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GOVERNMENT

The Energy Technology, Market, and Policy Nexus

ARPA-E University // Washington DC

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ENERGY OUTLOOK: TECHNOLOGY, MARKETS, AND POLICY

1 Electric Power

- » Mostly at the expense of coal, natural gas continues to gain market share in the power sector. EPA regulations and fuel prices help to reinforce this trend.
- » Global manufacturing capacity for wind and solar far exceeds demand; this is bad for producers, but good for consumers.
- » Solar PV prices have fallen by 80 percent since 2008 and wind prices have declined by nearly 30 percent over the same period. Policy support, however, remains critical.

2 Liquid Fuels

- » The shale gas revolution has spread to the oil sector; U.S. oil production increased by 15.3 percent in 2012.
- » U.S. biofuel production has also boomed over the prior decade: the federal renewable fuel standard (RFS) helped to drive U.S. biofuel consumption to a record 14.7 billion gallons in 2012 – a nearly fivefold increase compared with a decade earlier.
- » The so-called 10 percent ethanol “blend wall” is likely to constrain future biofuel consumption in the U.S.

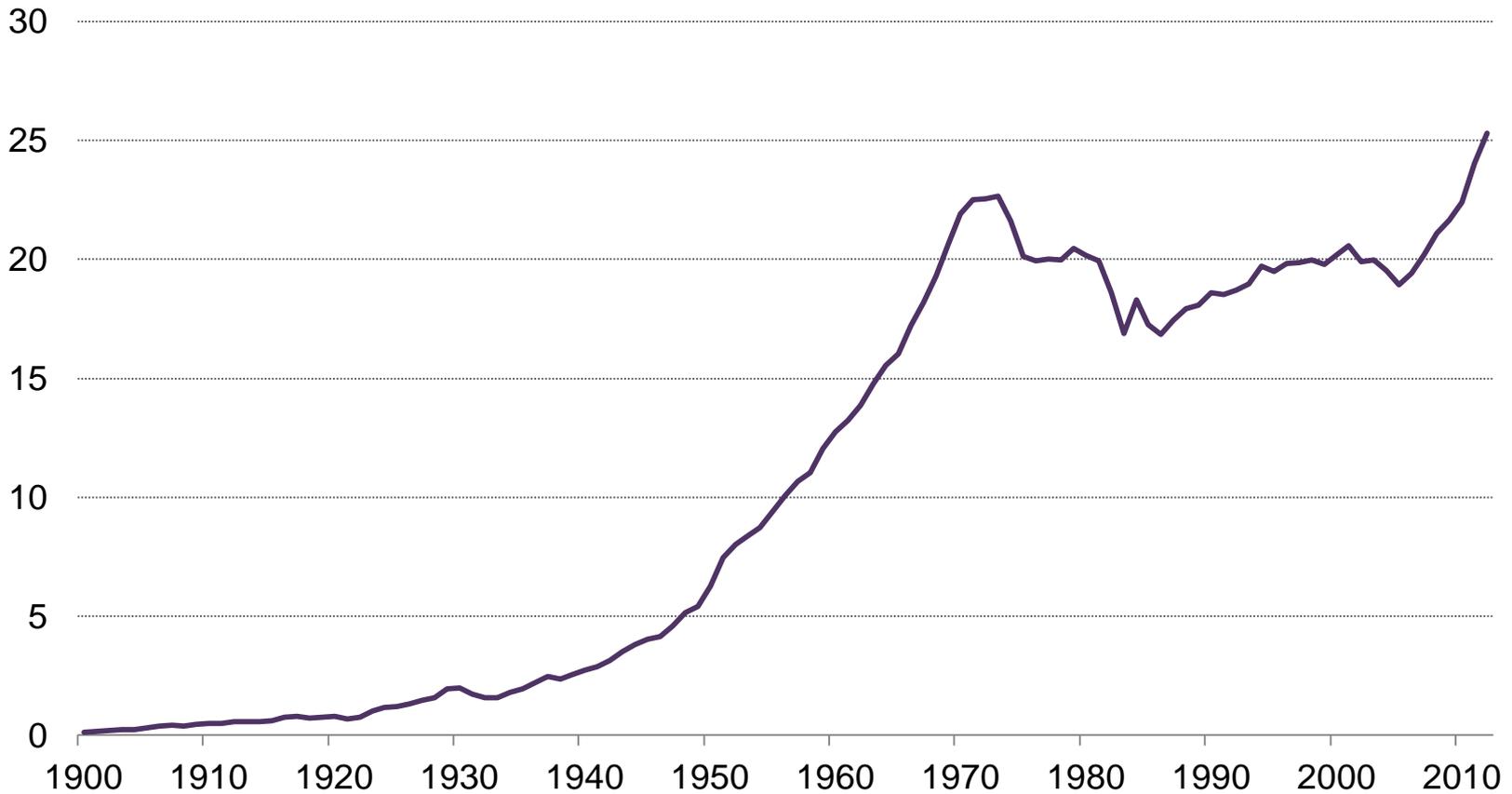


NATURAL GAS AND COAL

TOTAL U.S. NATURAL GAS PRODUCTION

U.S. natural gas production reached its highest level ever in 2012.

Billion Cubic Feet

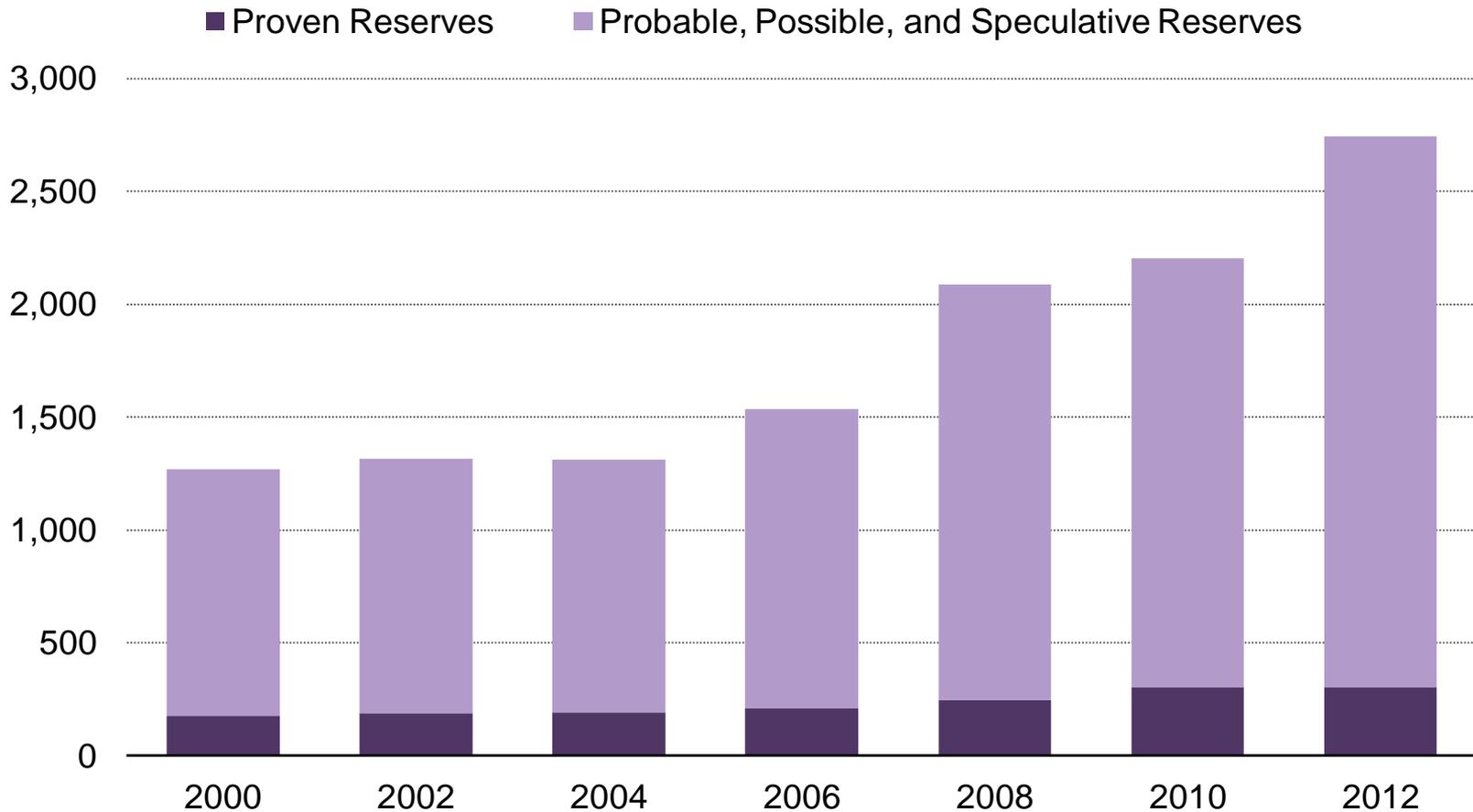


Source: Energy Information Administration and Bloomberg Government

U.S. NATURAL GAS RESOURCE ASSESSMENT

There are about 2.7 quadrillion cubic feet of natural gas reserves in the U.S., enough to last about 110 years at the current consumption rate.

