Industrial Renaissance: Will Natural Gas Fuel Both Power and End-Use Markets?

for

United States Association of Energy Economics, Pittsburgh Chapter

May 20, 2013| Pittsburgh, PA

by

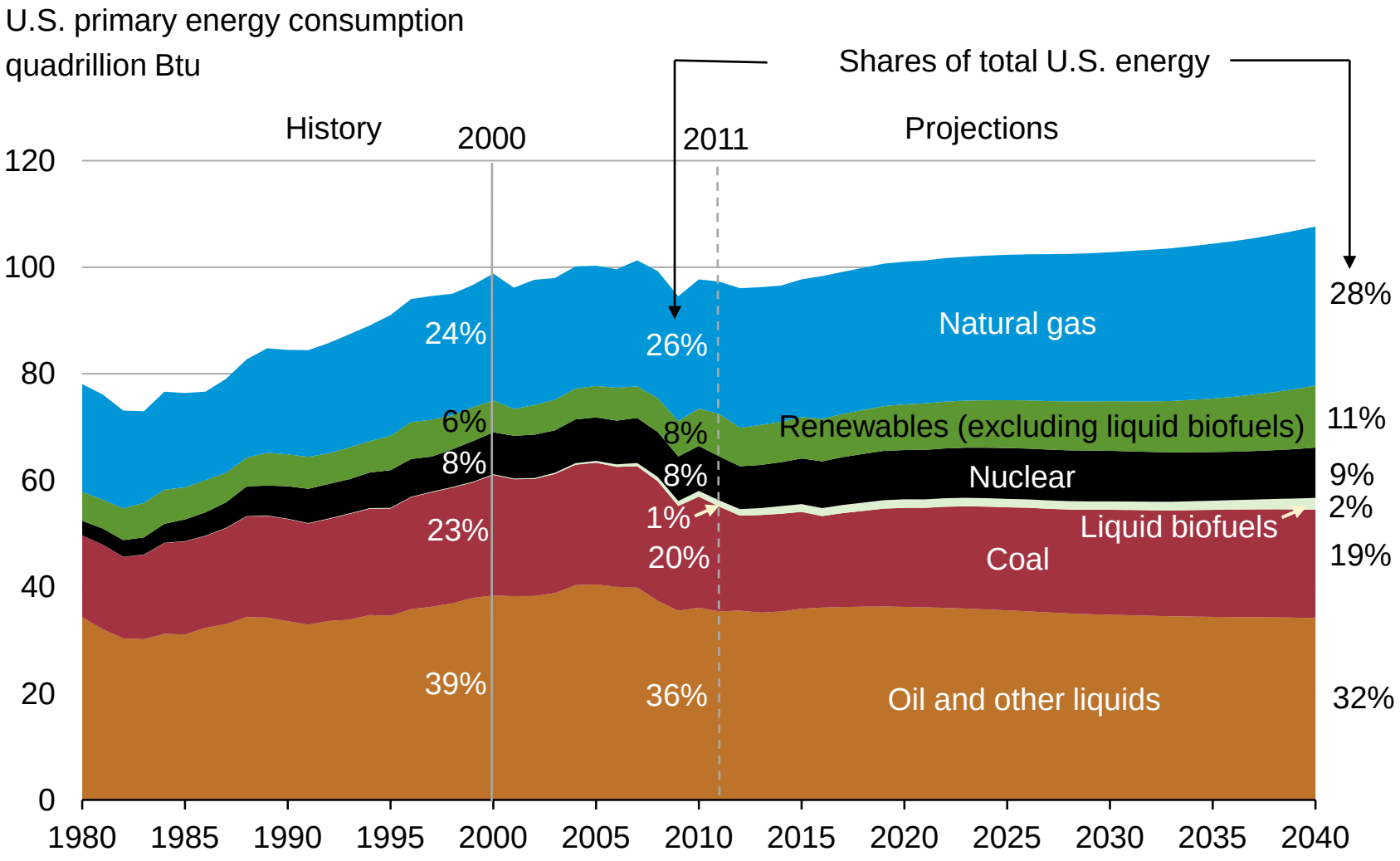
Howard Gruenspecht, Deputy Administrator

This article does not reflect the thoughts or opinions of either myself, my company, my friends, or my dog; don't quote me on that; don't quote me on anything; all rights reserved; you may distribute this article freely but you may not make a profit from it; terms are subject to change without notice; illustrations are slightly enlarged to show detail; any resemblance to actual persons, living or dead, is unintentional and purely coincidental; do not remove this disclaimer under penalty of law; do not bend, fold, mutilate, or spindle; your mileage may vary; no substitutions allowed; for a limited time only; this article is void where prohibited, taxed, or otherwise restricted; caveat emptor; article is provided "as is" without any warranties; reader assumes full responsibility; an equal opportunity article; no shoes, no shirt, no service; quantities are limited while supplies last; if any defects are discovered, do not attempt to read them yourself, but return to an authorized service center; read at your own risk; text may contain explicit materials some readers may find objectionable; keep away from sunlight; keep away from OJ; keep away from pets and small children; limit one-per-family please; no money down; no purchase necessary; you need not be present to win; some assembly required; instructions are included; action figures sold separately; no preservatives added; slippery when wet; safety goggles may be required during use; sealed for your protection, do not read if safety seal is broken; call before you dig; not liable for damages arising from use or misuse; for external use only; if rash, irritation, redness, or swelling develops, discontinue reading; read only with proper ventilation; avoid extreme temperatures and store in a cool dry place; keep away from open flames; avoid contact with eyes and skin and avoid inhaling fumes; do not puncture, incinerate, or store above 120 degrees Fahrenheit; do not place near a flammable or magnetic source; smoking this article could be hazardous to your health; the best safeguard, second only to abstinence, is the use of a condom; no salt, MSG, artificial color or flavoring added; if ingested, do not induce vomiting, if symptoms persist, consult a physician; possible penalties for early withdrawal; offer valid only at participating sites; allow four to six weeks for delivery; must be 18 to read; disclaimer does not cover misuse, accident, lightning, flood, tornado, tsunami, volcanic eruption, earthquake, hurricanes, and other Acts of God, neglect, damage from improper reading, incorrect line voltage, improper or unauthorized reading, broken antenna or marred cabinet, missing or altered serial numbers, electromagnetic radiation from nuclear blasts, sonic boom vibrations, customer adjustments that are not covered in this list, and incidents owing to an airplane crash, ship sinking or taking on water, motor vehicle crashing, dropping the item, falling rocks, leaky roof, broken glass, mud slides, forest fire, or projectile (which can include, but not be limited to, arrows, bullets, shot, BB's, shrapnel, lasers, napalm, torpedoes, or emissions of X-rays, Alpha, Beta and Gamma rays, knives, stones, etc.); other restrictions may apply. This product is meant for educational purposes only. Any resemblance to real persons, living or dead is purely coincidental. Void where prohibited. Some assembly required. Batteries not included.

Bottom line up front

- Unlike many other fuels, natural gas is used across a range of sectors, including power generation, industry and buildings
- Electricity has been the major growth sector for natural gas use in recent years
- Natural gas demand is projected to rise significantly despite very modest growth in overall U.S. energy use
- Domestic natural gas demand growth is concentrated in power generation, industry and transportation applications
- The United States also becomes a net exporter of natural gas
- The projected use of natural gas for electricity generation and exports is VERY sensitive to both prices and policy assumptions

