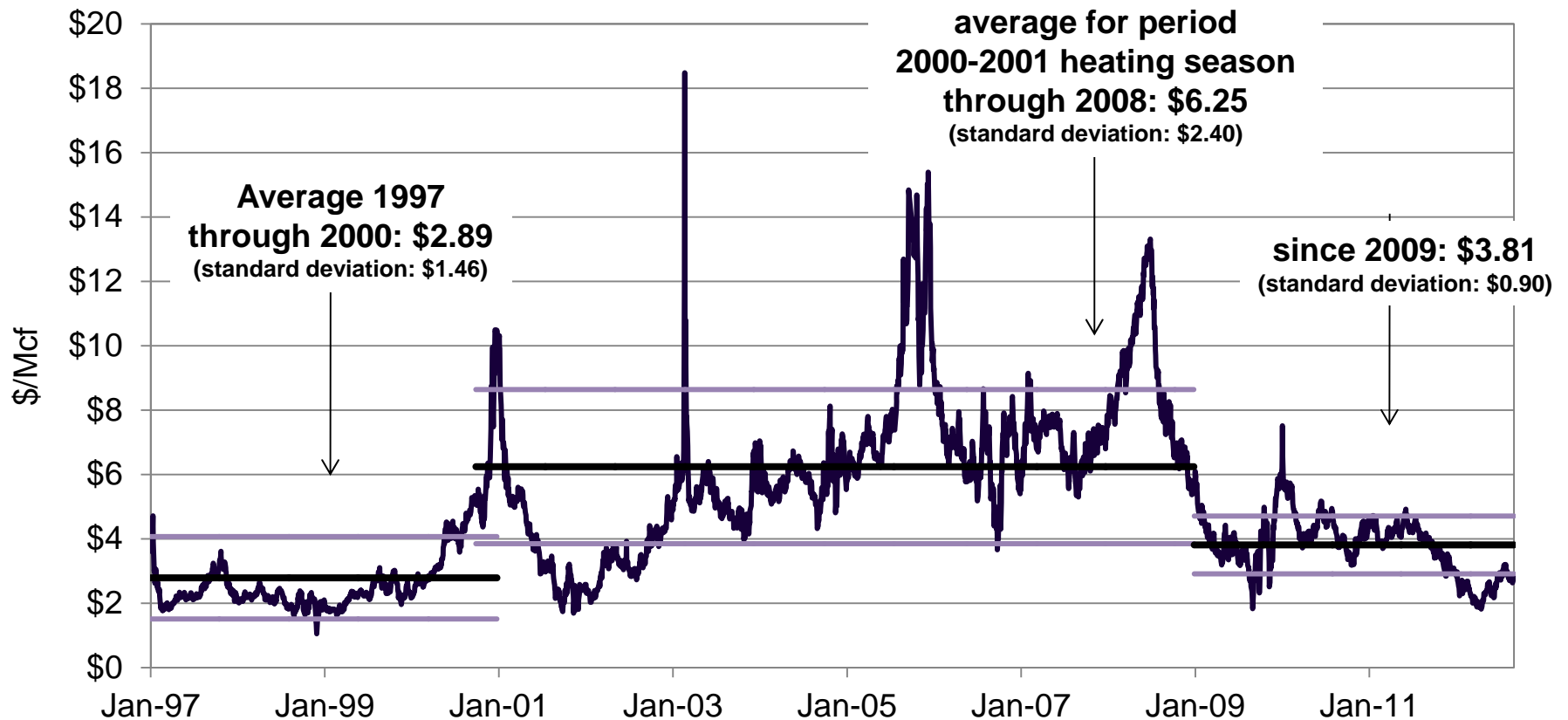


Energy/Natural Gas Prices



Natural Gas Price Variability

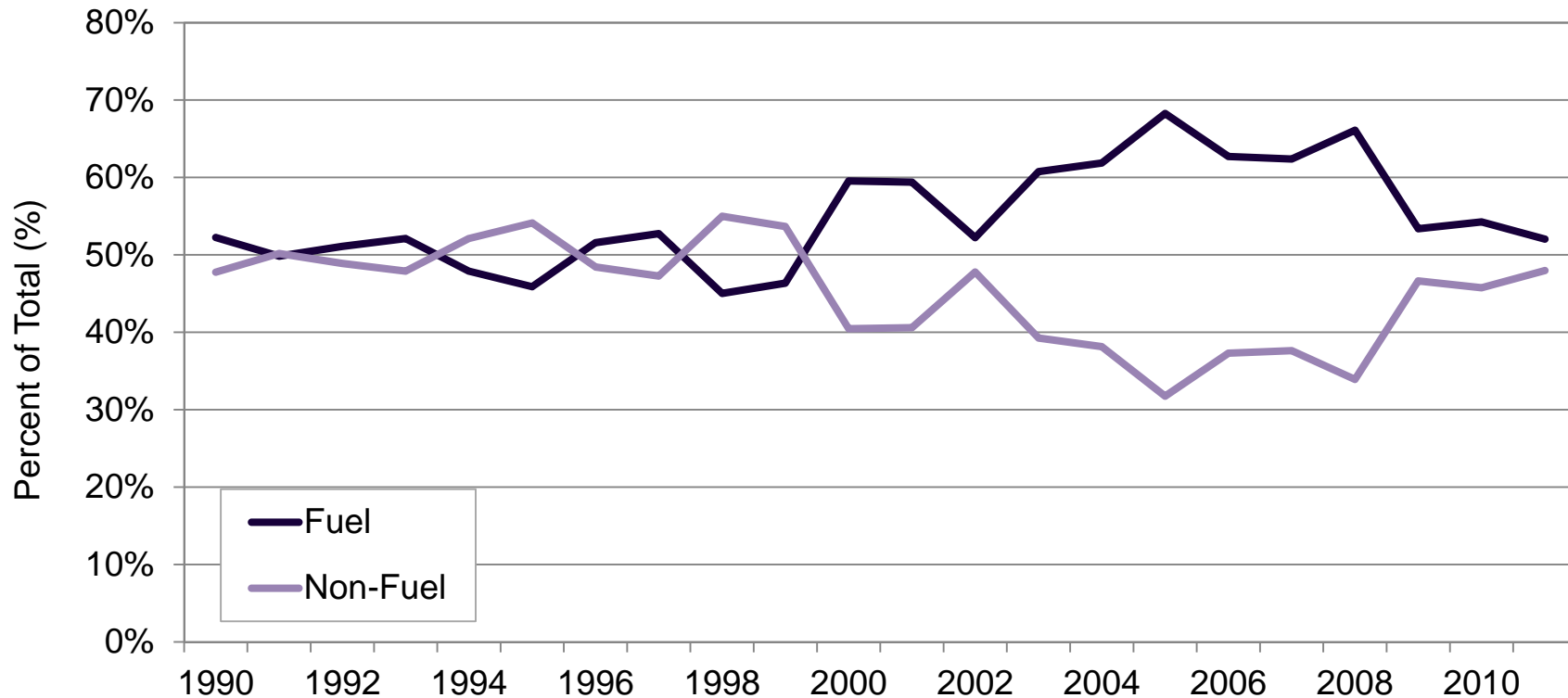
The 2001 to 2009 market trend of higher average prices coupled with high volatility is reversing itself and post 2009 prices are significantly lower.