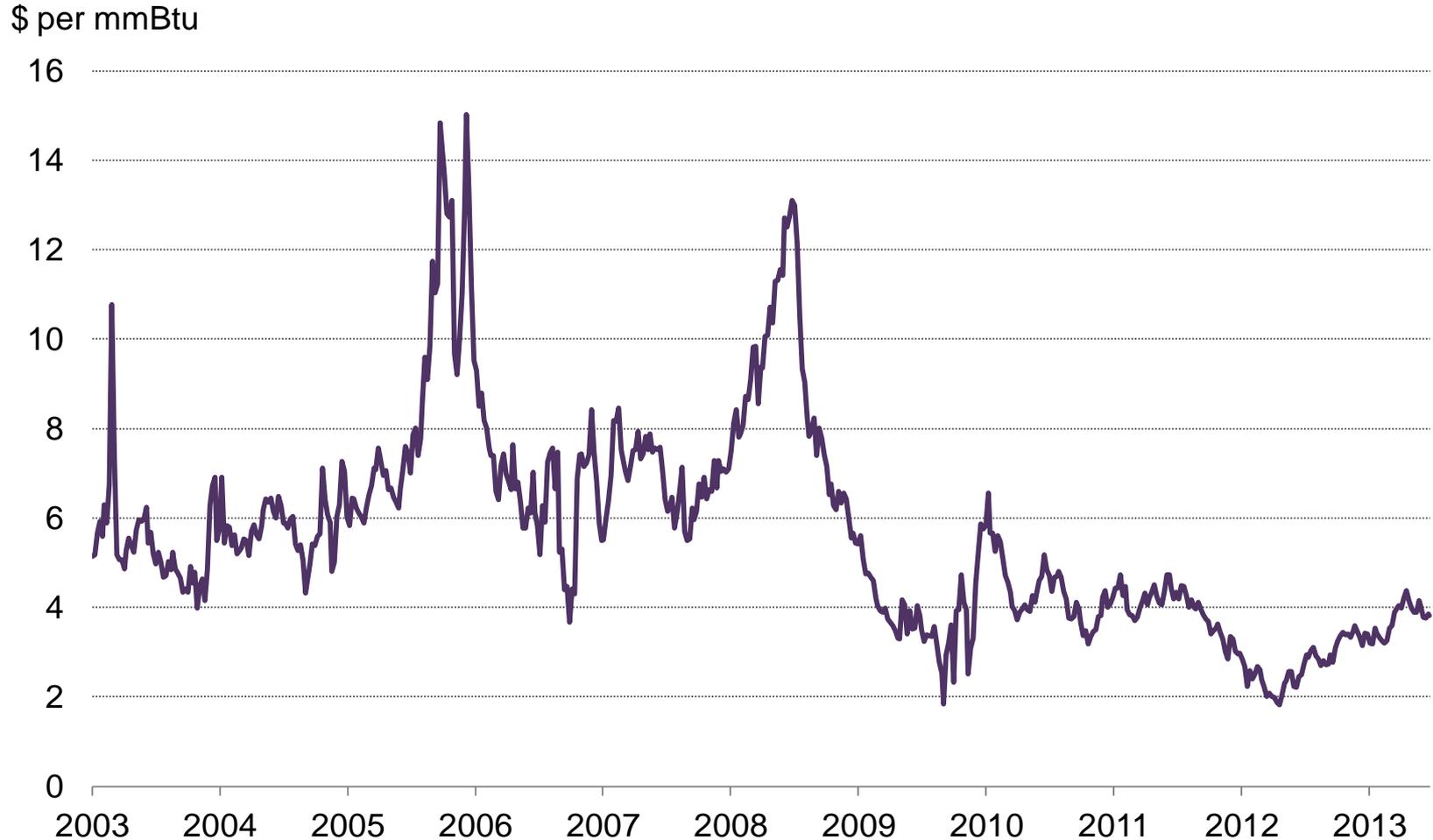
Trillion Cubic Feet



Source: Energy Information Administration, Potential Gas Committee, and Bloomberg Government

U.S. NATURAL GAS PRICES (HENRY HUB)

At just below \$4 per mmBtu, U.S. natural gas prices are still a bargain compared with prices observed between 2004 and 2008.



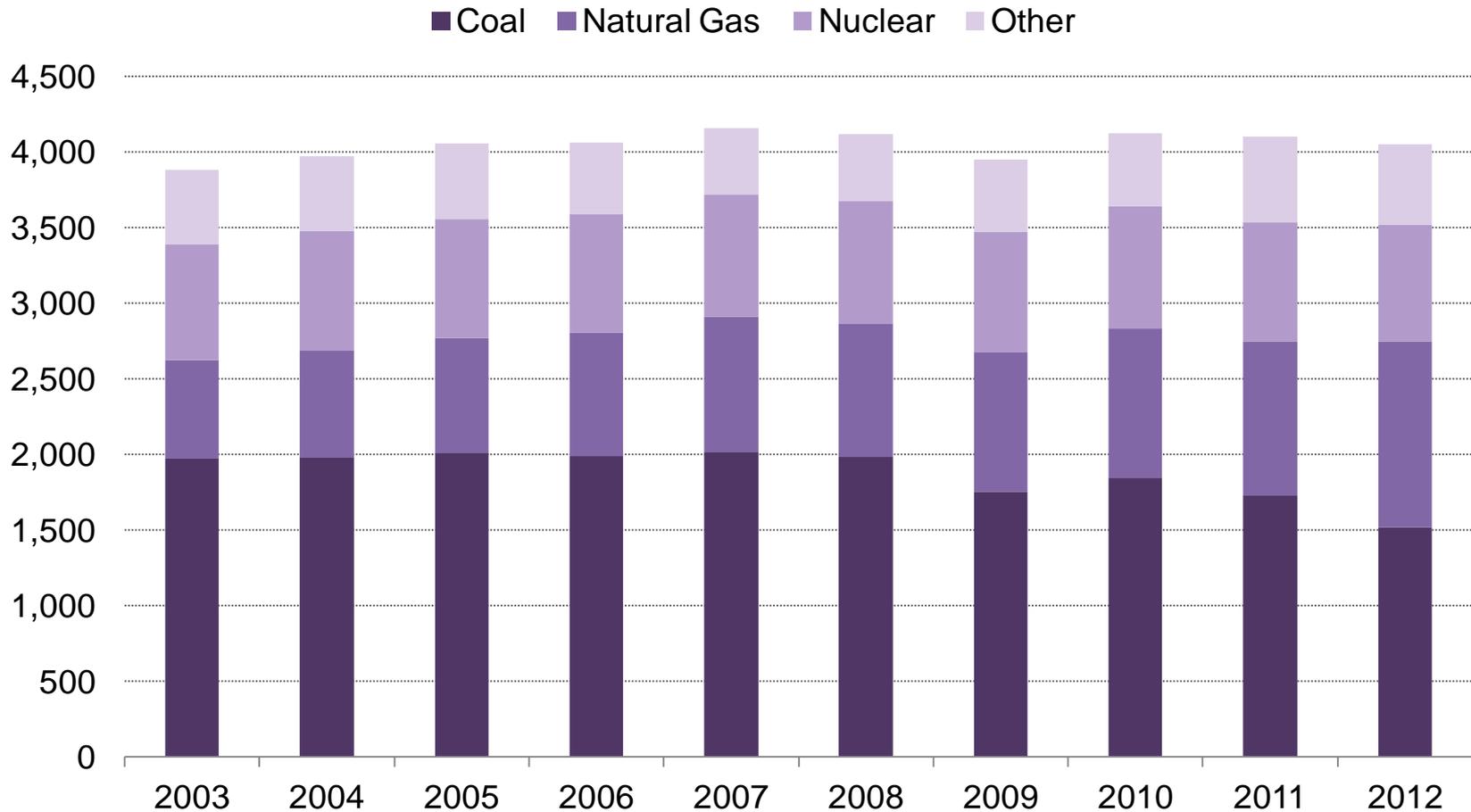
Source: Bloomberg Terminal

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ELECTRIC GENERATION BY SOURCE

Electricity generated from natural gas-fired power plants has increased nearly 40 percent since 2007. During the same period, coal generation has declined by 25 percent.