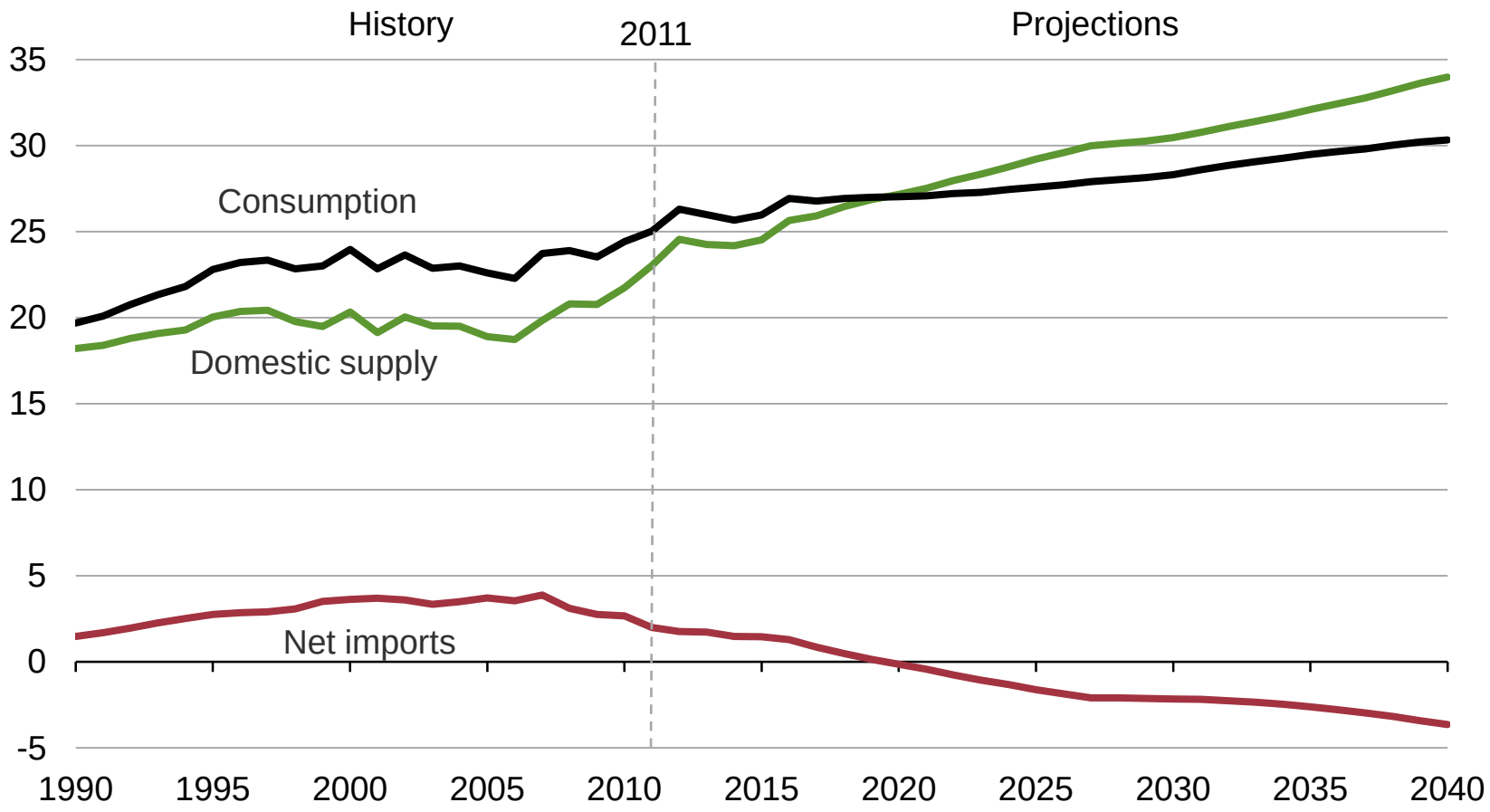
U.S. energy use grows slowly over projection reflecting improving energy efficiency and a slow and extended economic recovery



Source: EIA, Annual Energy Outlook 2013 Early Release

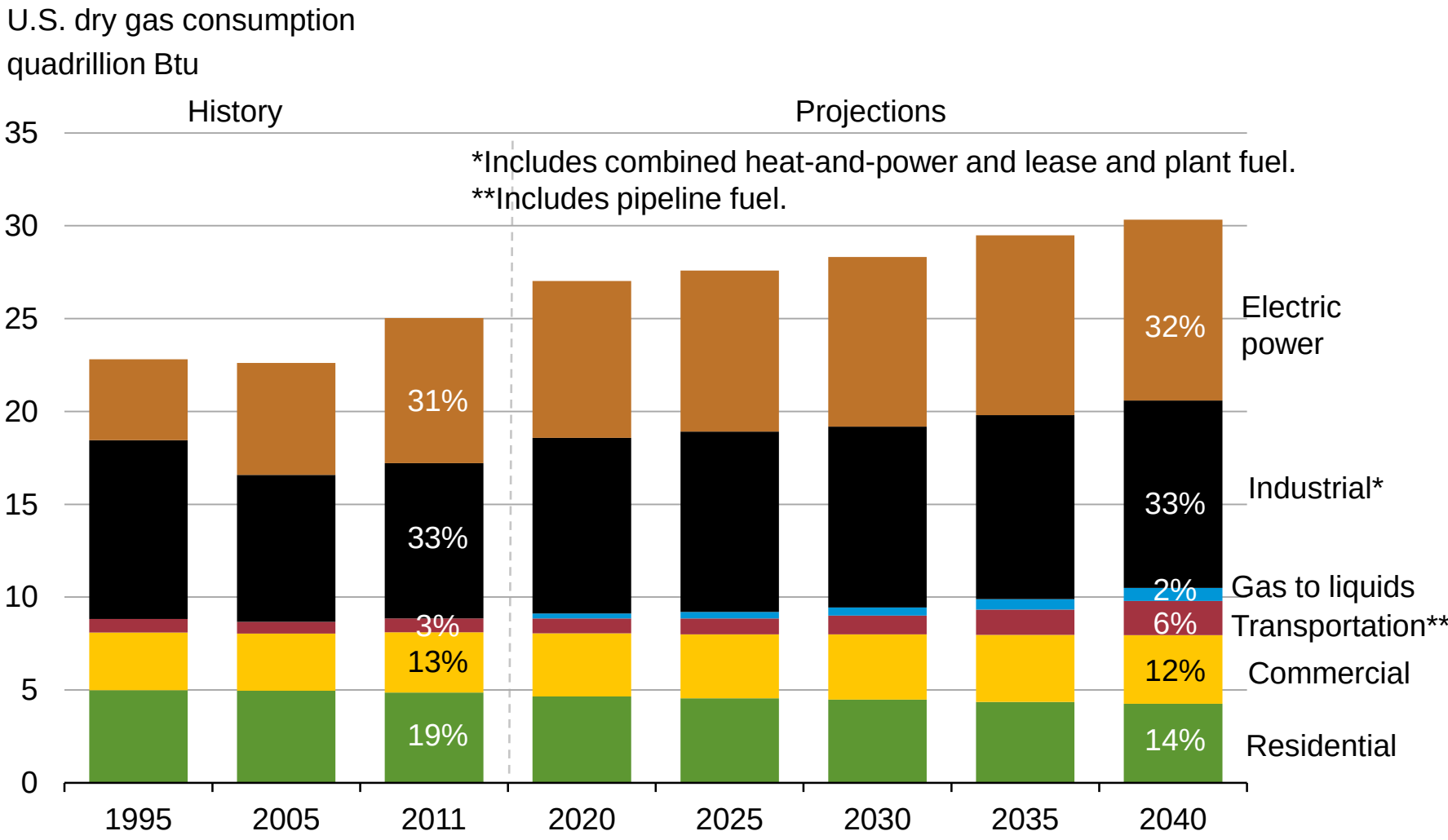
U.S. natural gas production grows faster than consumption and the nation becomes a net exporter of natural gas around 2020

U.S. dry gas
quadrillion Btu



Source: EIA, Annual Energy Outlook 2013

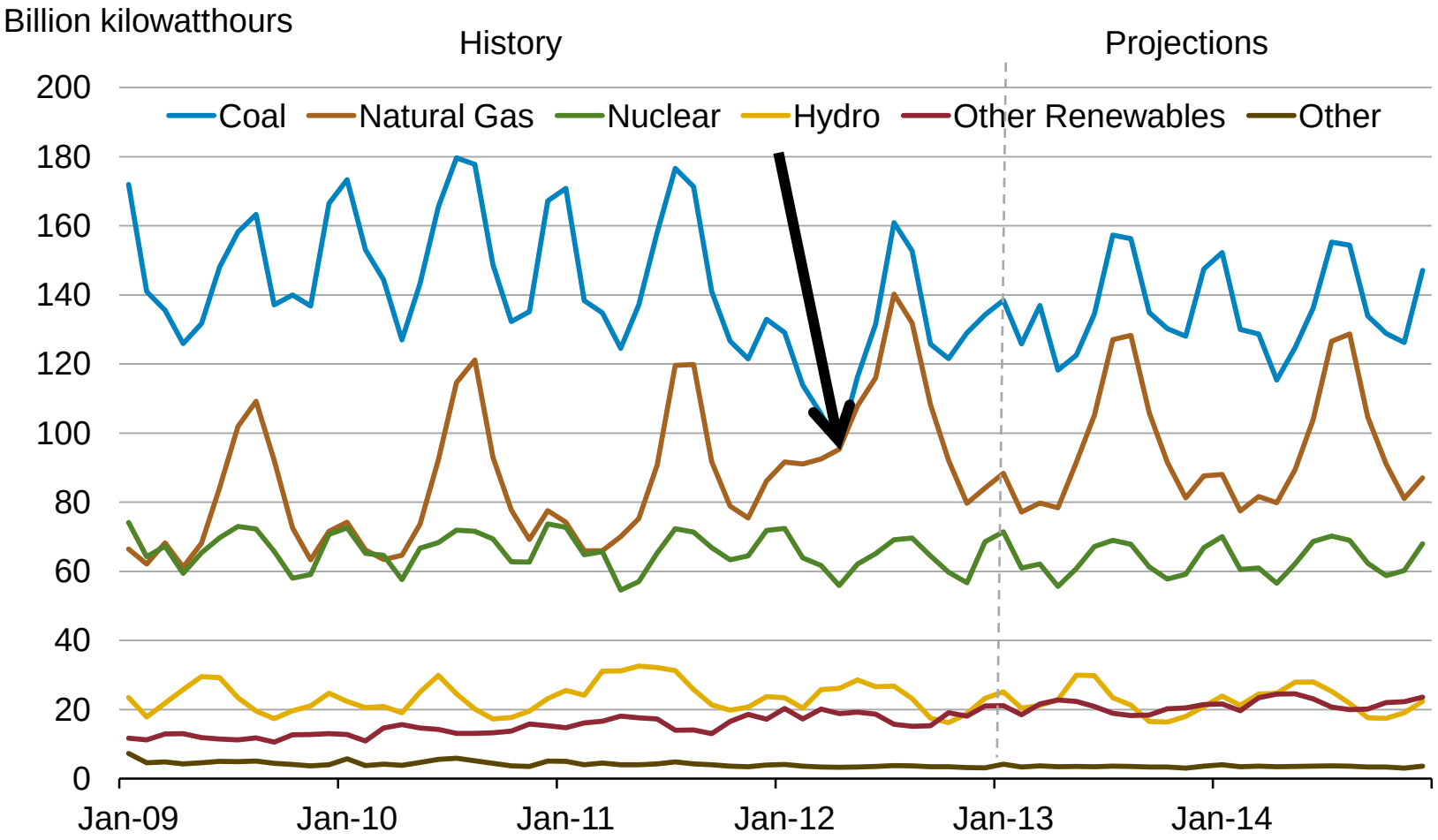
Natural gas consumption is quite dispersed with electric power, industrial, and transportation use driving projected demand growth