Estimated Gas and Non-Gas Costs in U.S. Distribution Rates

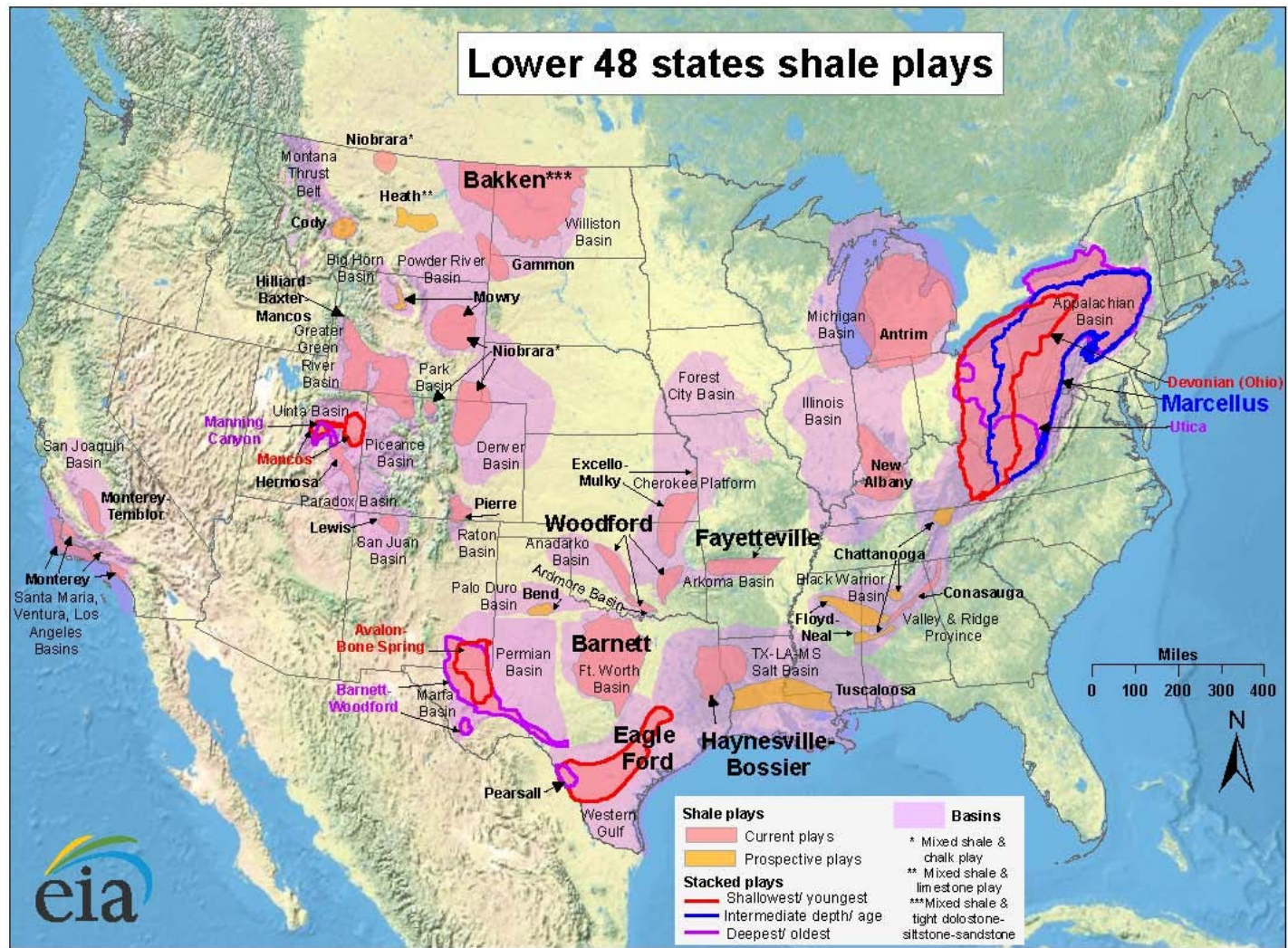
The commodity share of total bills are closer to percentages observed in the 1990s rather than the early 2000s. May start to move demand trends back to historic norms.





Domestic Shale Gas Basins and Plays

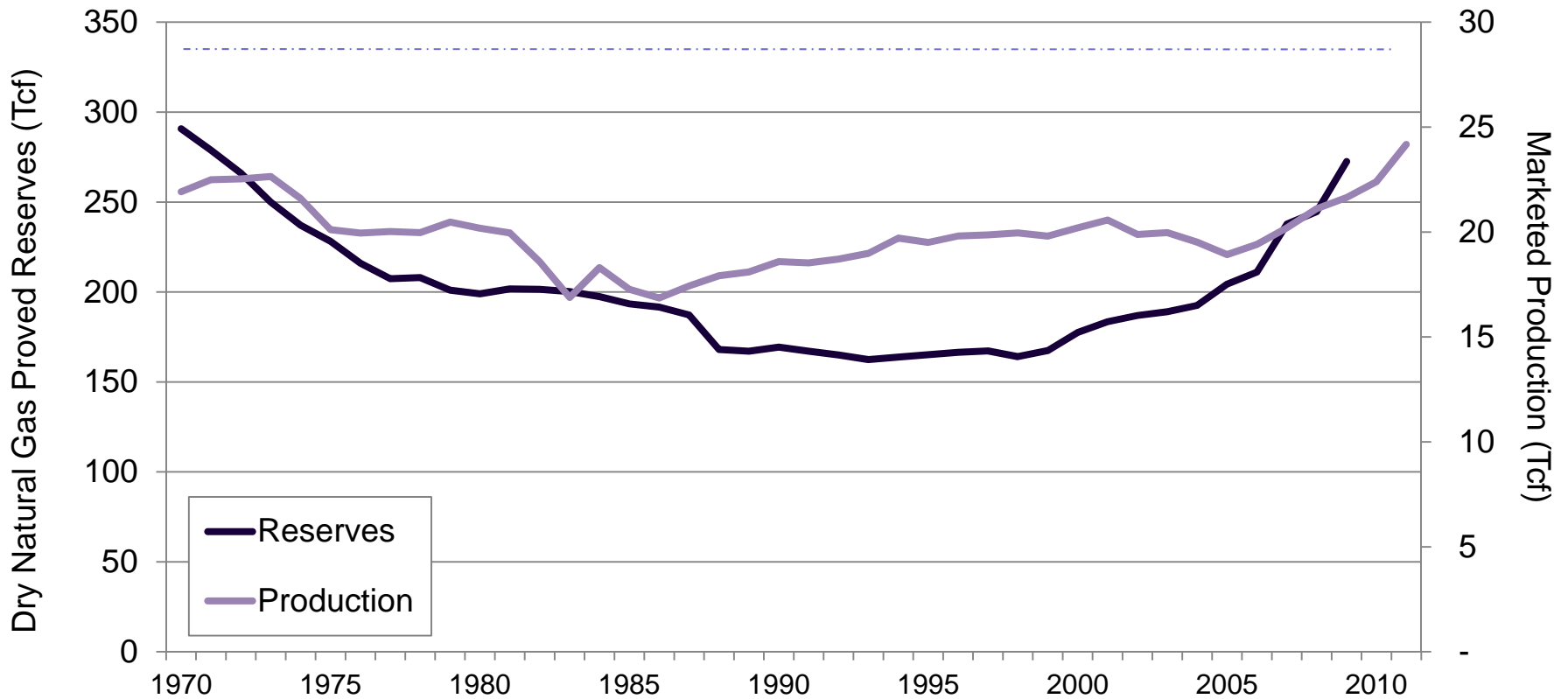
Unlike conventional resources, shale plays (natural gas, liquids, and crudes) are located almost ubiquitously throughout the U.S. and are the primary reason for the decrease in overall and regional natural gas prices.





Natural Gas Proved Reserves and Production

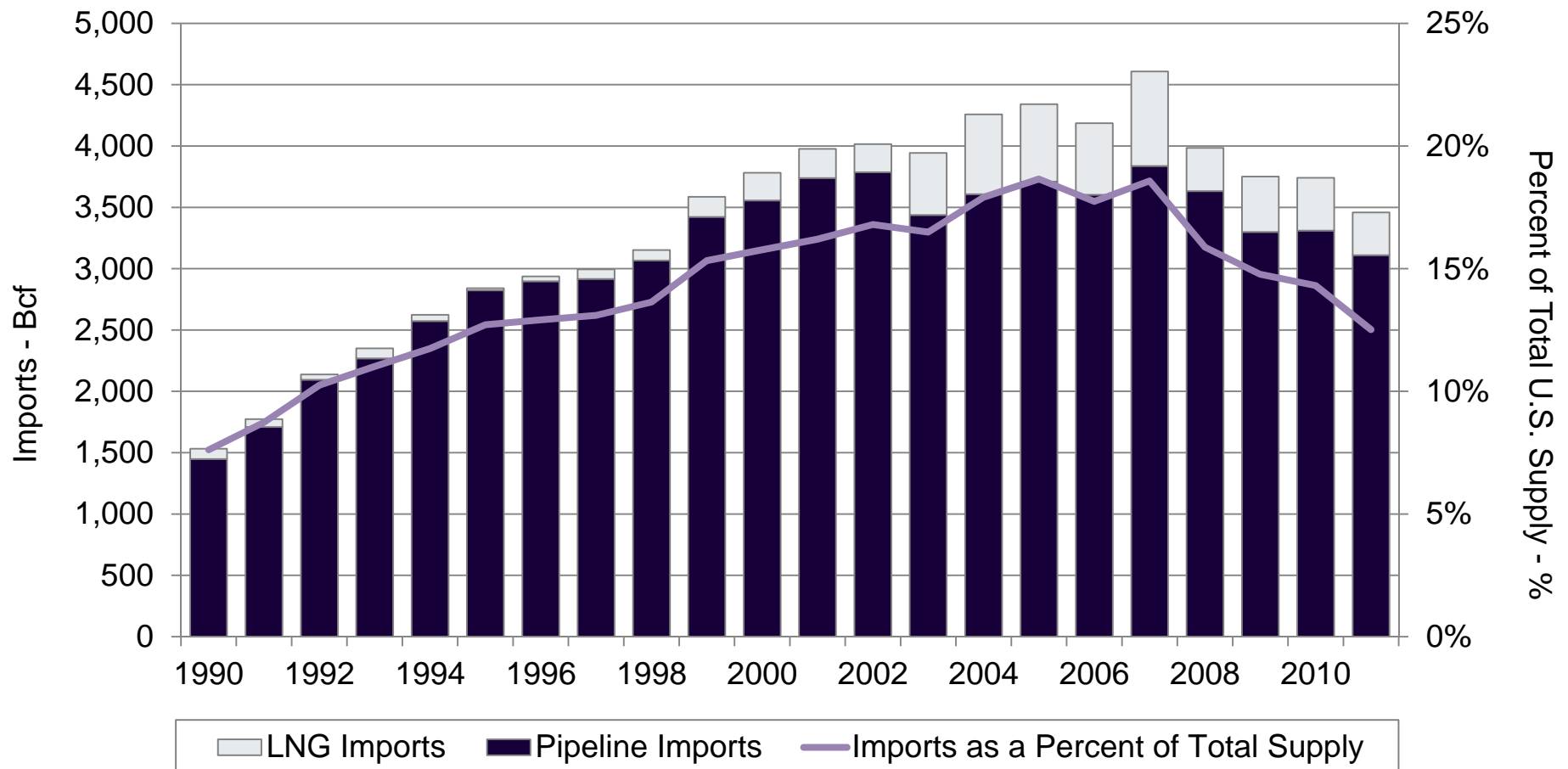
Current U.S. natural gas reserves are approaching record levels not seen since 1970. Natural gas production is at levels that surpass historic peaks.