Terawatt-hours



Source: Energy Information Administration and Bloomberg Government

ENVIRONMENTAL REGULATIONS HAVE REINFORCED TREND AWAY FROM COAL TOWARD NATURAL GAS

- 1 EPA has a crowded regulatory agenda. The agency has a variety of rulemakings underway:**
 - » Replacement Rule for CSAPR
 - » Mercury and Air Toxics Rule (Court Challenge)
 - » 316b Water Cooling Rule
 - » Coal Ash Rule
 - » Final NSPS for GHG Emissions from New Power Plants
 - » Final Tier 3 Regulation
 - » Fracking Water Study (Due Dec. 2014)

- 2 EPA also has ambitious plans to promulgate new regulations in the following areas.**
 - » New Ozone NAAQS
 - » NSPS for GHG Emissions from Existing Power Plants
 - » NSPS for GHG Emissions from Refineries

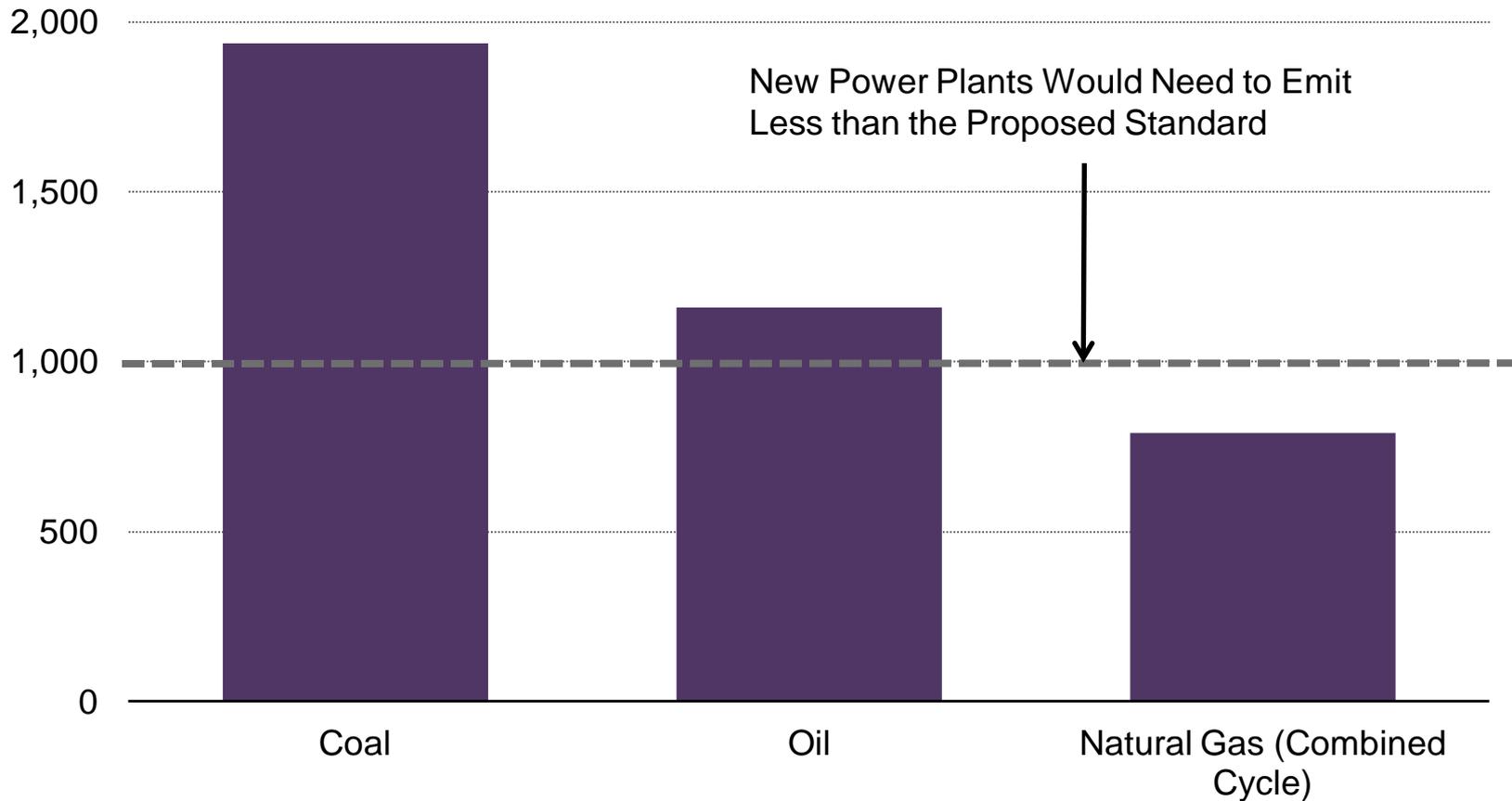
- 3 “Shot selection” will be important for EPA. The timing of certain rules is likely to slip as the agency prioritizes key rulemakings.**



NSPS FOR GHG EMISSIONS FROM NEW POWER PLANTS (PROPOSED APRIL 2012)

New coal-fired power plants would be effectively banned based on EPA's NSPS proposal for GHG emissions from new power plants.

CO₂ Emission Rate (lbs CO₂ / MWh)



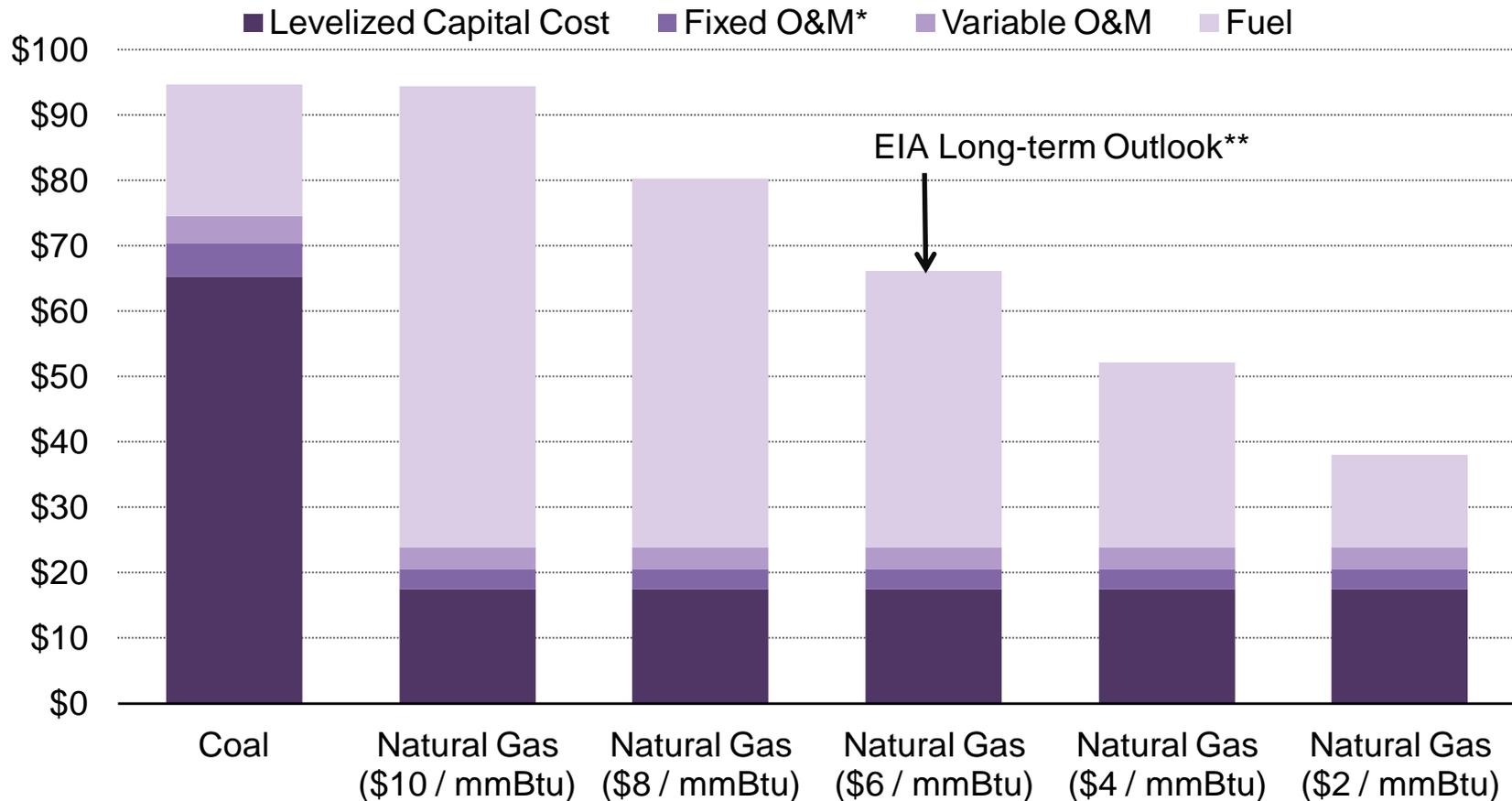
Source: Bloomberg Government

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ECONOMICS AND NSPS RULE OUT NEW COAL FIRED POWER PLANTS

Even without EPA regulations, new coal-fired power plants are effectively an out-of-the-money investment.