Source: EIA, Annual Energy Outlook 2013

Electricity generation

U.S. Monthly Net Electric Power Generation by Fuel, 2009 - 2014



Source: Short-Term Energy Outlook, May 2013

Key electricity takeaways from AEO2013 projections

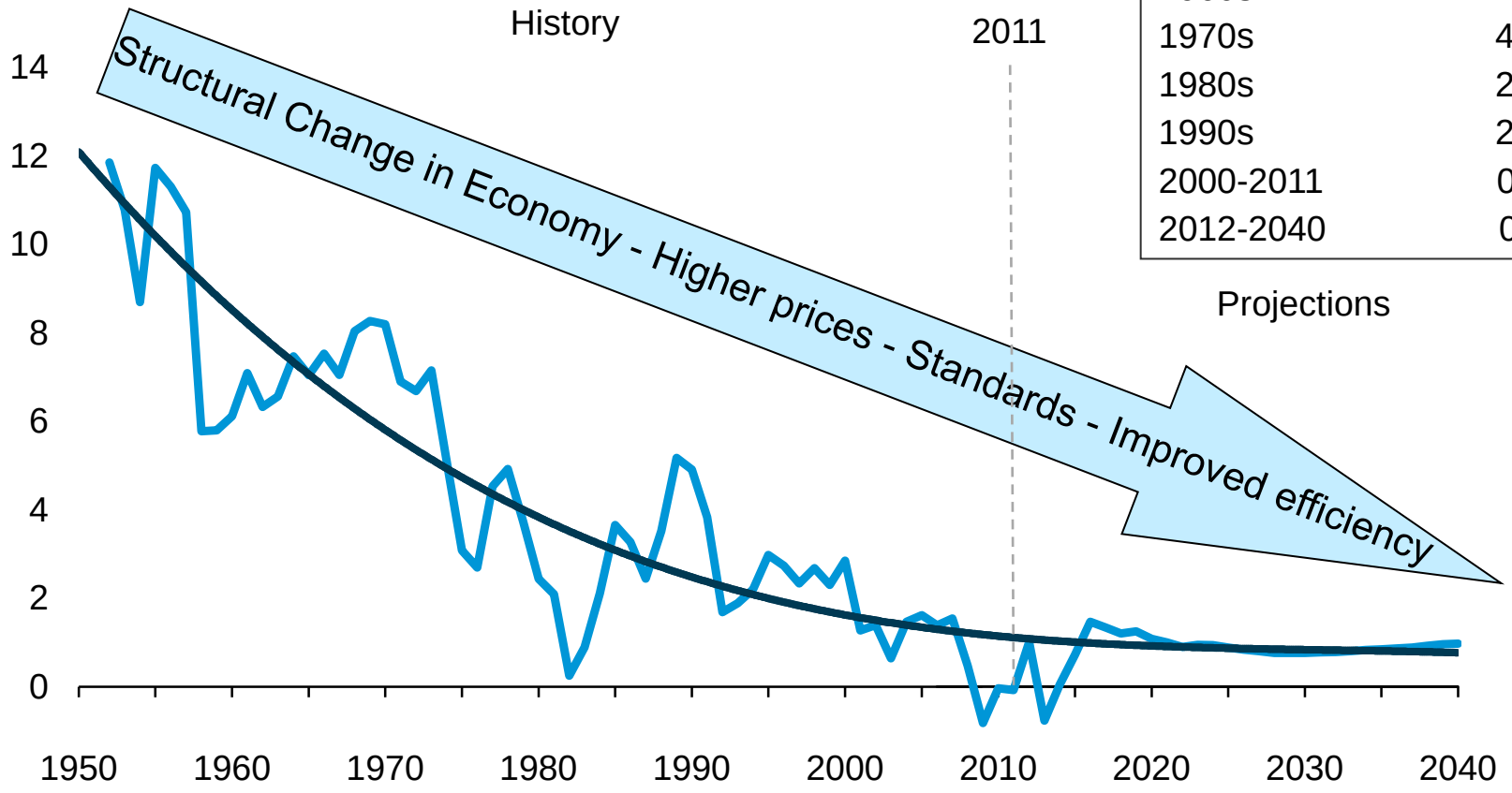
- Slow growth in electricity demand in the Reference case, averaging 0.9 percent per year over the 2012-40 period
- The natural gas share of total generation is 30% in 2040 in the Reference case (from 25% in 2011)
- BUT, in cases with lower natural gas prices, higher coal prices, or greenhouse gas mitigation policies, the natural gas share of generation is significantly higher
- 49 GW of existing coal-fired capacity are retired in the Reference case – retirements are significantly higher in the High Oil and Natural Gas Resource case, which has lower natural gas prices, or in cases with GHG policies

Growth in electricity use slows, but still increases by 28% from 2012 to 2040

U.S. electricity use

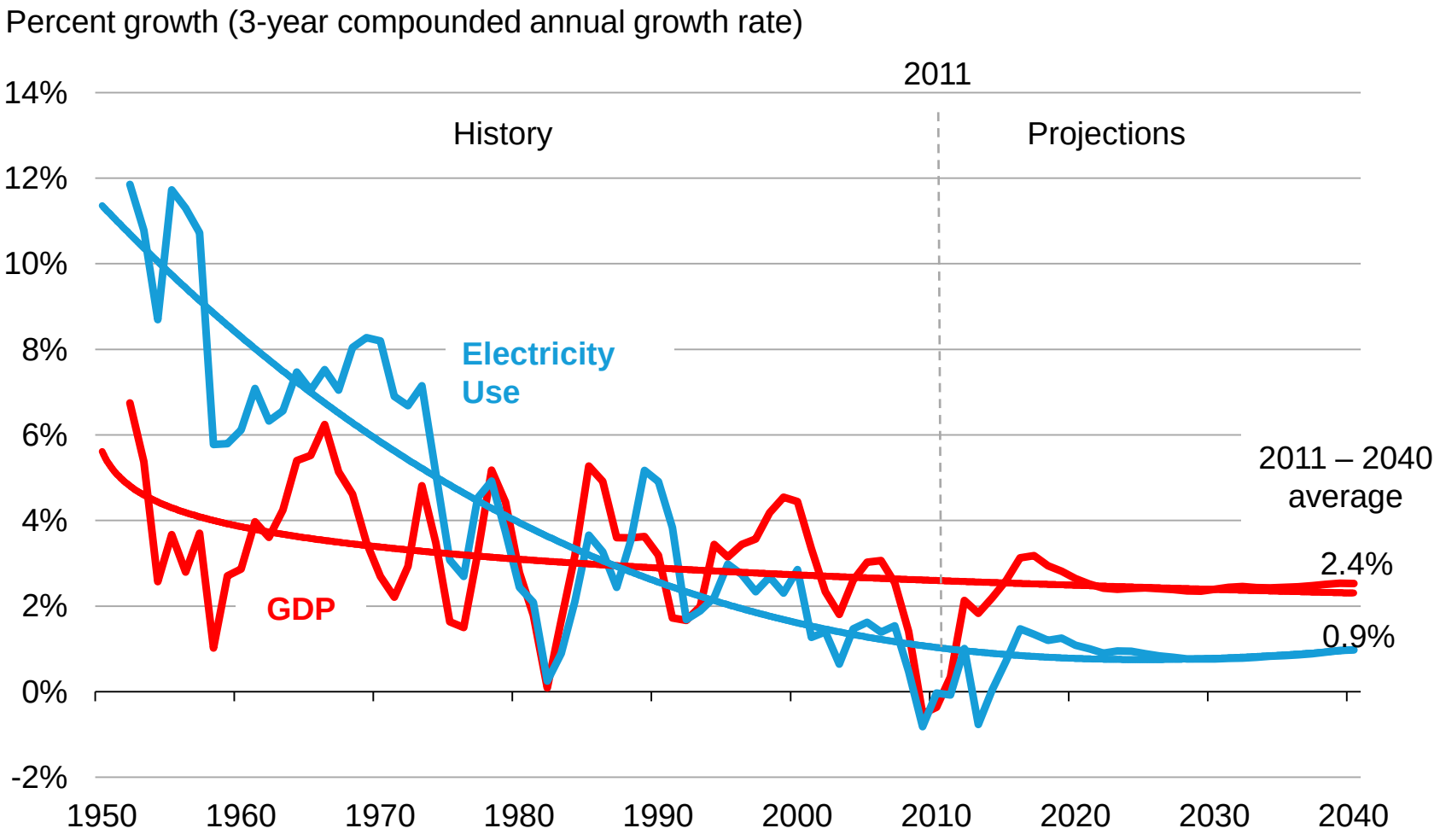
percent growth (3-year compounded annual growth rate)