Natural Gas Imports

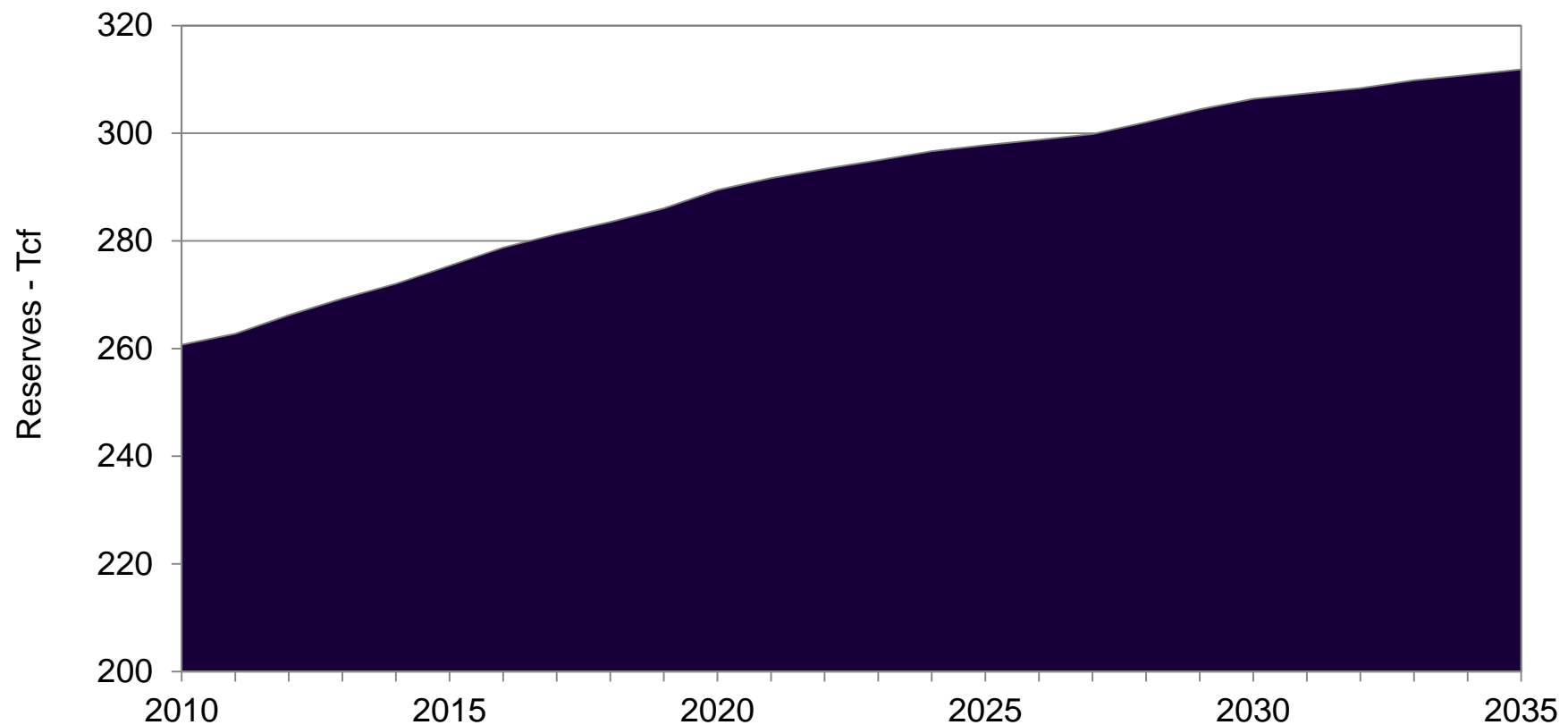
Natural gas imports, once thought to be the supply remedy for meeting future gas needs are falling to levels also not seen since the 1990s.





Annual Energy Outlook, Natural Gas Reserves

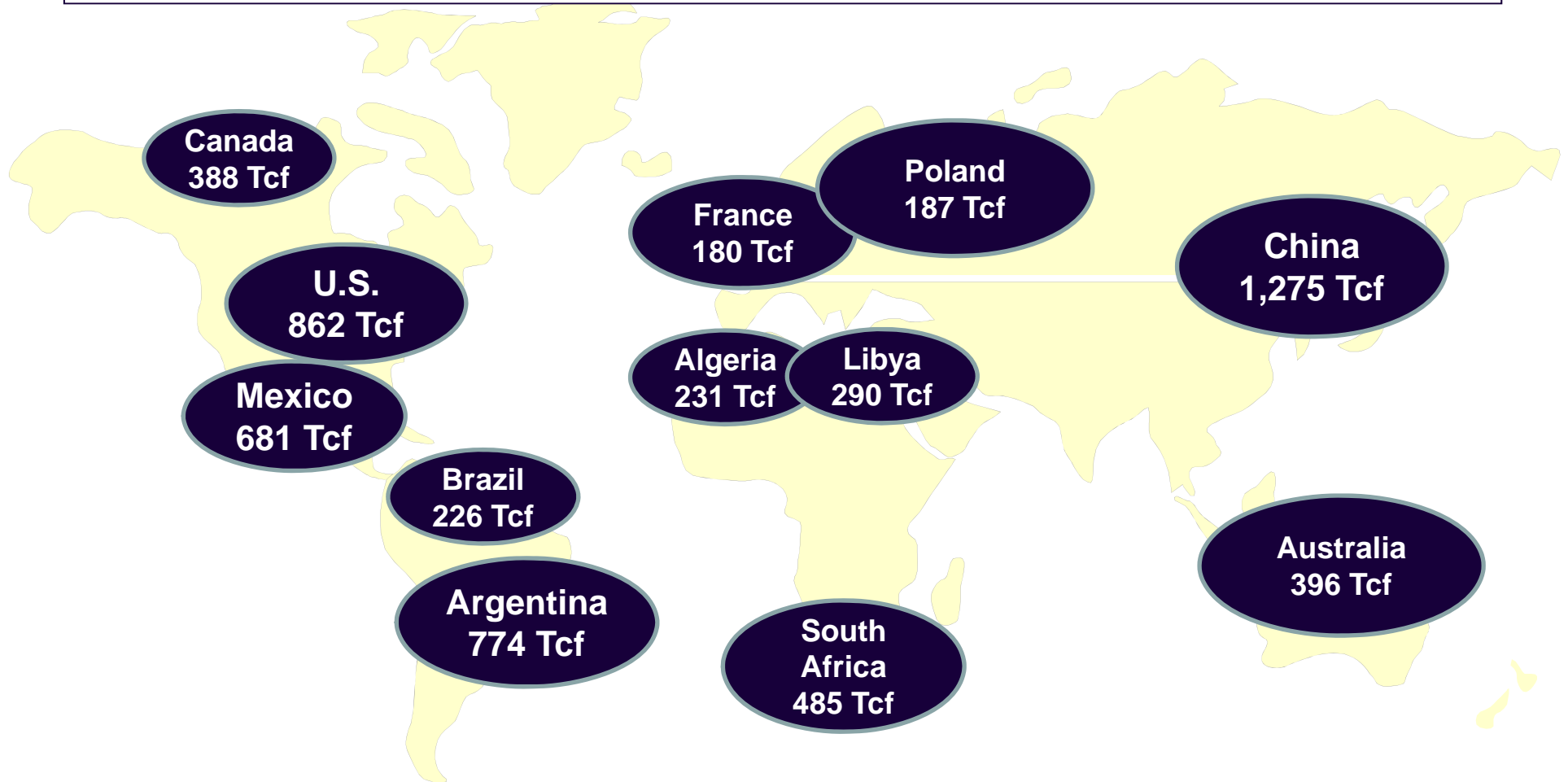
Unconventional resources are not a “flash in the pan” and are anticipated to continue to increase over the next two decades or more.