2009 dollars per megawatt-hour

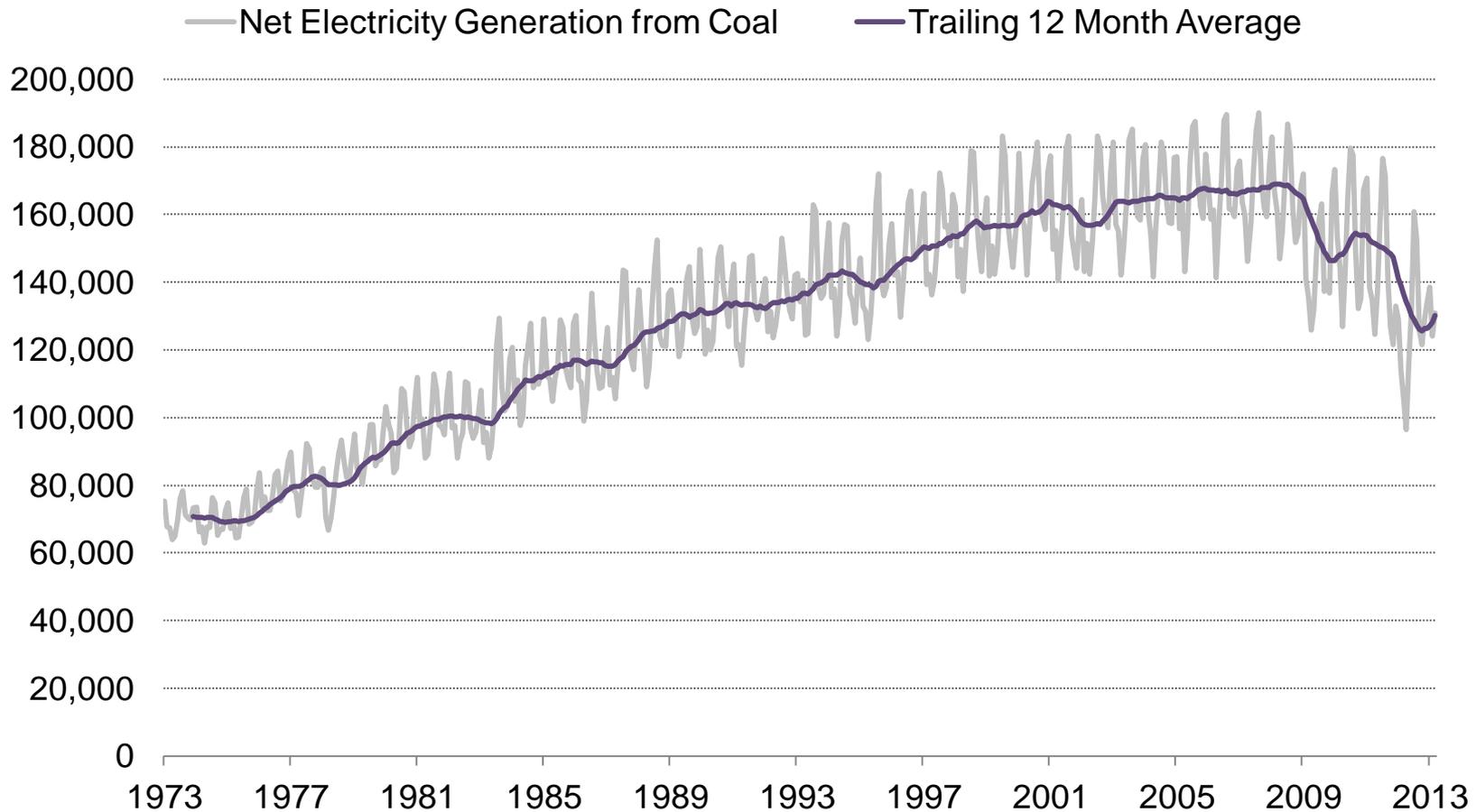


Source: Bloomberg Government and the Energy Information Administration

ELECTRIC GENERATION FROM COAL-FIRED POWER PLANTS

U.S. coal generation has rebounded slightly in 2013, but it remains nearly 25 percent below pre-recession levels.

Million Kilowatt-hours



Source: Bloomberg Government and Energy Information Administration

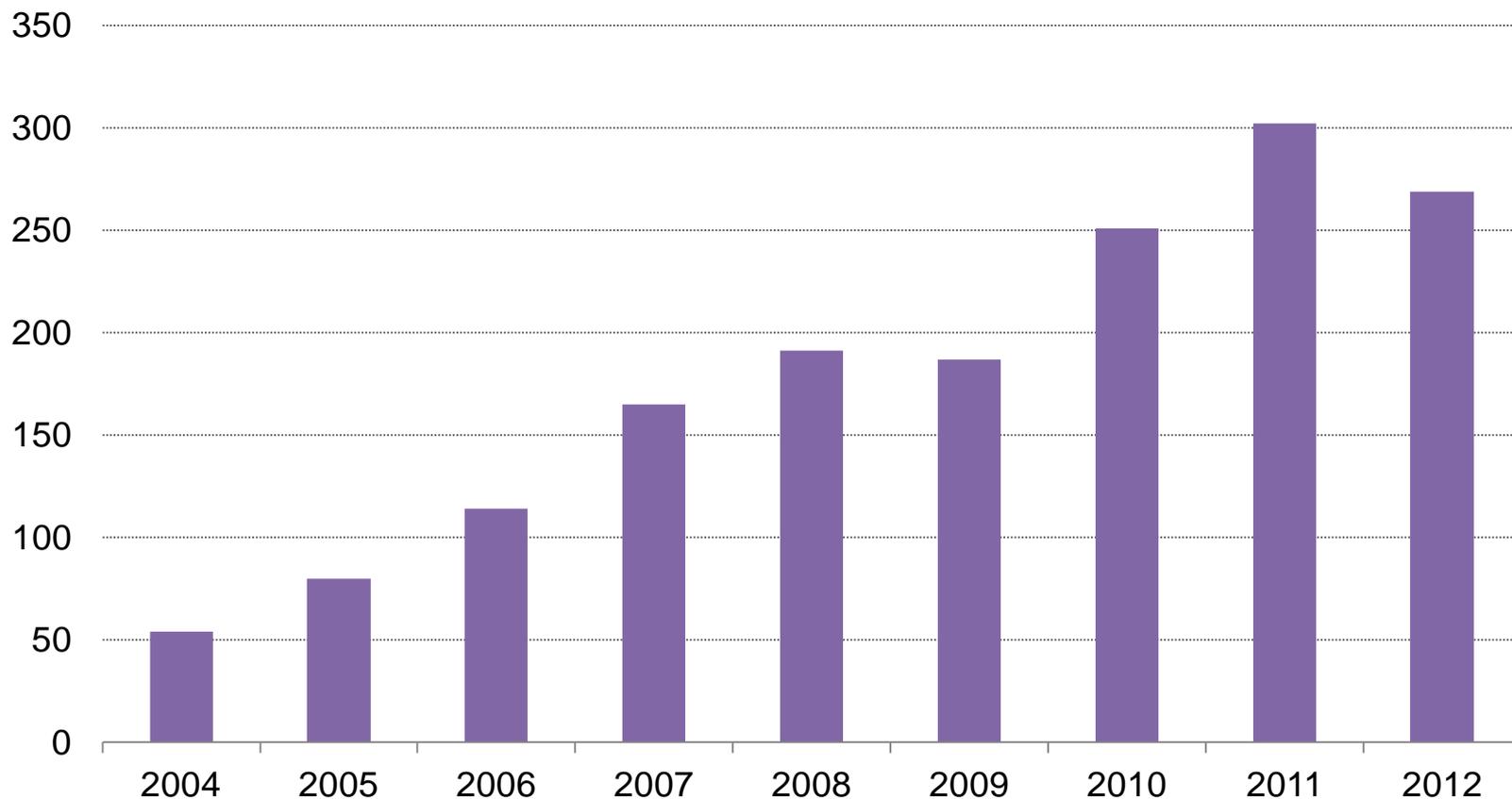
RENEWABLE POWER



GLOBAL TOTAL NEW INVESTMENT IN CLEAN ENERGY 2004–12

Global investment in renewables dipped by about 11 percent in 2012.