Period	Annual Growth
1950s	9.8
1960s	7.3
1970s	4.7
1980s	2.9
1990s	2.4
2000-2011	0.9
2012-2040	0.9



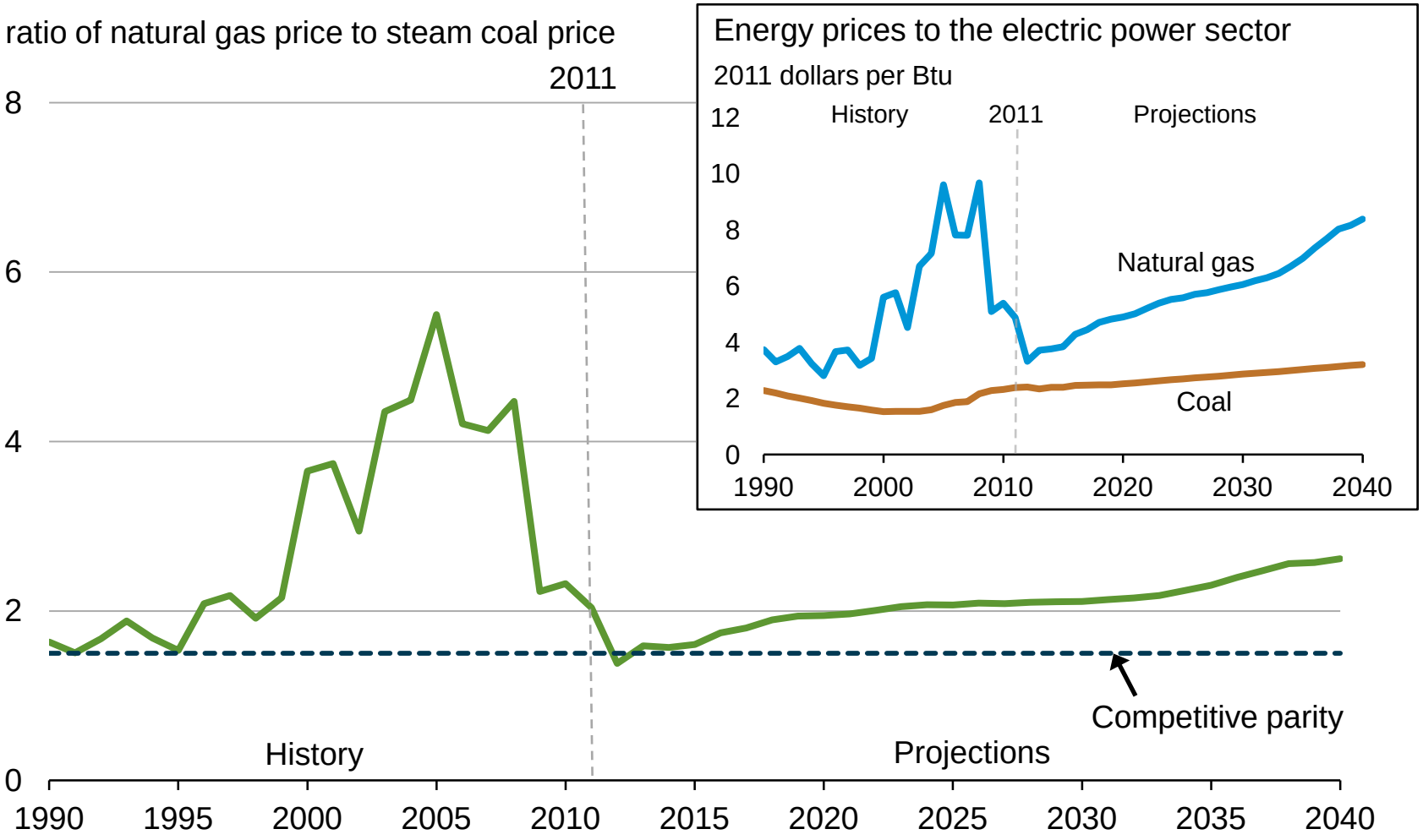
Source: EIA, Annual Energy Outlook 2013

U. S. electricity use and economic growth, 1950-2040



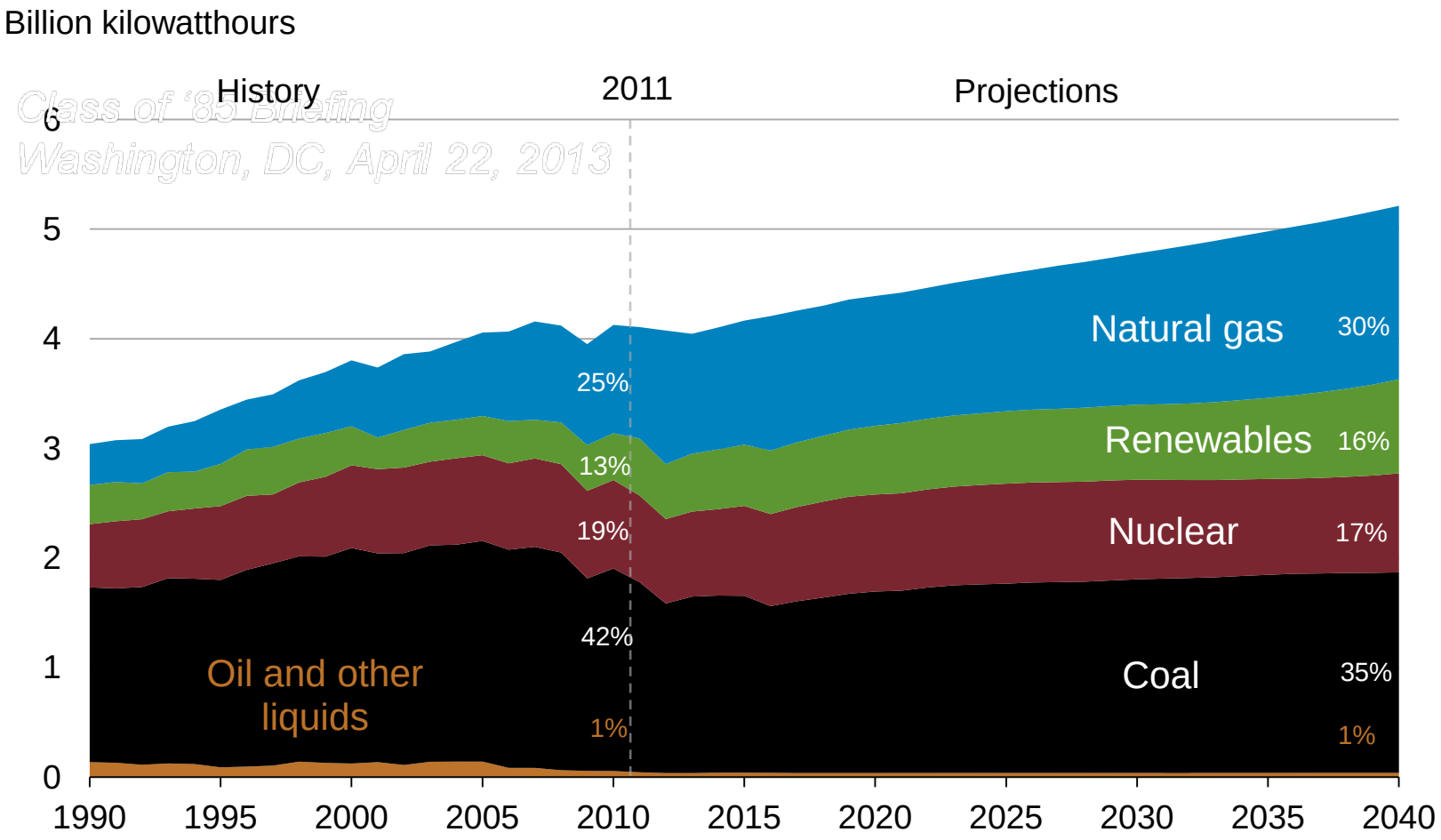
Source: EIA, Annual Energy Outlook 2013

Coal regains some competitive advantage relative to natural gas on a national average basis in the Reference case