Basin Competition

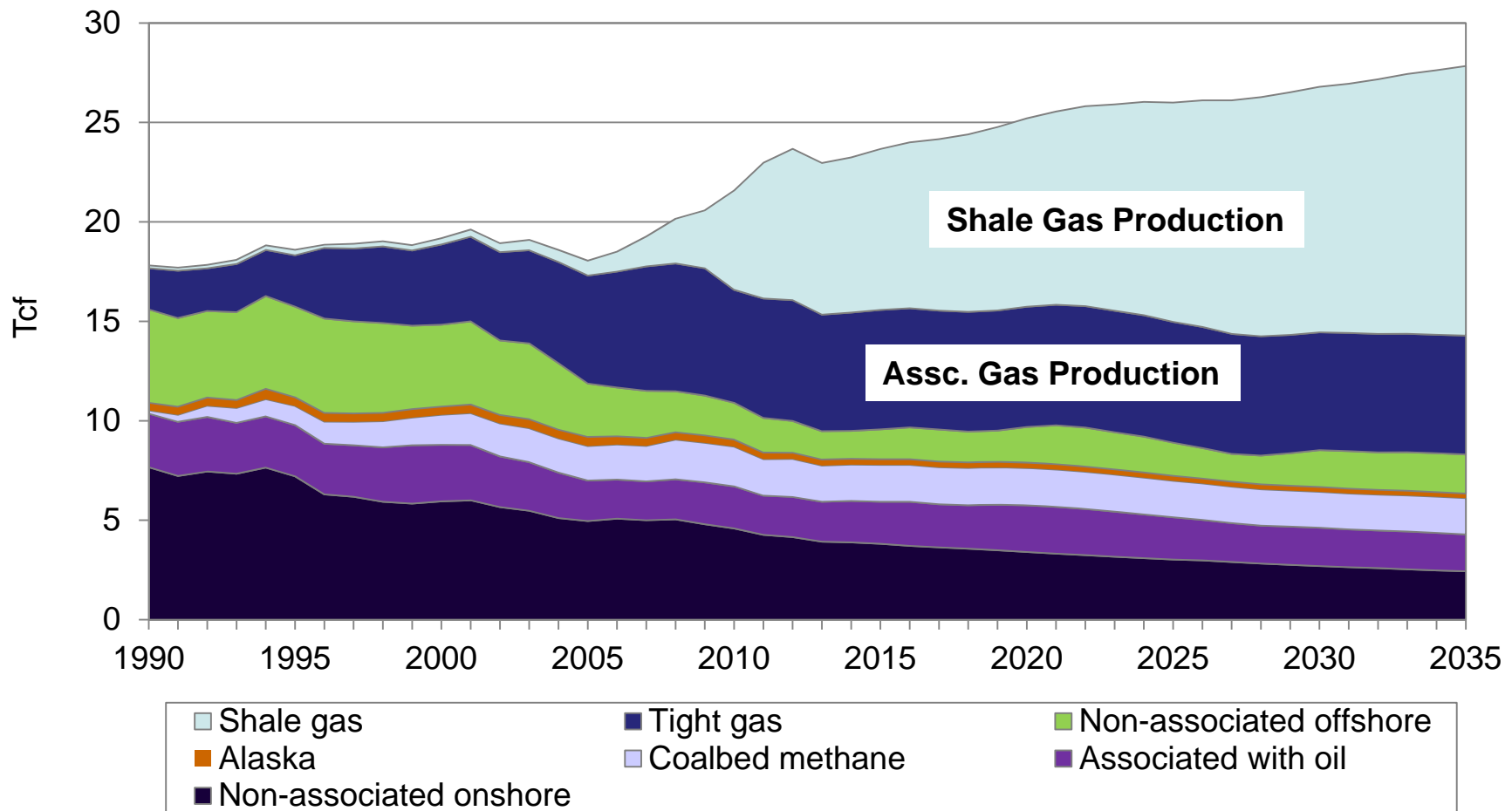
Close to 6,000 TCF of shale gas opportunities around the world. Coupled with 9,000 Tcf in conventional suggest a potentially solid resource base for many decades.





Forecast U.S. natural gas production, 1990-2035

Shale availability will drive U.S. natural gas supply.

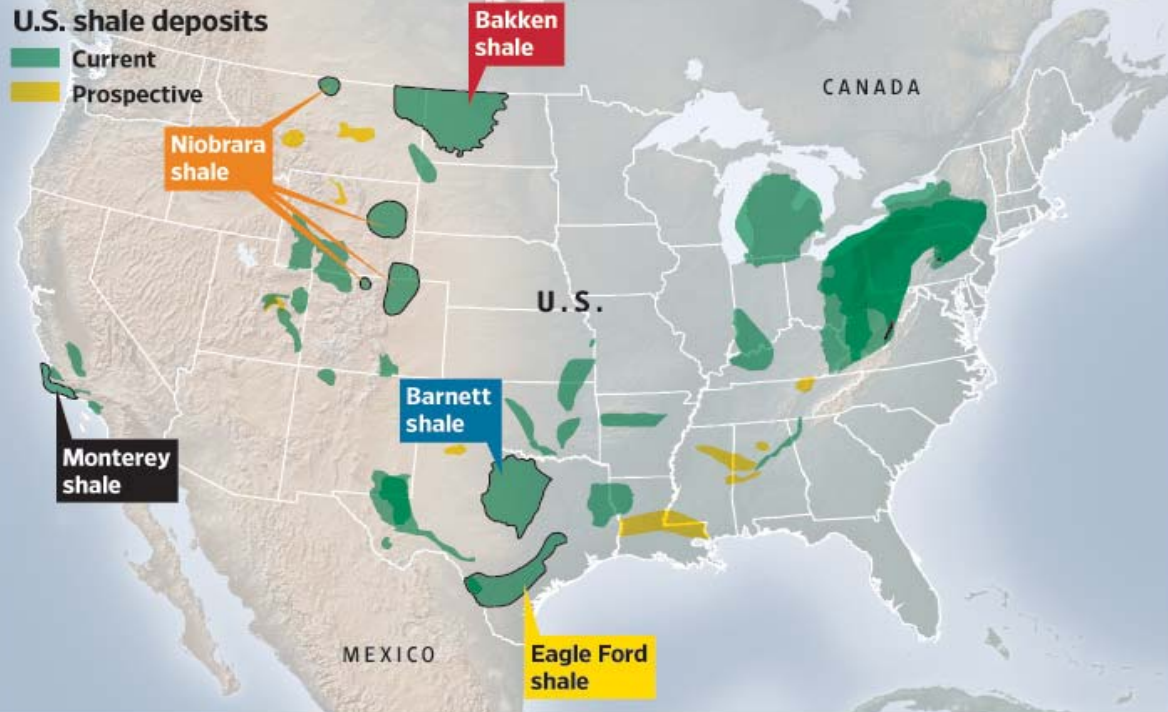




Crude Awakening | Fracking has helped ignite a rise in U.S. oil production

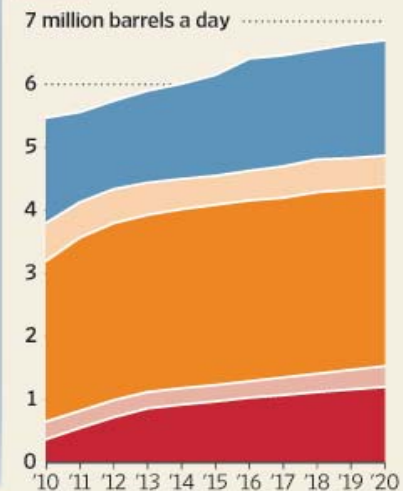
U.S. shale deposits

- Current
- Prospective

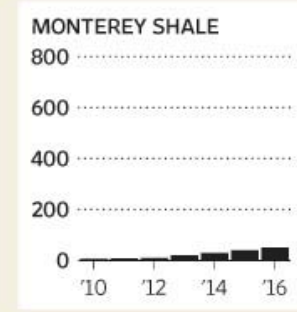
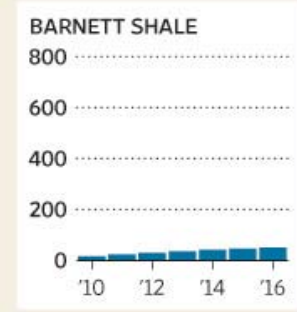
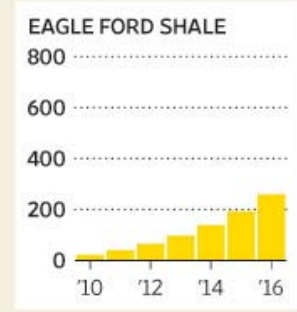
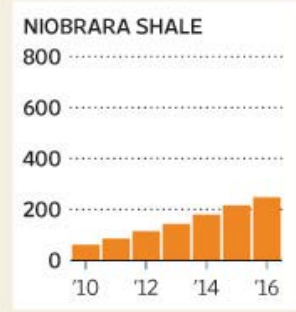
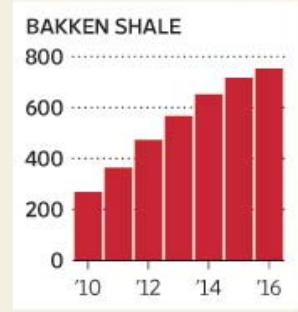


U.S. oil-production forecast

- Gulf of Mexico
- Alaska
- Other onshore oil
- CO2-enhanced oil recovery
- Oil from fracking**



Light crude oil supplies from U.S. shale fields, in thousands of barrels a day



Note: Projections begin in 2011 for all data.