Billion U.S. dollars

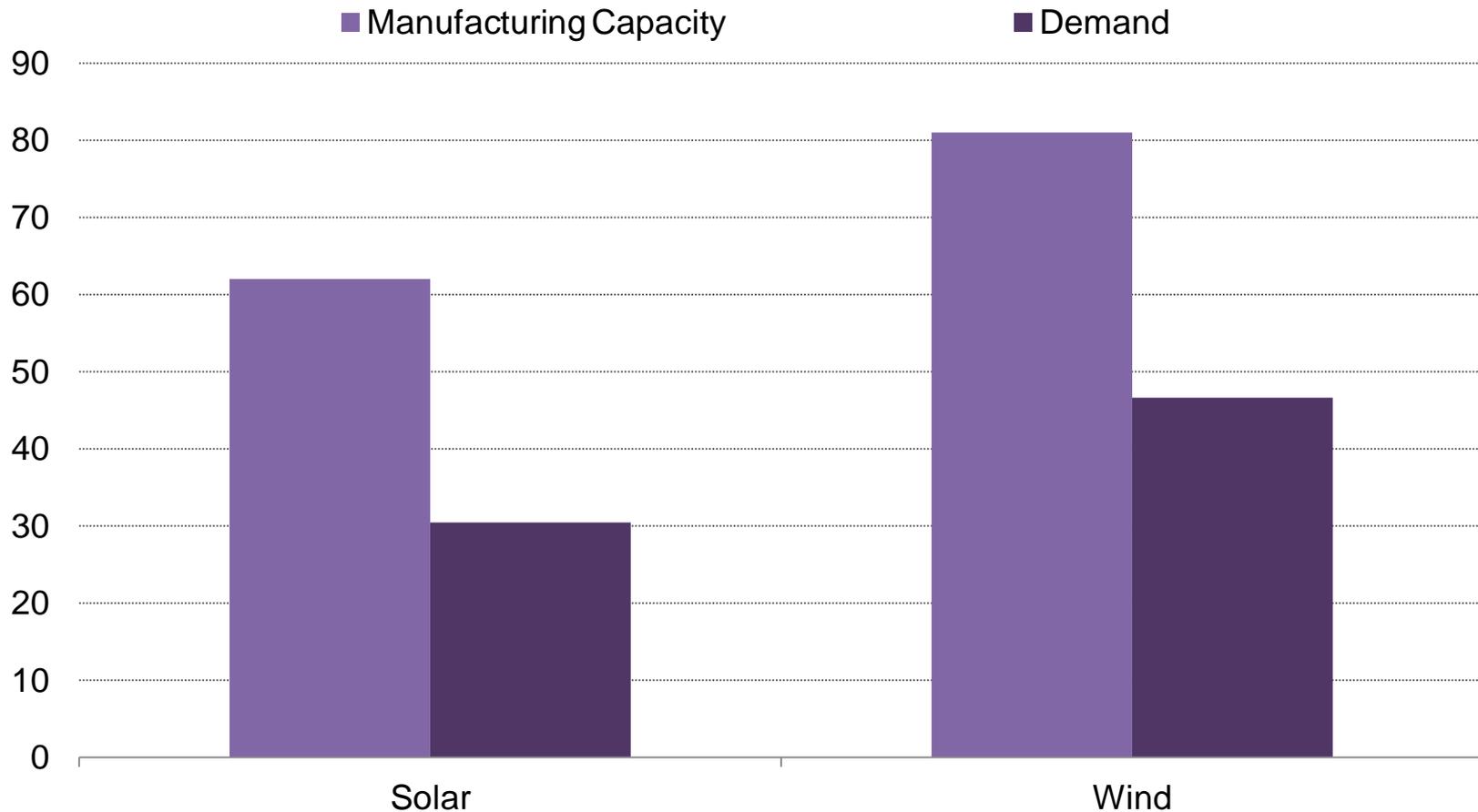


Note: Includes corporate and government R&D, and small distributed capacity. Adjusted for re-invested equity. Does not include proceeds from acquisition transactions
Source: Bloomberg New Energy Finance

EQUIPMENT SUPPLY AND DEMAND (2012)

Global manufacturing capacity of solar PV and wind turbines far exceeded demand (new installations) in 2012.

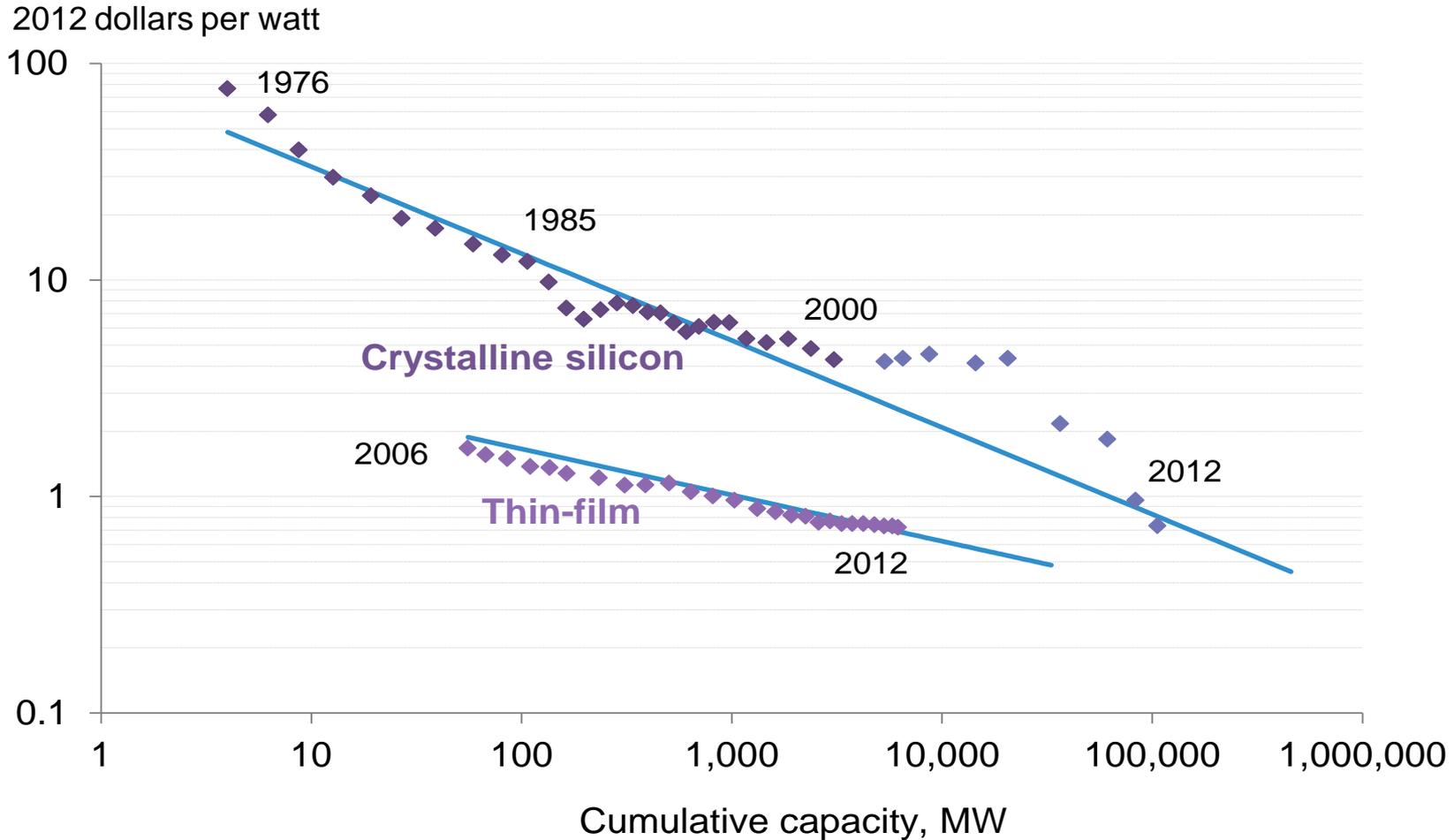
Gigawatts



Source: Bloomberg New Energy Finance

SOLAR PV EXPERIENCE CURVE, 1976-2012

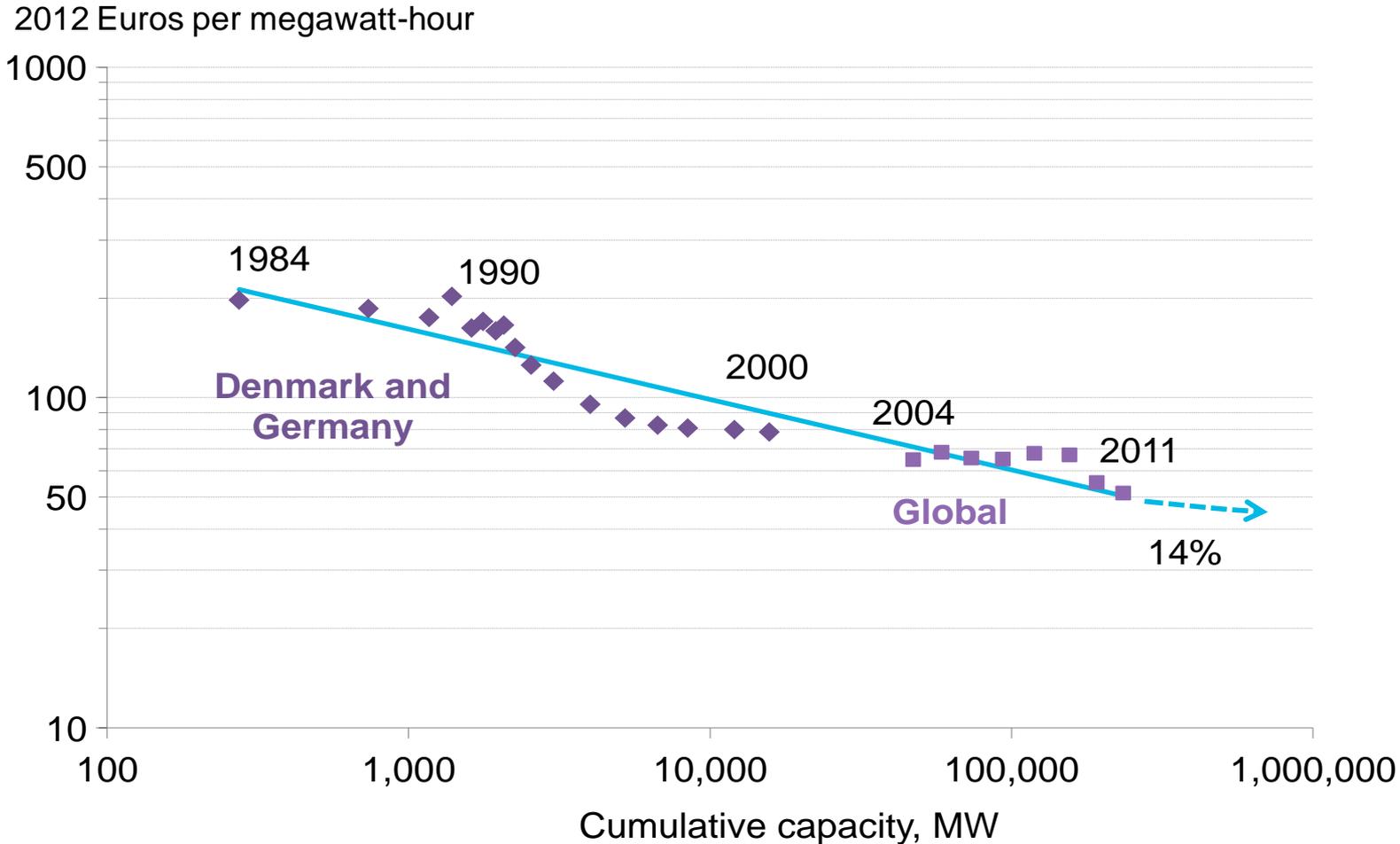
Solar photovoltaic (PV) prices have fallen 80 percent since 2008. They declined by 20 percent in 2012.