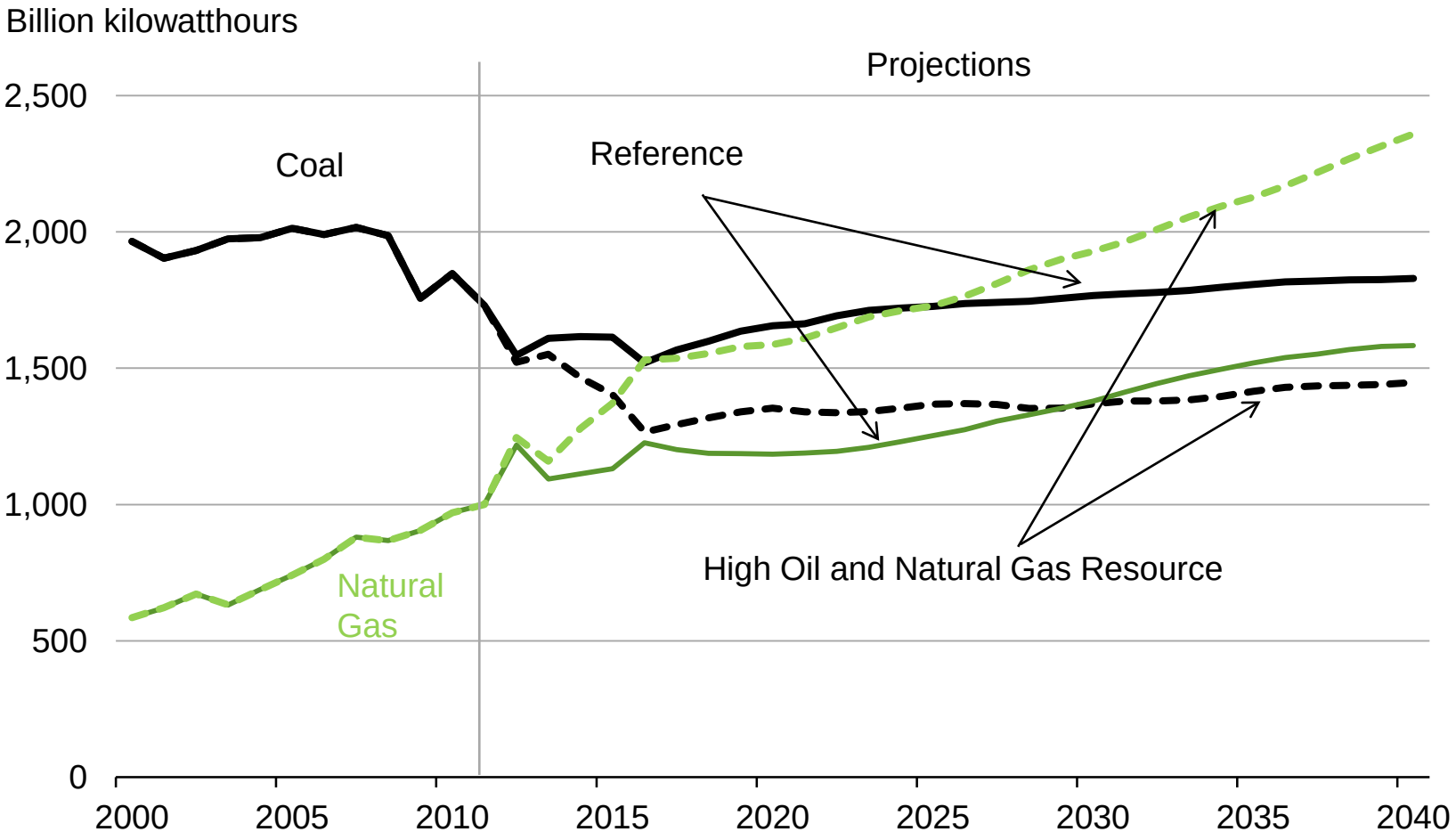
Source: EIA, Annual Energy Outlook 2013

Electricity generation by fuel in the Reference Case, 1990-2040



Source: EIA, Annual Energy Outlook 2013, Reference Case

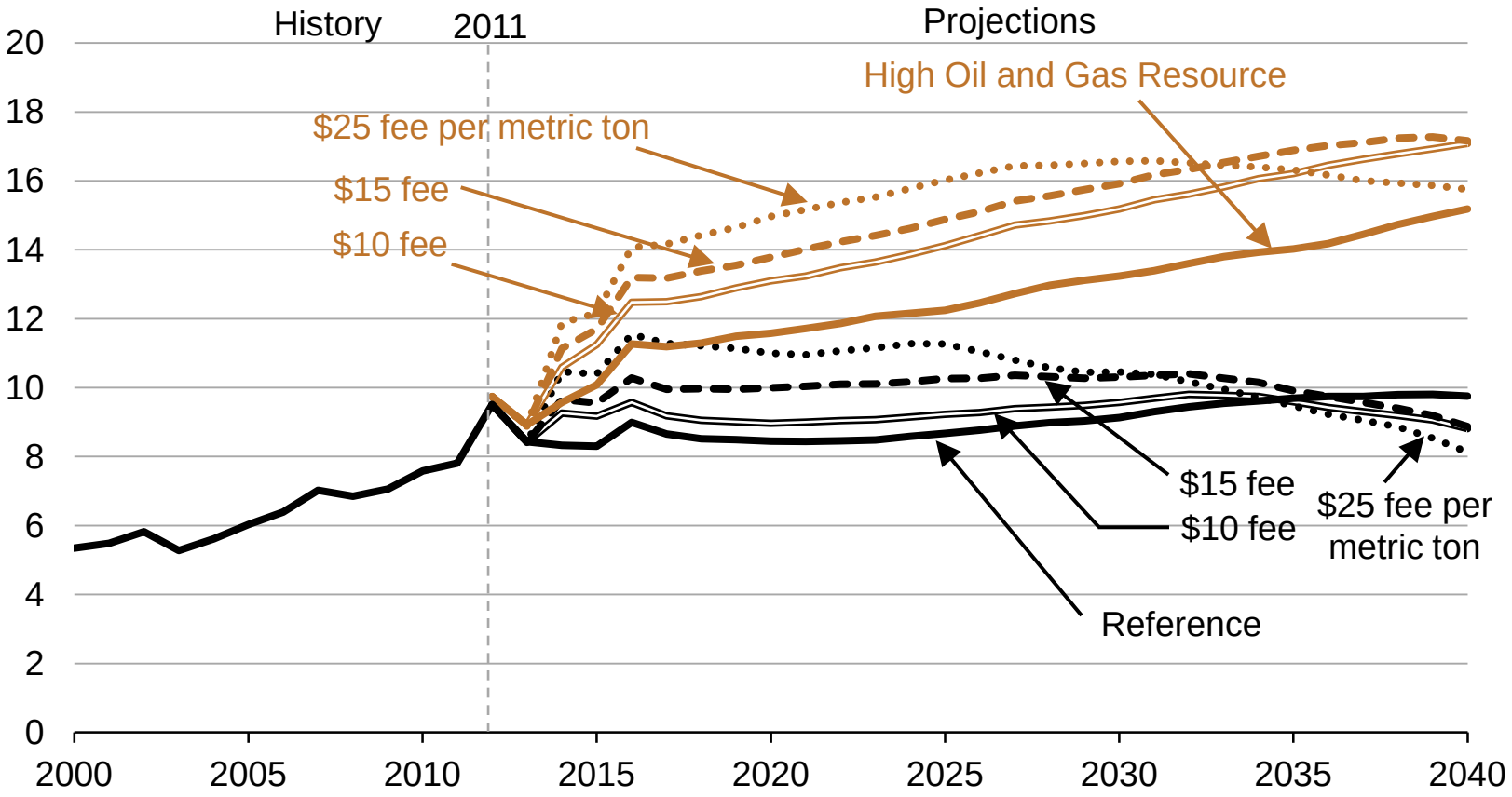
With lower natural gas prices in the High Oil and Gas resource case, coal is permanently displaced as the leading generation source in the near future