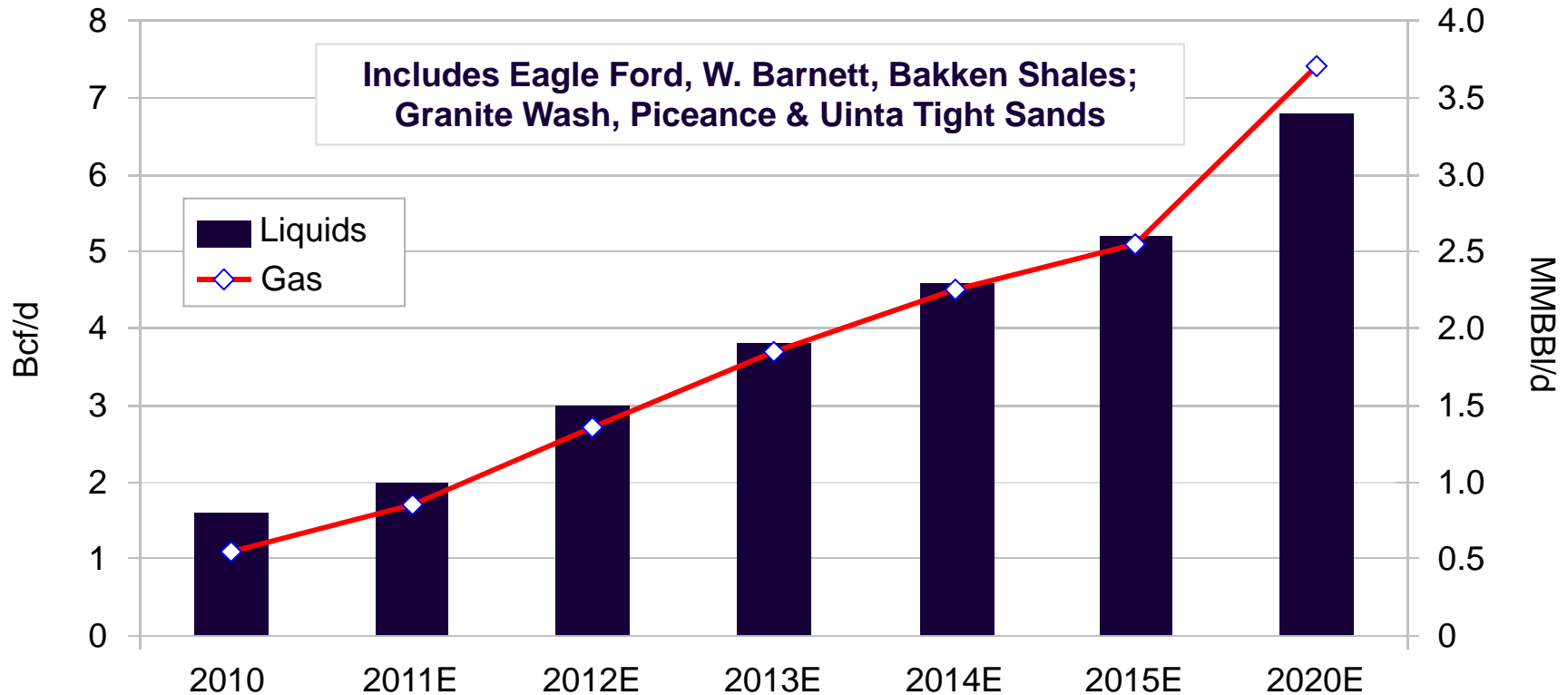
Sources: U.S. Energy Information Administration; International Energy Agency (individual shale production)

The Wall Street Journal



Annual Production, Unconventional Resources

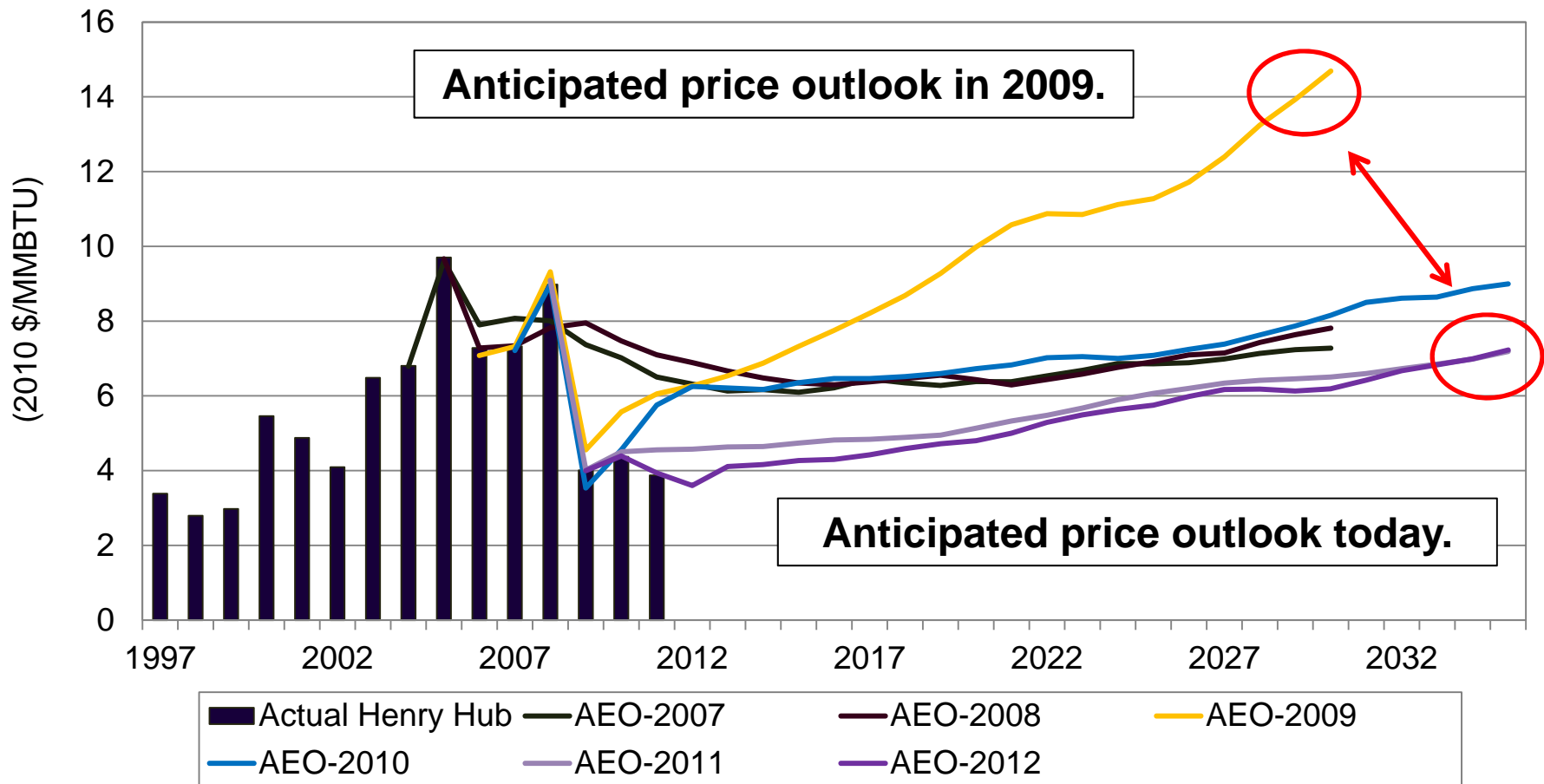
Liquids production from shale plays > 3 million barrels per day by 2020
Associated natural gas > 7 Bcf/d of “costless” supply (or about 2.3 Bcf/d per every 1.0 MMBbls/d of shale-based liquids production).





Choosing Most Current Natural Gas Price Forecasts: AEO-2007 to AEO-2012

Shale availability has significant impact on future price outlook.