Source: Bloomberg New Energy Finance

ONSHORE WIND EXPERIENCE CURVE, 1984-2012

Wind turbine prices have declined 29 percent since 2008.



Source: Bloomberg New Energy Finance

POLICY SUPPORT REMAINS CRITICAL FOR CONTINUED RENEWABLE INVESTMENT

- 1 Renewable energy technologies are unlikely to receive much additional support from the federal government in the near-term, but will efforts on energy efficiency or renewable MLP tax structures gain momentum in Congress?**
- 2 All encompassing energy bill from Congress is unlikely, but targeted measures might be possible.**
- 3 State energy policies, including renewable portfolio standards, will be critical.**



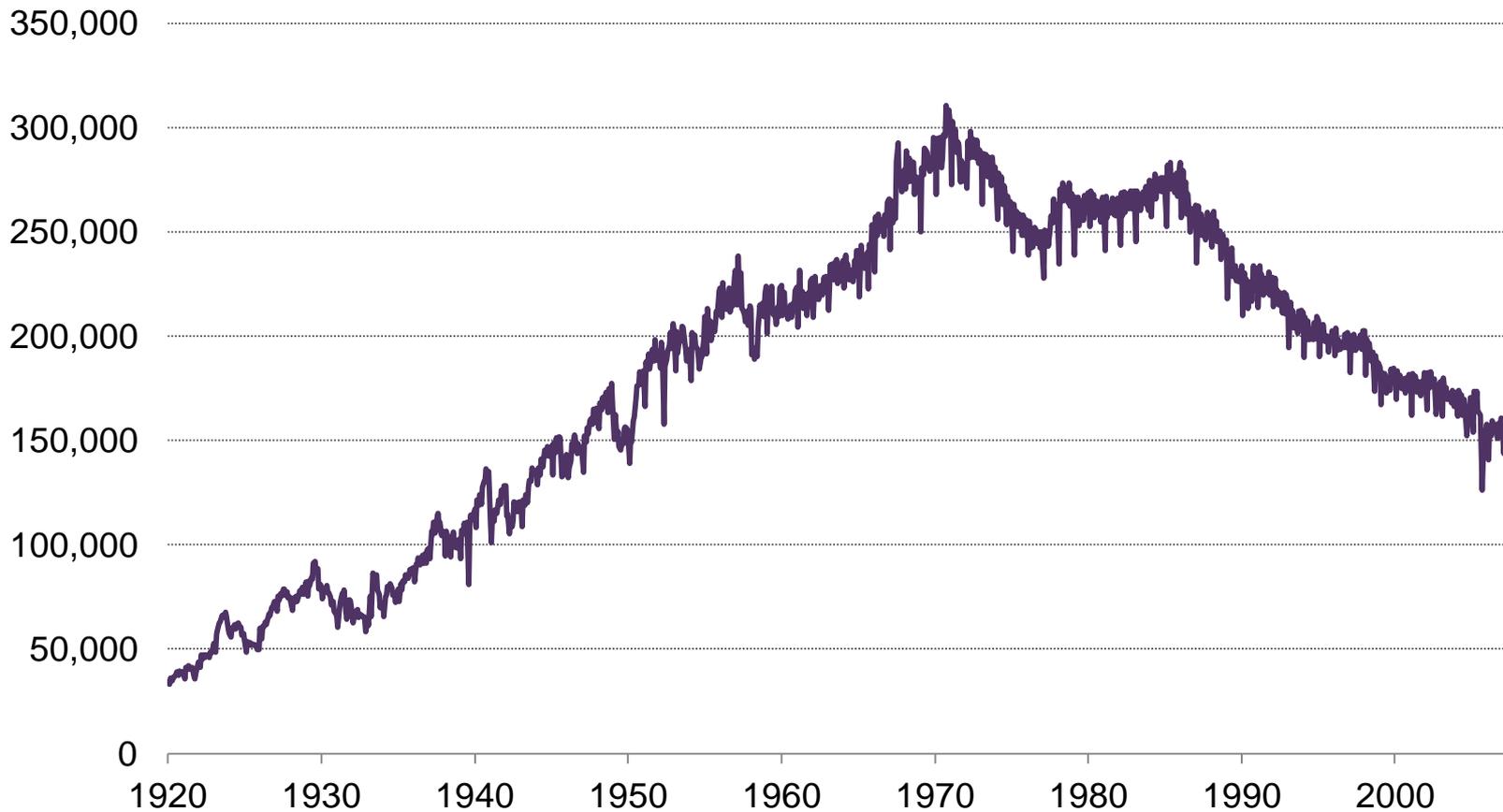
LIQUID FUELS



U.S. OIL PRODUCTION

U.S. Oil Production increased 15.3 percent in 2012 compared with 2011.

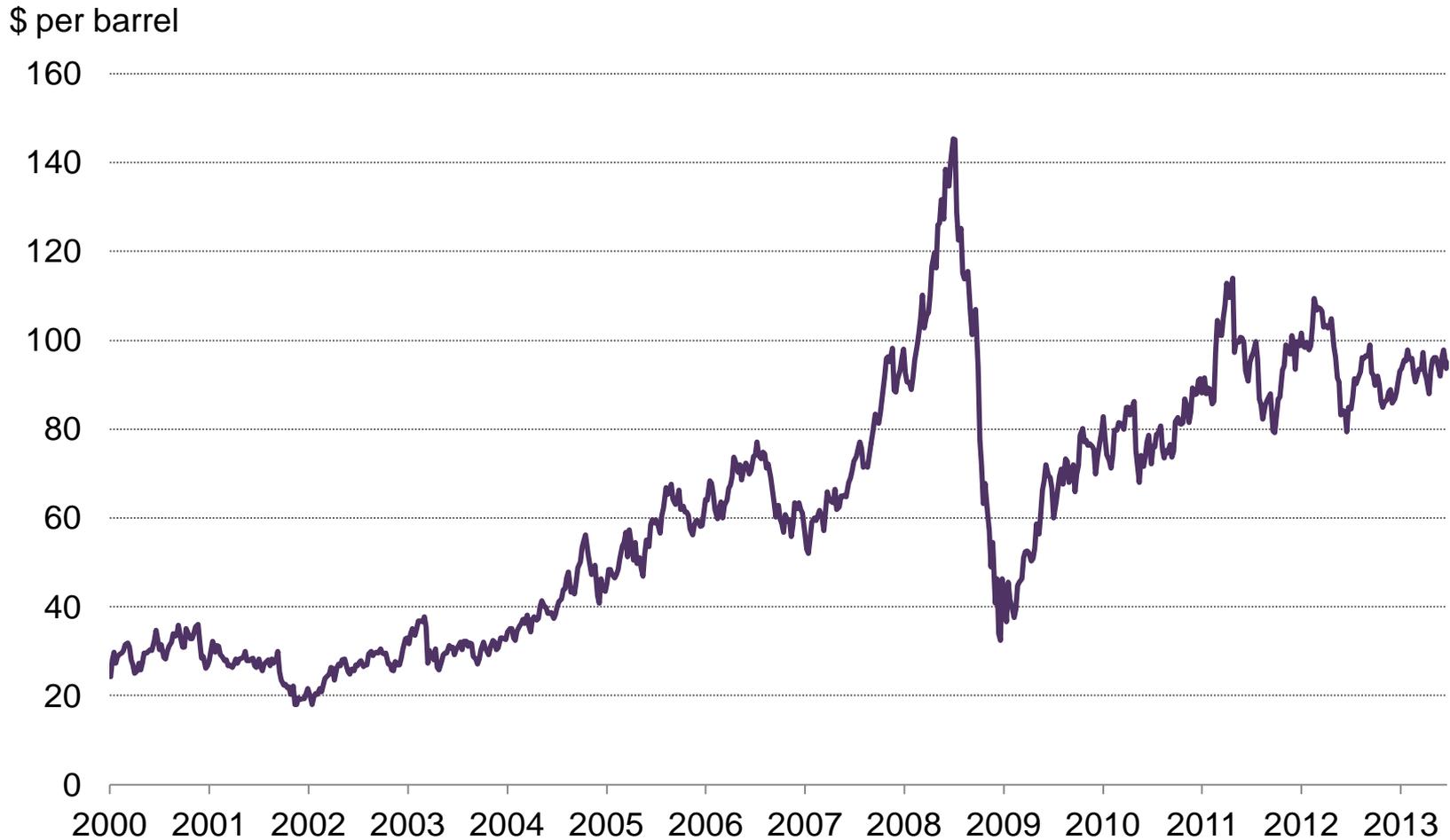
Thousand barrels per month



Source: Energy Information Administration and Bloomberg Government

U.S. OIL PRICES (WTI)

Oil prices remain close to \$100 per barrel despite surging U.S. production.