Source: EIA, Annual Energy Outlook 2013

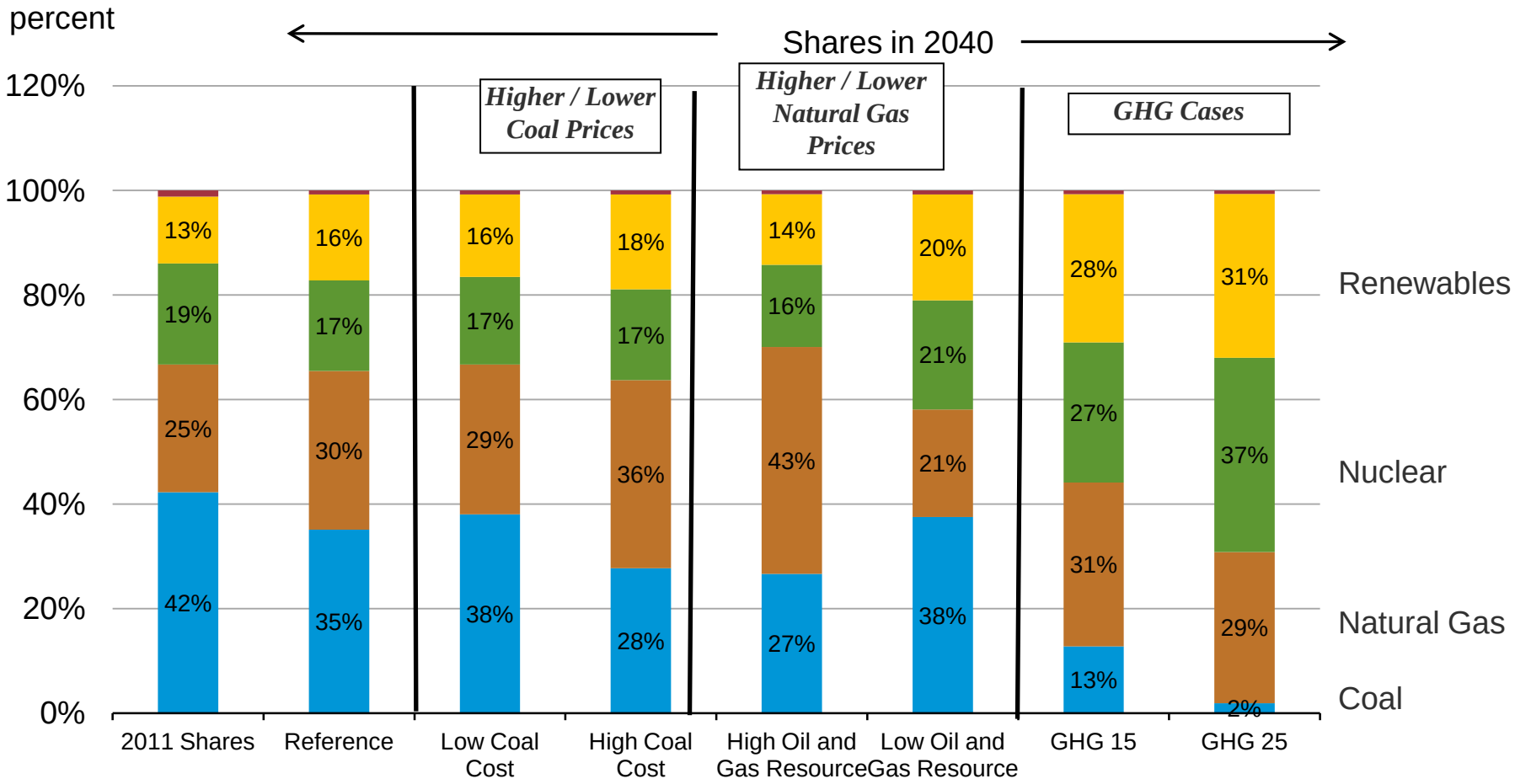
Both resource realizations and policy decisions affect the projected use of natural gas for U.S. electricity generation

U.S. natural gas used for electricity generation
quadrillion Btu



Source: EIA, Annual Energy Outlook 2013

Projected electricity generation shares of different fuels in 2040 are very sensitive to both fuel prices and future policy developments



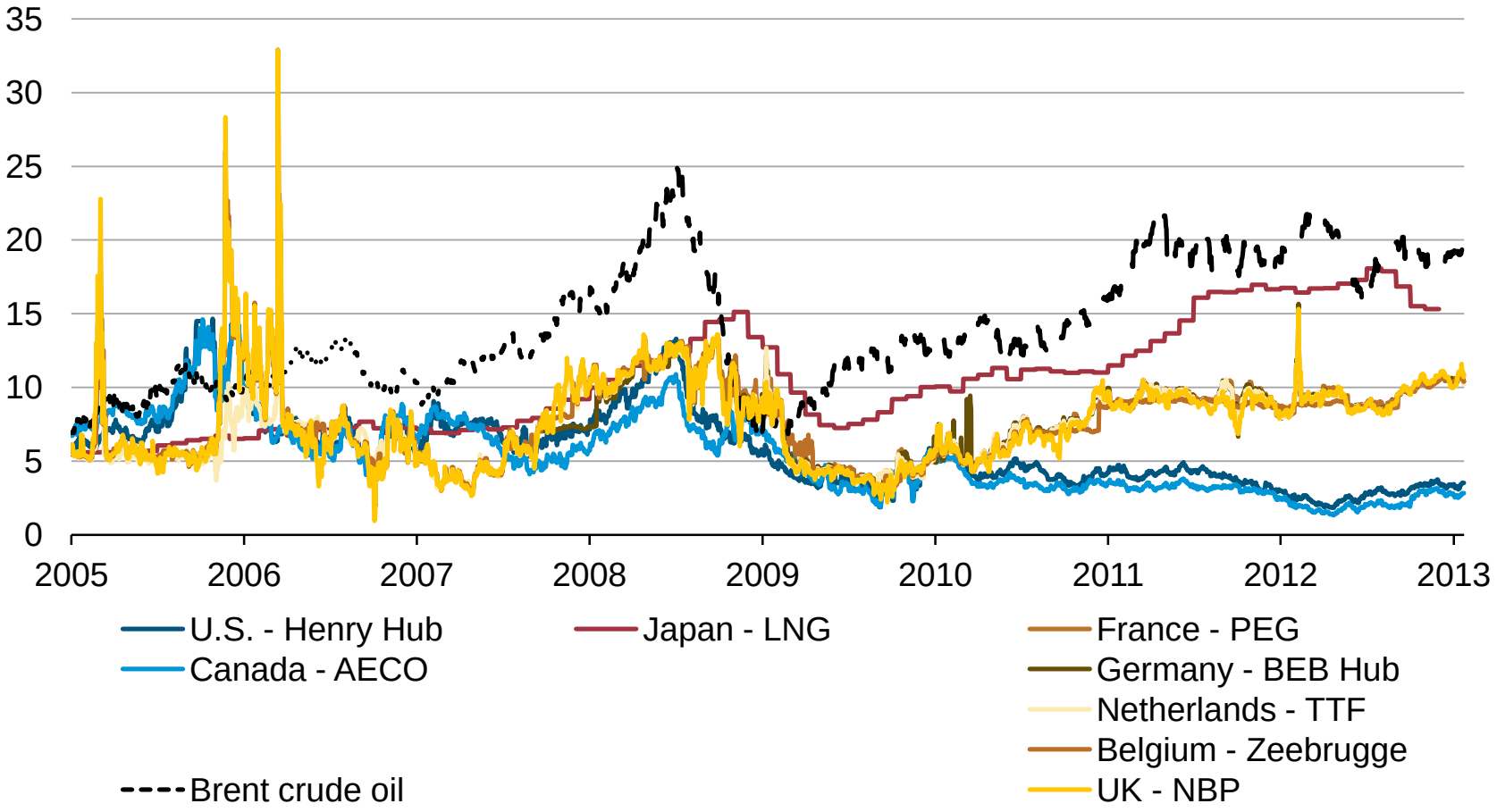
Source: EIA, Annual Energy Outlook 2013

Natural gas trade

Spot natural gas prices vary significantly across global markets since 2008, with many markets far below oil-related benchmarks

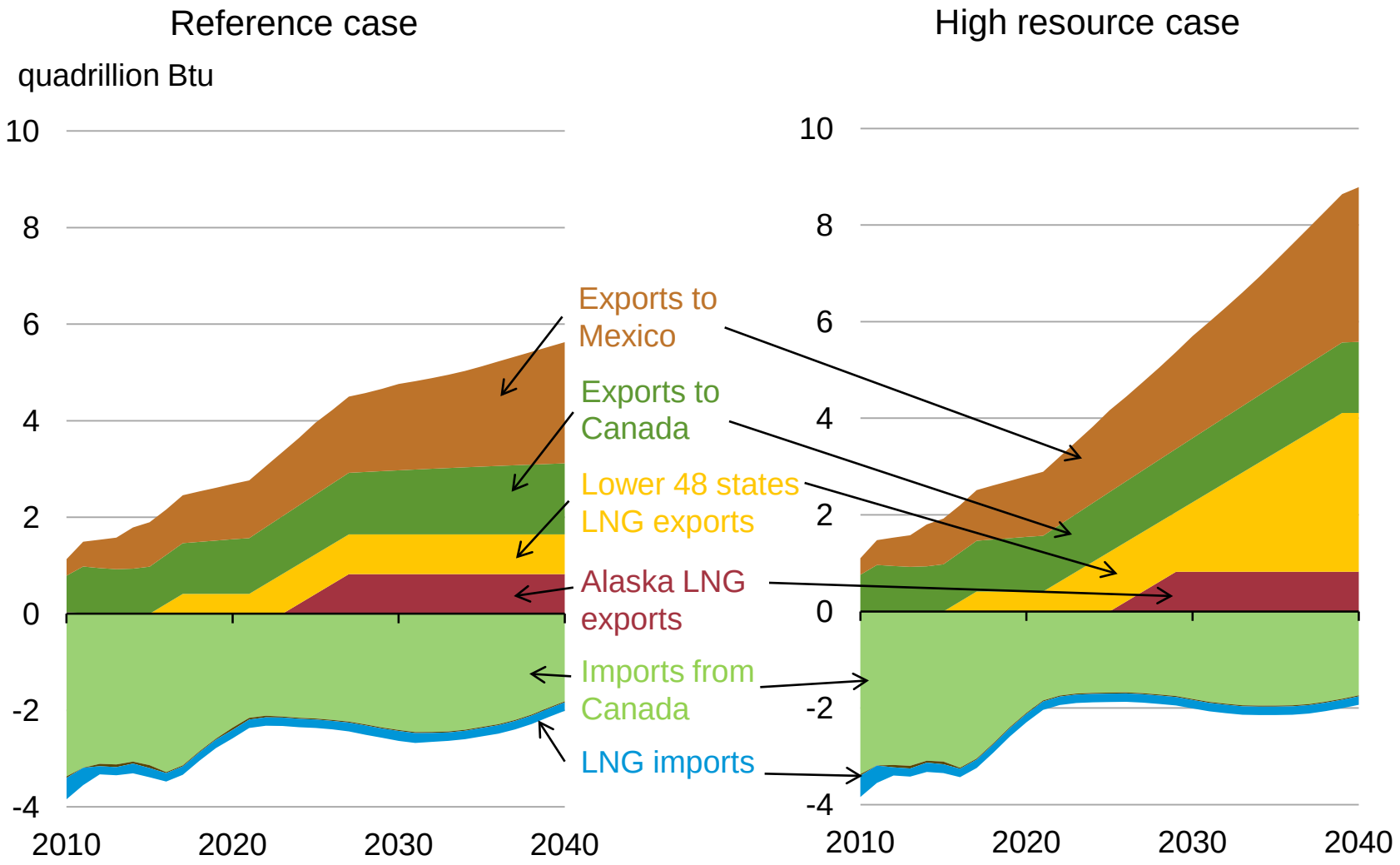
Global spot natural gas, crude oil, and LNG prices

U.S. dollars per million British thermal unit



Source: Derived from Bloomberg, L.P.