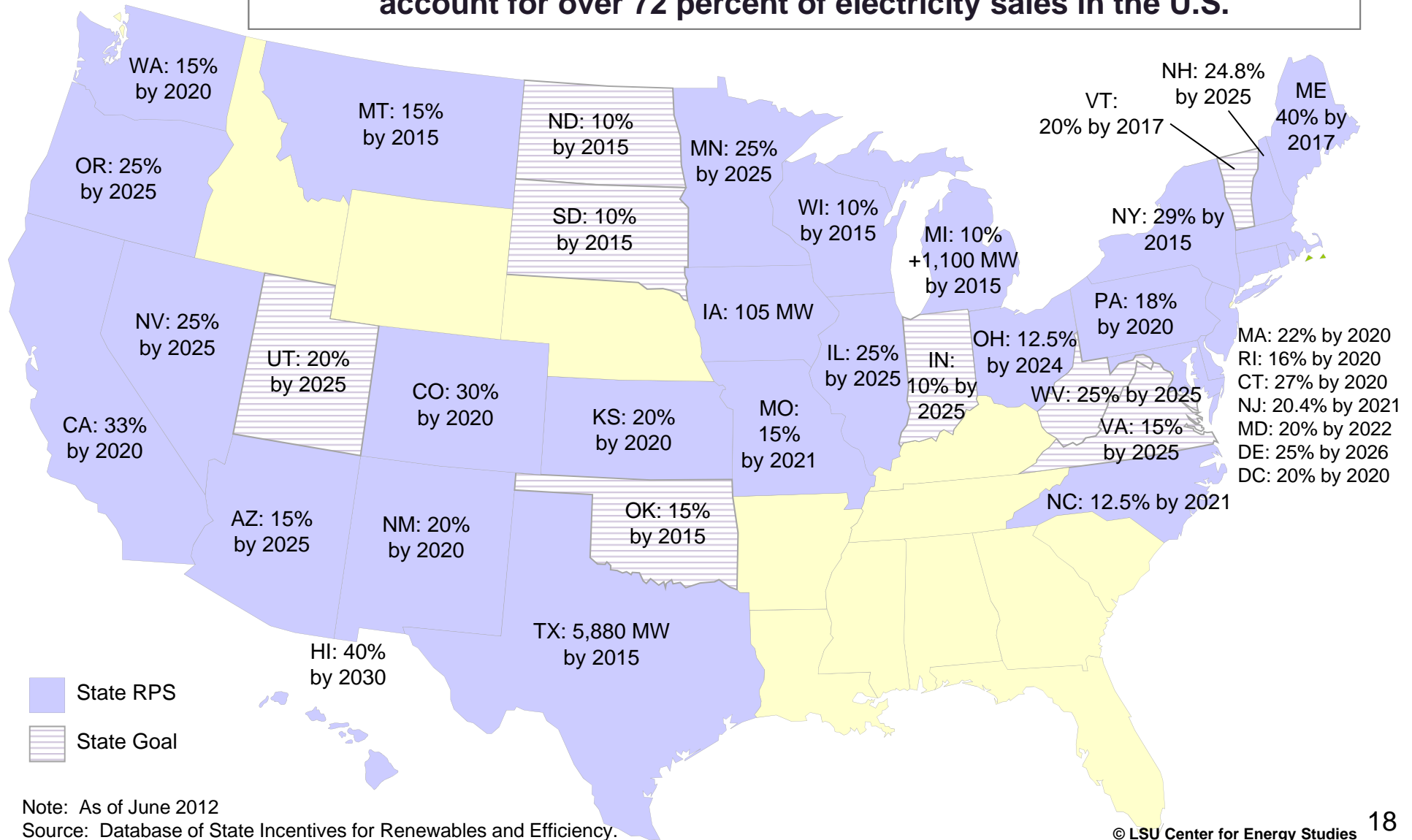


Renewable Energy Markets



RPS States

Currently 37 states have RPS policies in place. Together these states account for over 72 percent of electricity sales in the U.S.



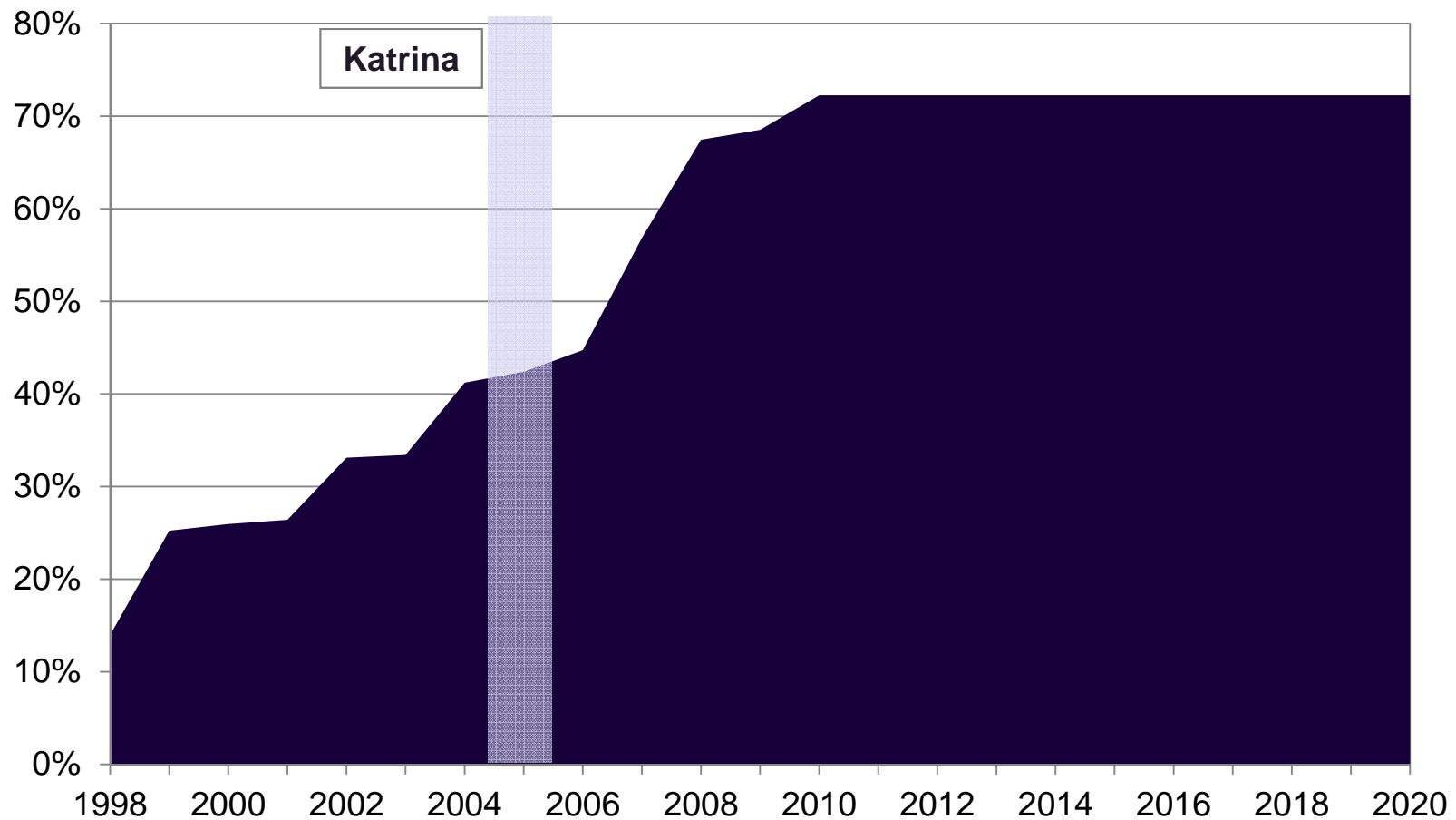
Note: As of June 2012

Source: Database of State Incentives for Renewables and Efficiency.



RPS Phase-In: Share of Total U.S. Retail Sales with RPS Requirements

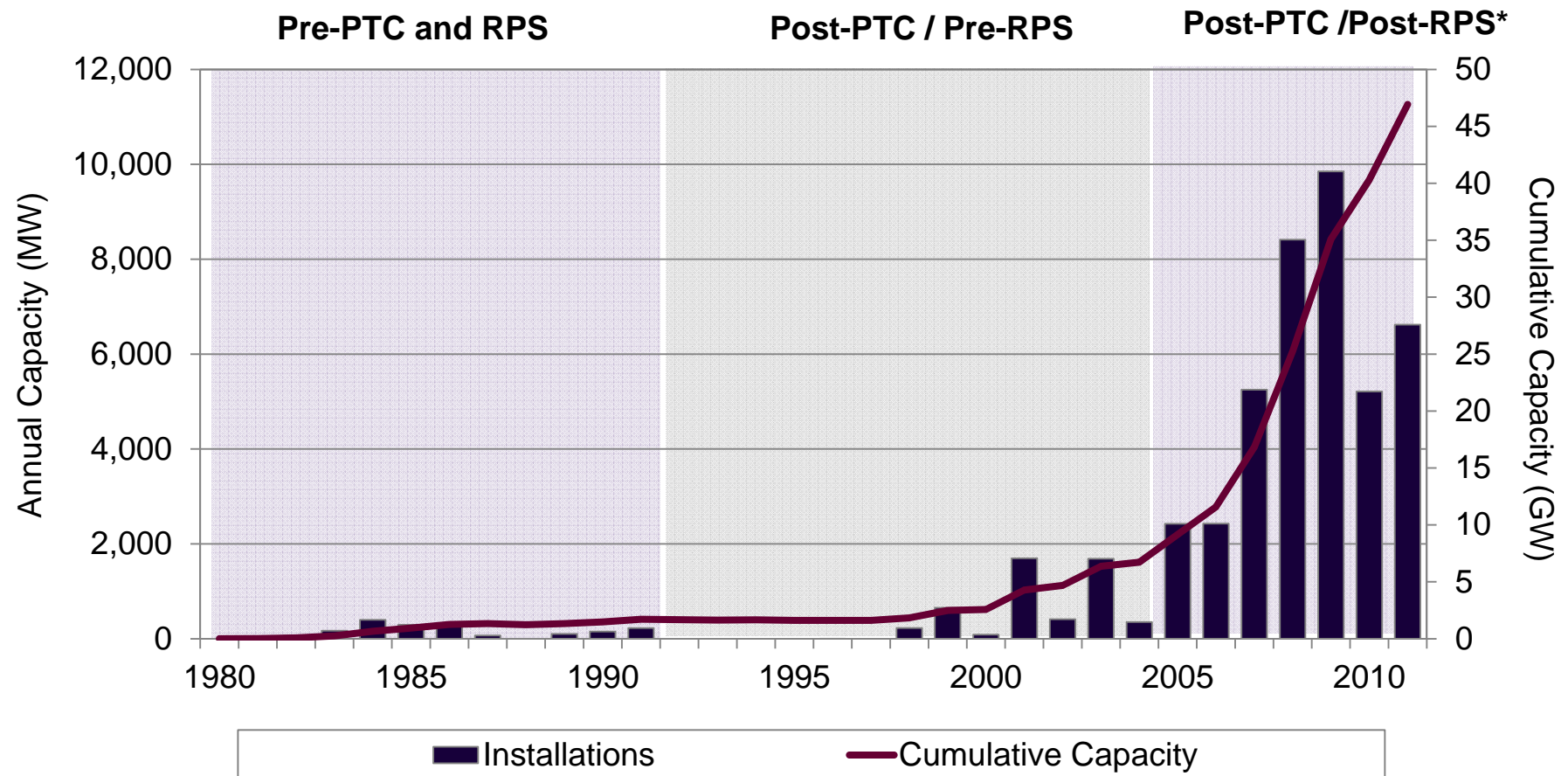
State RPS requirements have been increasing significantly since 2005 and the post-Hurricane Katrina volatility in energy prices.