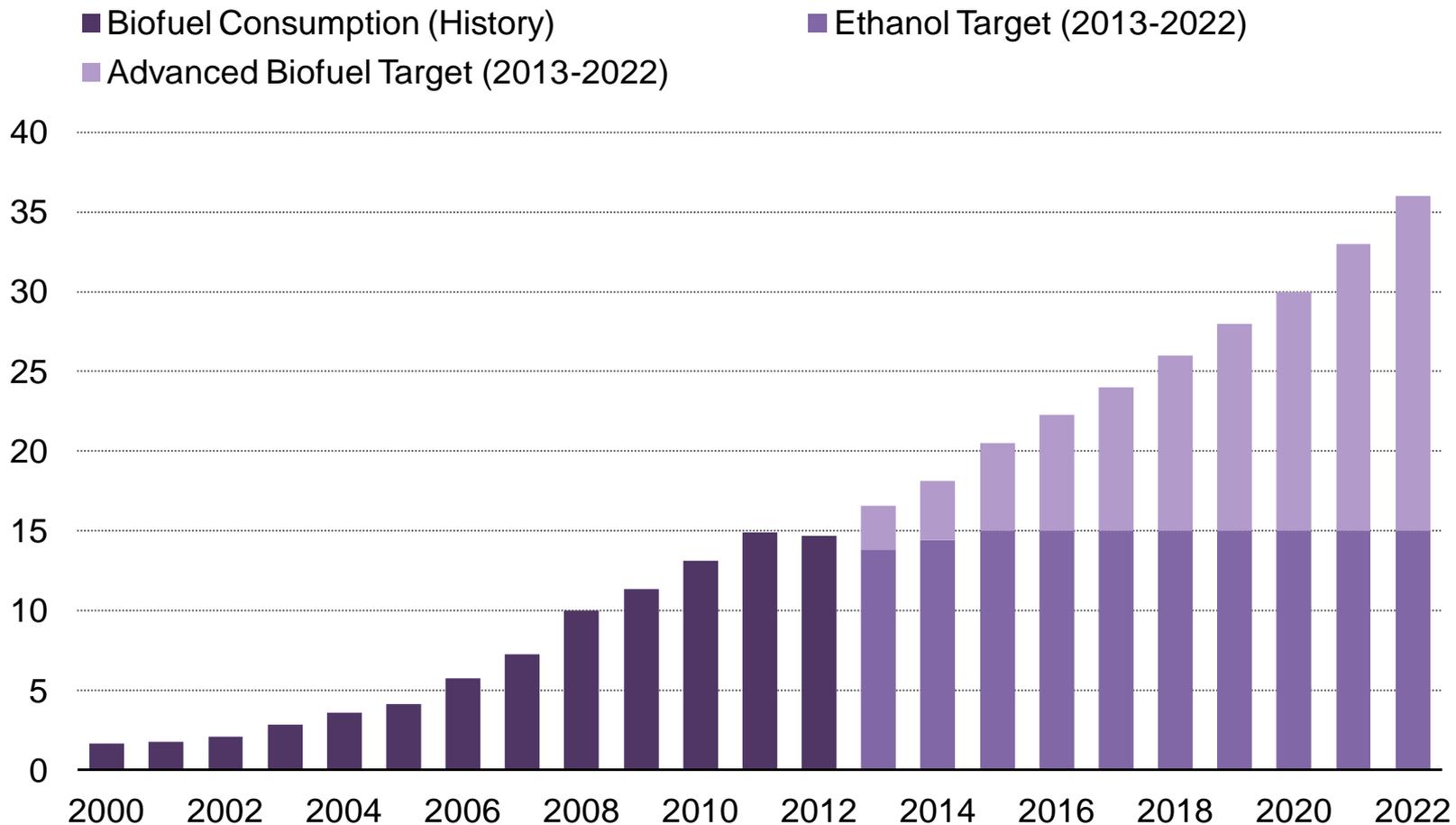
Source: Bloomberg Terminal

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THE RENEWABLE FUEL STANDARD

The RFS helped to drive U.S. biofuel consumption to a record 14.7 billion gallons in 2012 - a nearly fivefold increase compared with a decade earlier.

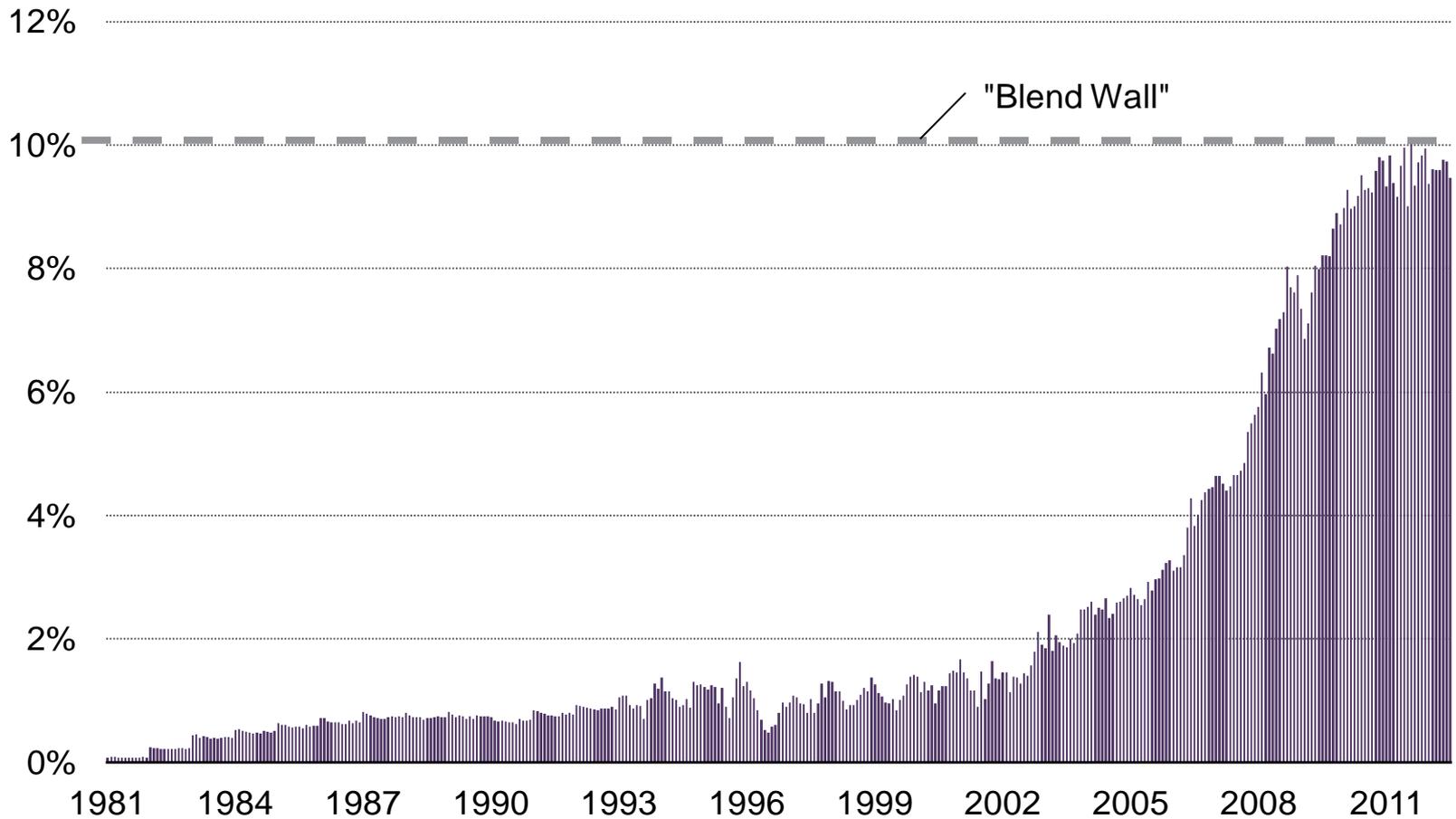
Billion gallons per year



Source: Bloomberg Government, Energy Information Administration, and Environmental Protection Agency