U.S. natural gas imports and exports



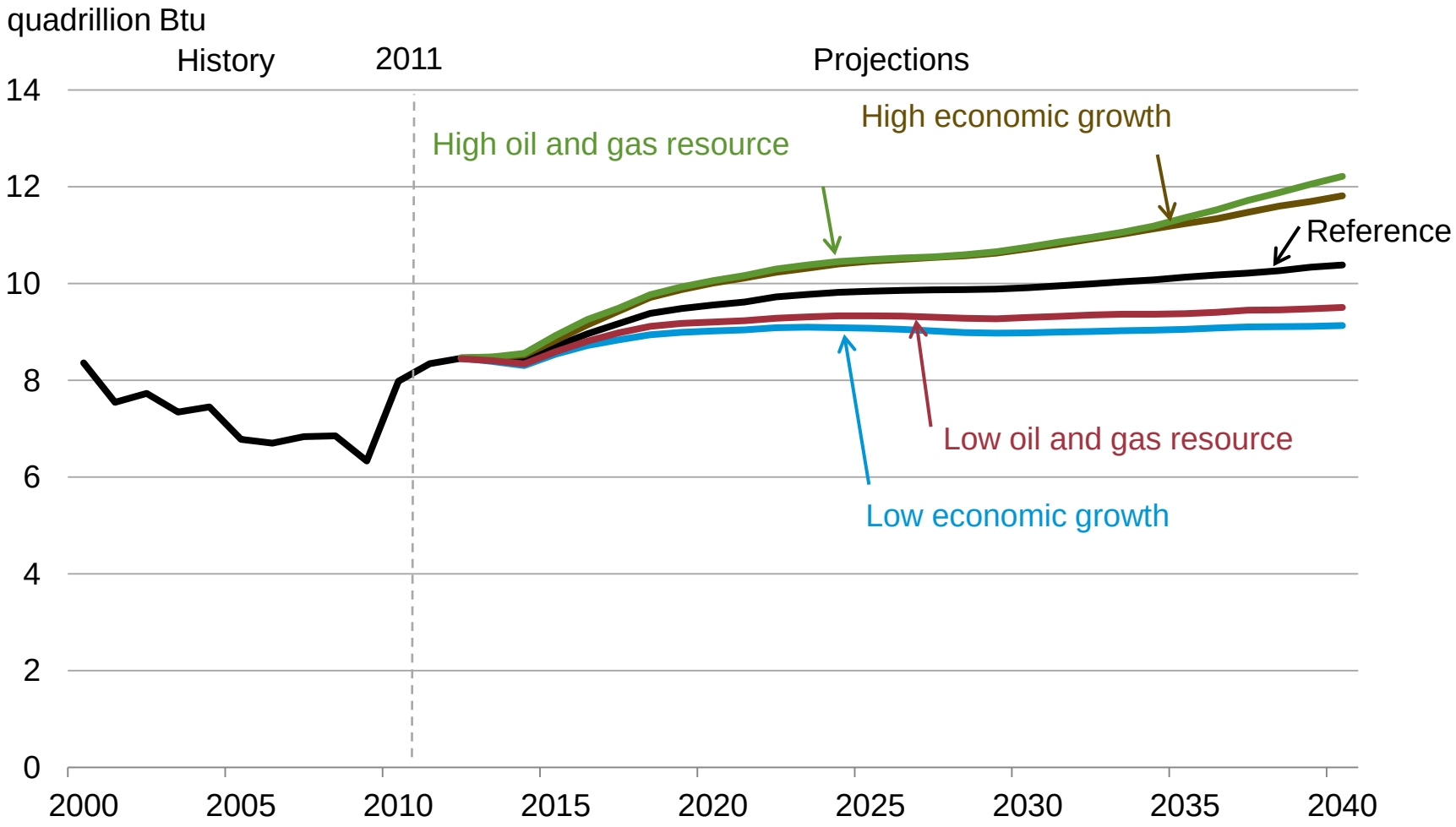
Source: EIA, Annual Energy Outlook 2013

Natural gas trade wild cards

- Quality and extent of shale gas resources outside North America
- Success (or not) in addressing above-the-ground issues in key areas with resources outside North America
- Importance of economic and physical links between natural gas and tight oil production
- Speed of global natural gas market convergence
- Relative strength of gas-on-gas or gas-on-oil pricing models in key market regions

Industrial sector

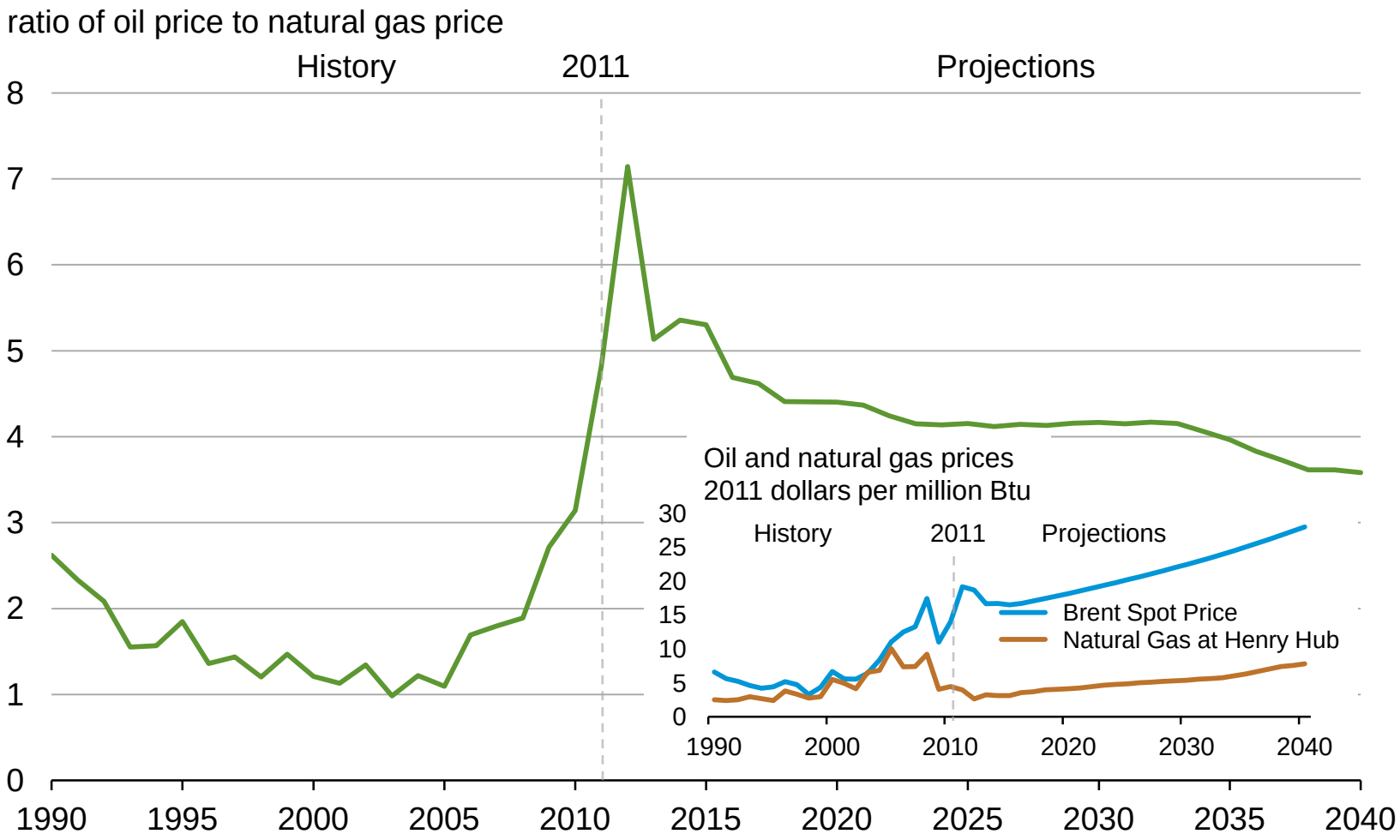
Economics and resource realizations impact the projected U.S. industrial natural gas use