Historic Wind Generation Capacity Development

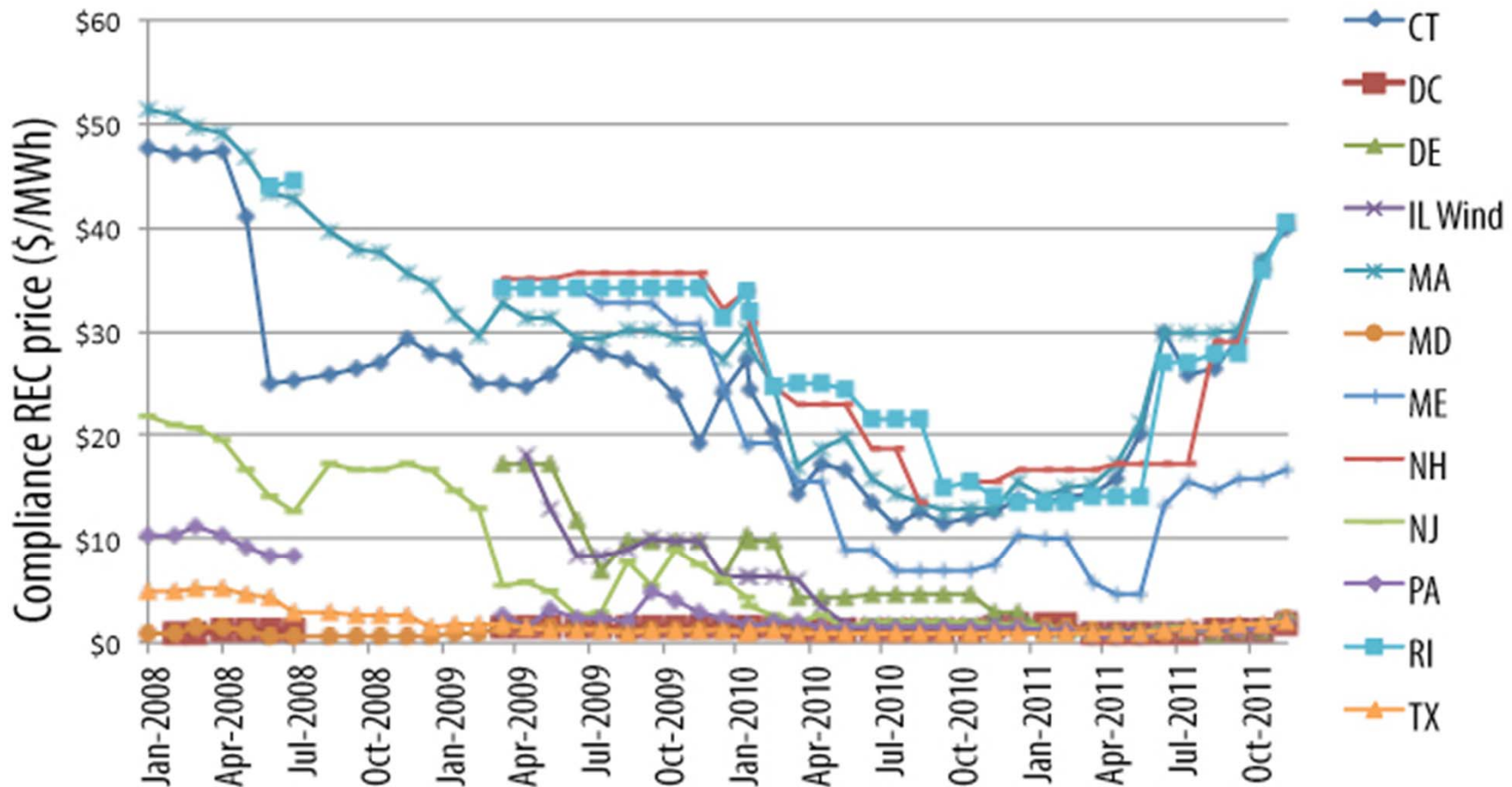
Wind capacity development has been considerable. The last several years has seen considerable over-development and the industry current has about 4 GW of excess manufacturing capacity even if the federal wind PTC is continued. The federal 1603 option created considerable speculative activity.





Cost of Non-Solar Renewable Energy Credits

Class 1 RECs have also seen considerable price decreases although there has been some rebounding in the past year.

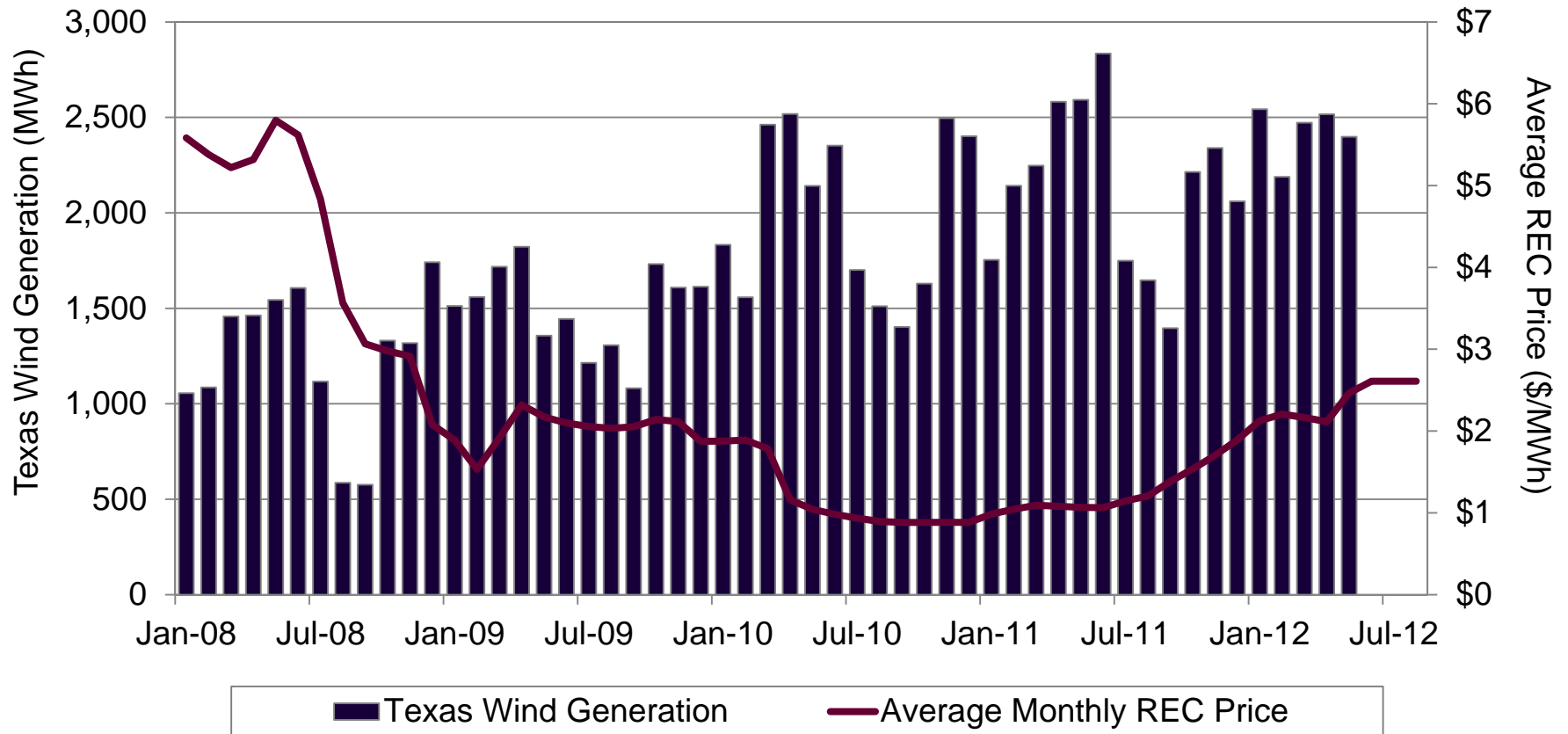


Source: Energy Efficiency & Renewable Energy Division, U.S. Department of Energy; Citing Spectron Group
Accessed at: <http://apps3.eere.energy.gov/greenpower/markets/certificates.shtml?page=5>