HITTING BIOFUEL'S BLEND WALL

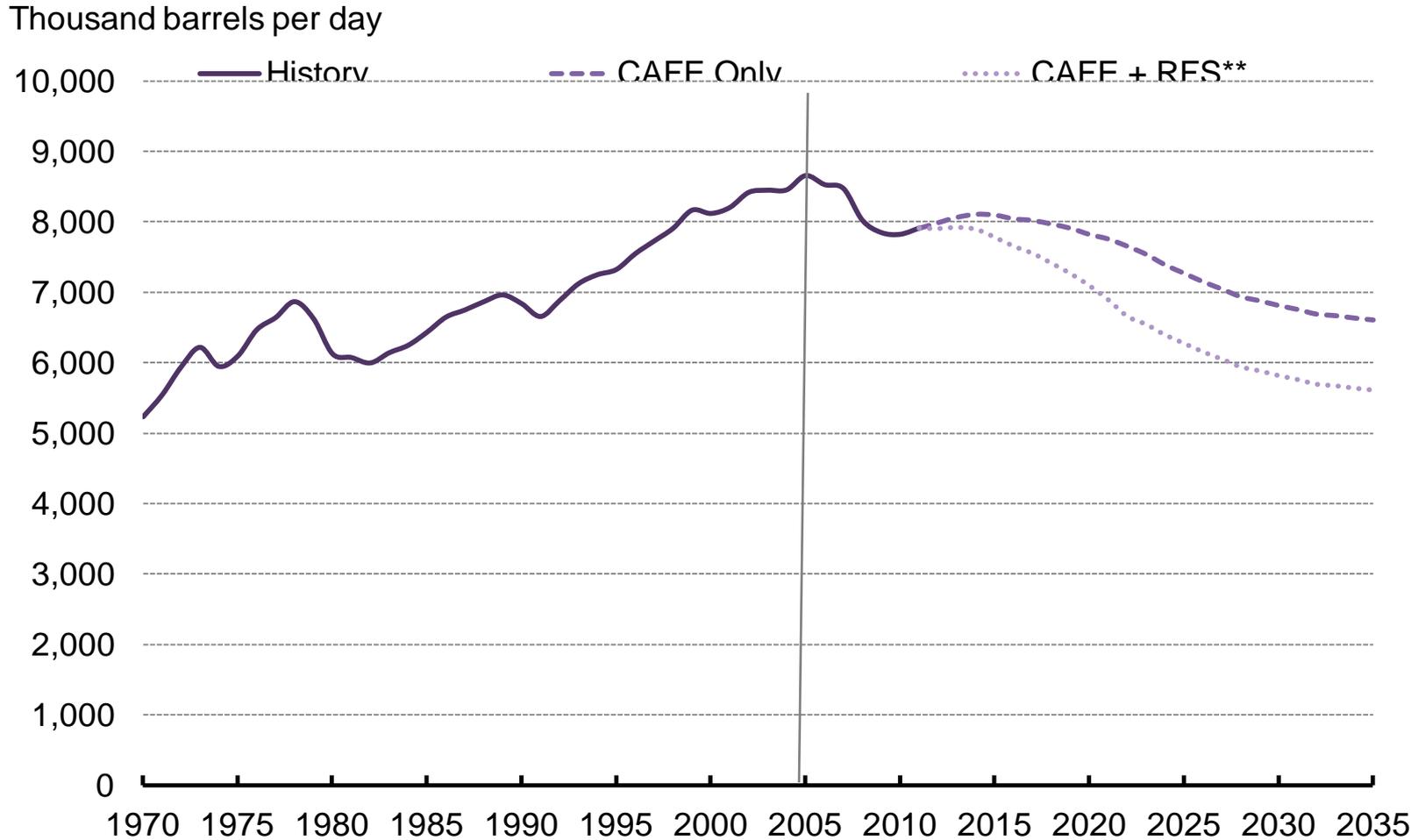
The market's failure to deliver "advanced biofuels" and the so-called blend wall are likely to prevent RFS compliance in future years.



Source: Bloomberg Government, Energy Information Administration, and Environmental Protection Agency

AND WHAT ABOUT GASOLINE DEMAND

Gasoline demand likely to drop by 8 to 20 percent by 2025 based on automobile fuel economy requirements and the RFS.



Source: Bloomberg Government and Energy Information Administration (history)

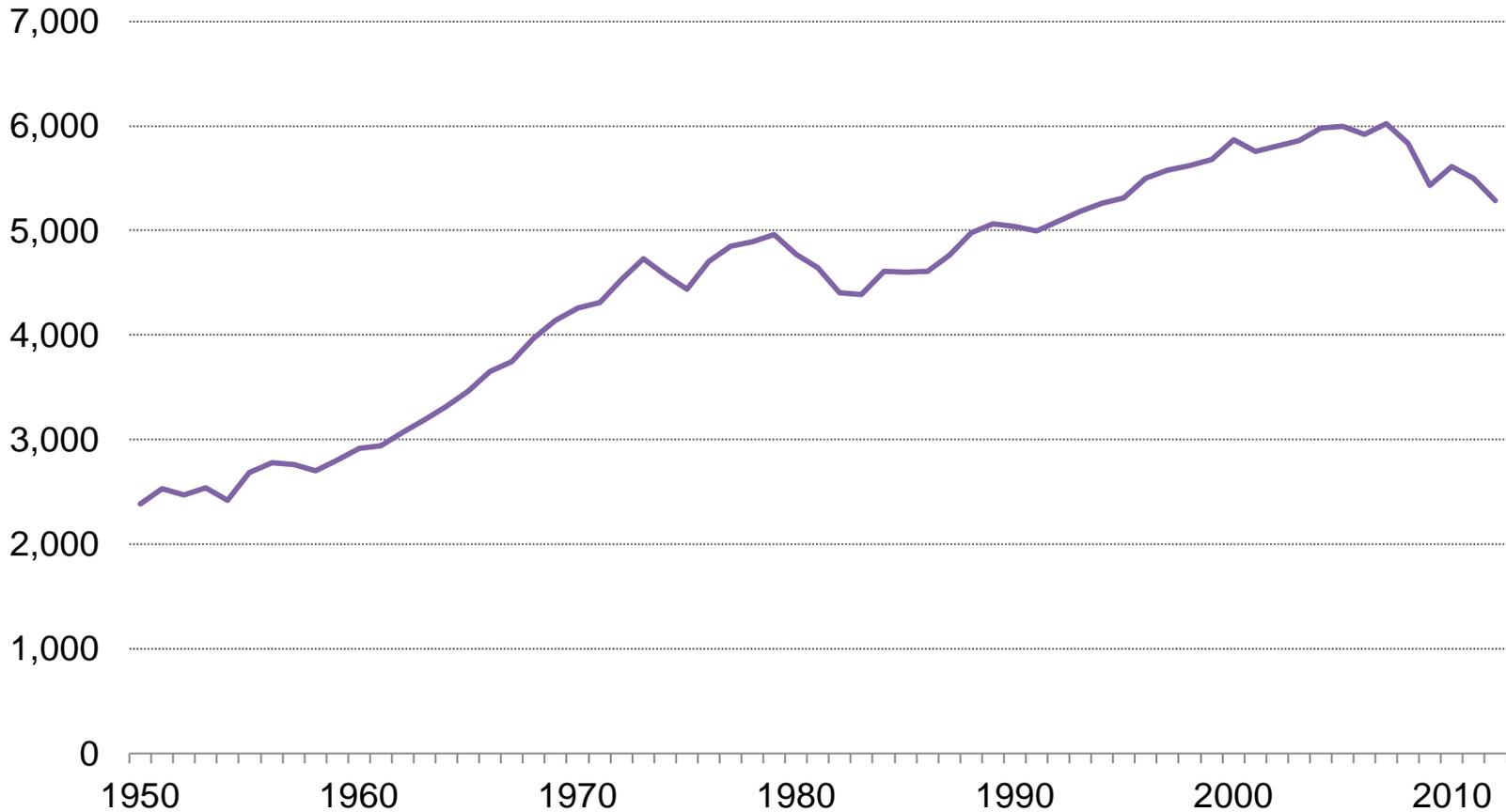
KEY FINDINGS



U.S. CO₂ EMISSIONS

U.S. CO₂ emissions have declined 730 million tons per year since 2007 – or about 12 percent.

Million metric tons of carbon dioxide



Source: Bloomberg Government and Energy Information Administration

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Q&A

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ABOUT THE ANALYST



Rob Barnett, an energy analyst at Bloomberg Government, specializes in energy sector economics, environmental policy and strategy, and EPA regulations. Before joining Bloomberg, he was an associate director of Climate Change and Clean Energy at IHS Cambridge Energy Research Associates. At IHS CERA he led the environmental and energy analysis for various studies, including "Growth in the Canadian Oil Sands: Finding the New Balance," and "Crossing the Divide: The Future of Clean Energy." Before that, Barnett worked for Clemson's Power Quality and Industrial Applications Laboratory, where he modeled electric power systems to assess the impact of distributed generation.

Barnett holds a master's degree in economics from Boston University and undergraduate and master's degrees in electrical engineering from Clemson University.

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