REC Prices and Wind Development

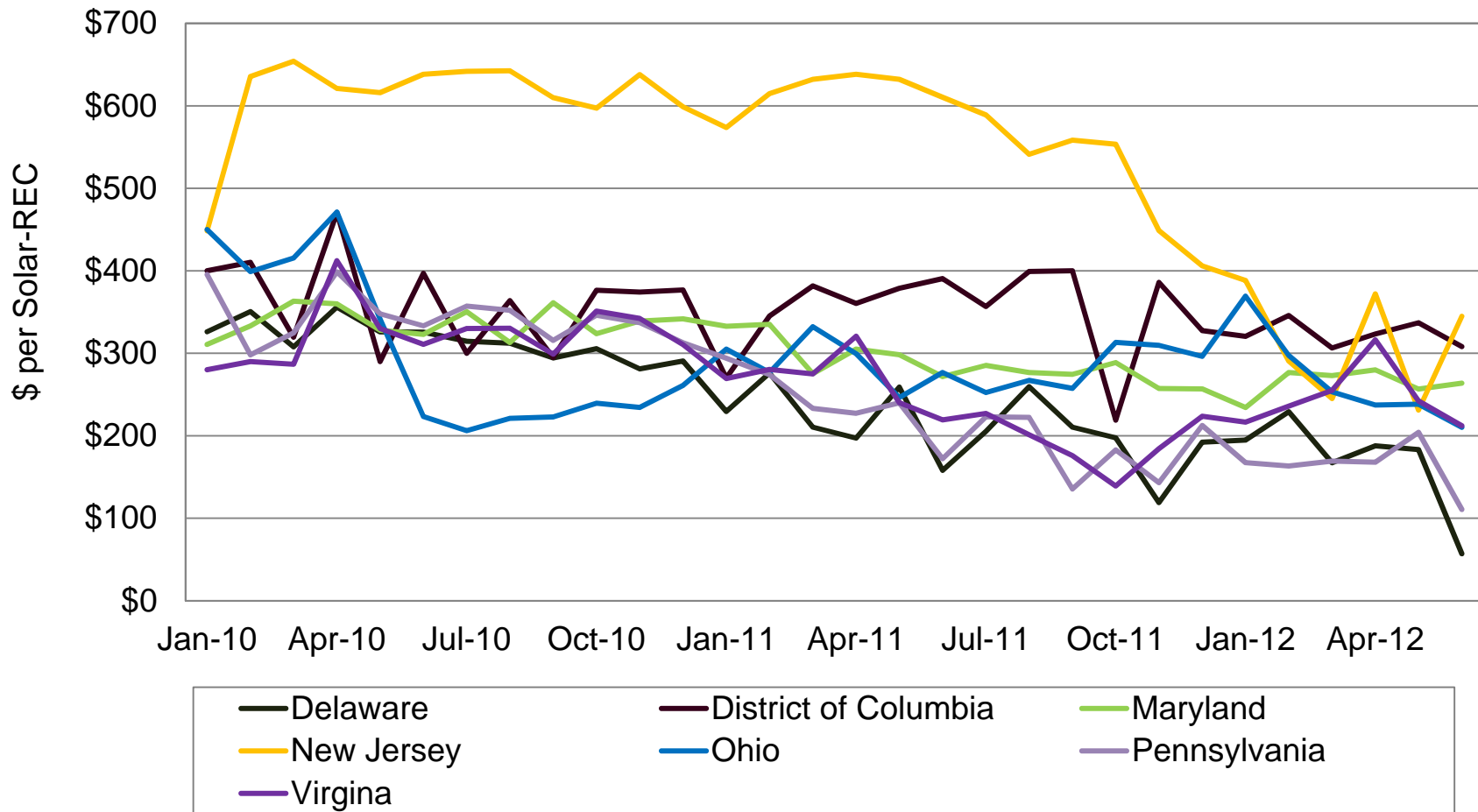
REC prices in ERCOT have fallen considerably in large part due to the overdevelopment of wind capacity over the past several years. High correlation between the increase in wind generation and decrease in REC prices.





Cost of Solar Renewable Energy Credits through PJM-GATS

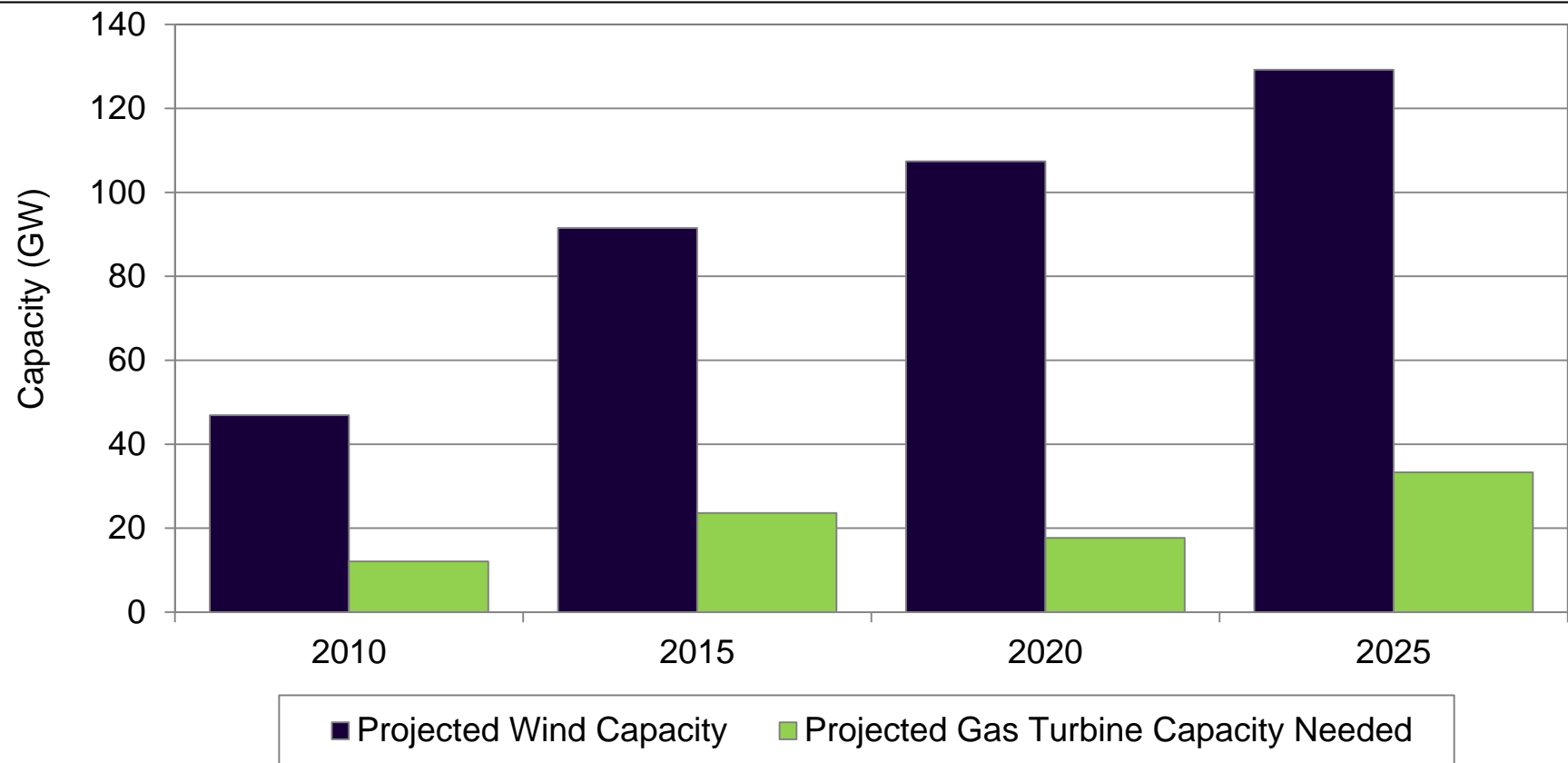
Solar energy costs (SRECs) have decreased considerably over the past year, even in high priced states such as New Jersey.





Forecasted Gas and Wind Generation Capacity

Projected wind capacity increases from just under 50 GW in 2010 to almost 130 GW in 2025; as does the gas turbine capacity needed for firming wind generation. Gas-fired capacity needed to support intermittent wind will grow from about 12 GW in 2010 to more than 33 GW in 2025.



Note: Assumes the required gas turbine capacity for firming wind generation is 25.8 percent of the installed wind capacity and the average annual utilization of gas turbines for firming purposes is 15.6 percent.

Source: ICF International.



Conclusion



Conclusions

- **The change in energy markets created by shale has been “revolutionary.”**
- **High crude oil prices are stimulating continued shale drilling. While this is primarily concentrated in liquids, current and forecasted associated gas requirements are considerable.**
- **While there will be continued risks associated with shale development, the “conventional wisdom” is that the resource will continue to be developed.**
- **To date, these gains will likely not have as considerable an impact on renewable energy as they will on energy efficiency.**
- **Since RPS requirements are typically based on generation requirements (demand), lower prices stimulating use could be positive for renewables.**
- **Biggest short run challenge for renewables is the wind overdevelopment that dampens Class 1 REC prices.**



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