Source: EIA, Annual Energy Outlook 2013

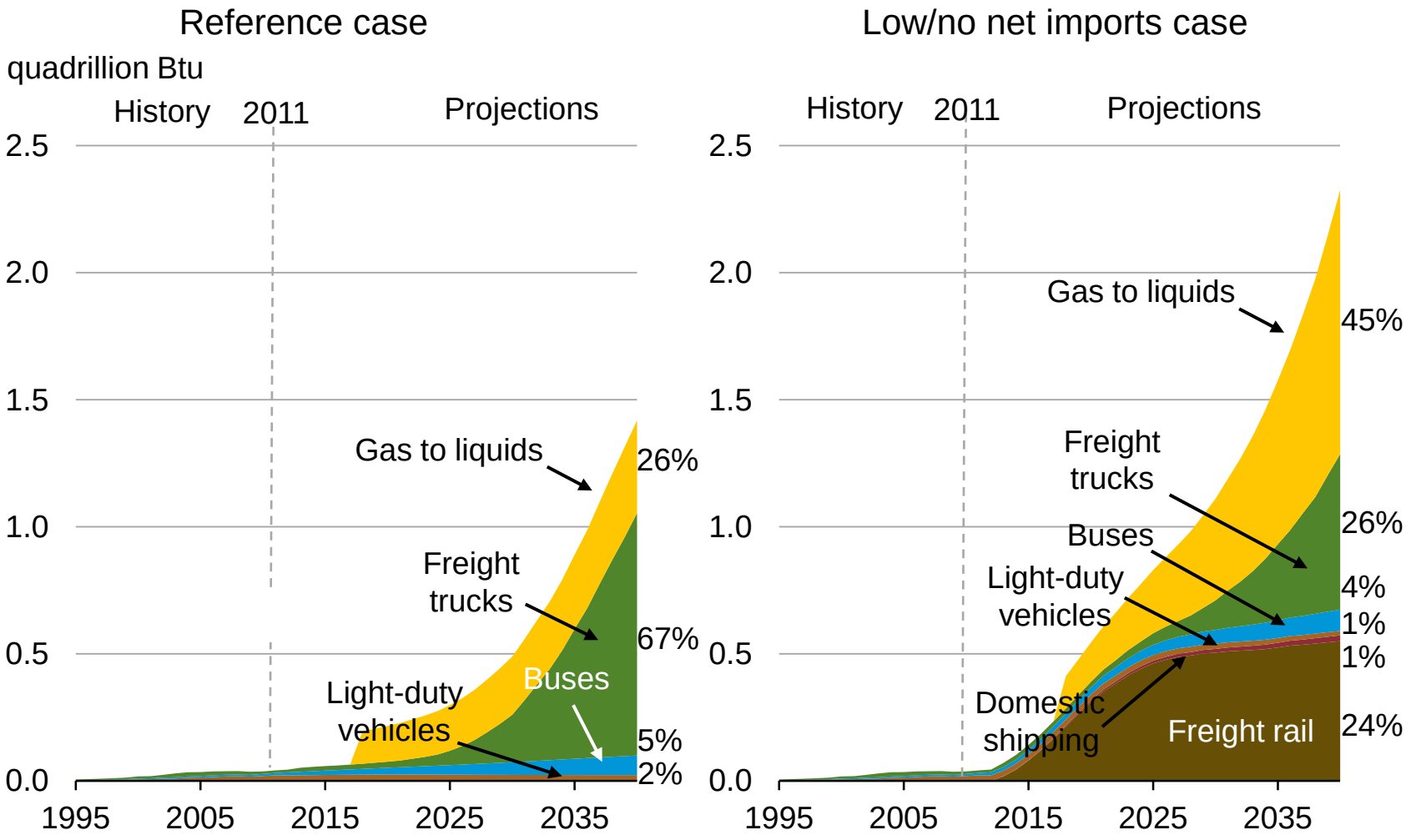
Transportation

The ratio of oil to natural gas prices in the United States remains high through 2040 in EIA's *AEO2013* Reference case projection



Source: EIA, Annual Energy Outlook 2013

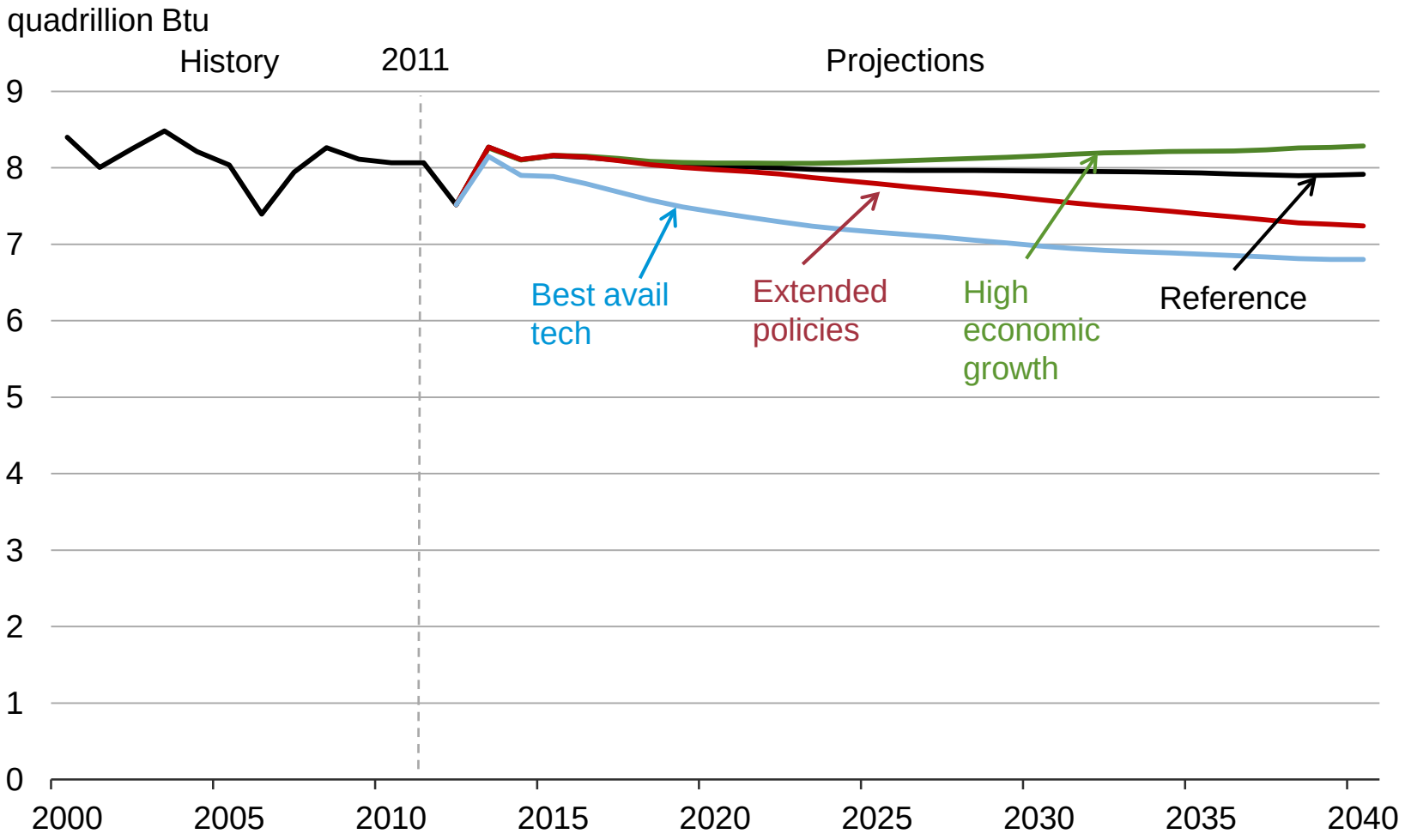
Growth of natural gas in transportation other than pipeline use is led by heavy duty trucks (LNG) and gas to liquids (diesel)… rail and marine transport are also potential markets



Source: EIA, Annual Energy Outlook 2013

Residential and commercial buildings

Energy efficiency technology improvements, policies, and economic growth affect projected natural gas use in buildings



Source: EIA, Annual Energy Outlook 2013

Takeaways on natural gas demand from EIA analyses

In EIA's Reference case, U.S. natural gas production grows to 35 Tcf and domestic use grows to 30 Tcf by 2040

- Use of natural gas is very sensitive to price and GHG policies. There is up to an 8 Tcf/y swing across EIA's analysis cases
- Net exports of natural gas approach 5 Tcf/y in the Reference case, but can vary depending on the domestic resource realization and prices. They are also linked to developments in world gas markets
- Growth in industrial use of gas is linked to both gas prices and overall economic growth trends.
- Transportation use of natural gas is expected to grow beyond its current role as a fuel for pipelines, but remains modest relative to other uses
- Natural gas use in buildings is projected to be stagnant, with modest (~ 1 Tcf/y) risks to the downside if building and appliance efficiency advance rapidly

For more information

U.S. Energy Information Administration home page | www.eia.gov

Annual Energy Outlook | www.eia.gov/forecasts/aeo

Short-Term Energy Outlook | www.eia.gov/forecasts/steo

International Energy Outlook | www.eia.gov/forecasts/ieo

Today In Energy | www.eia.gov/todayinenergy

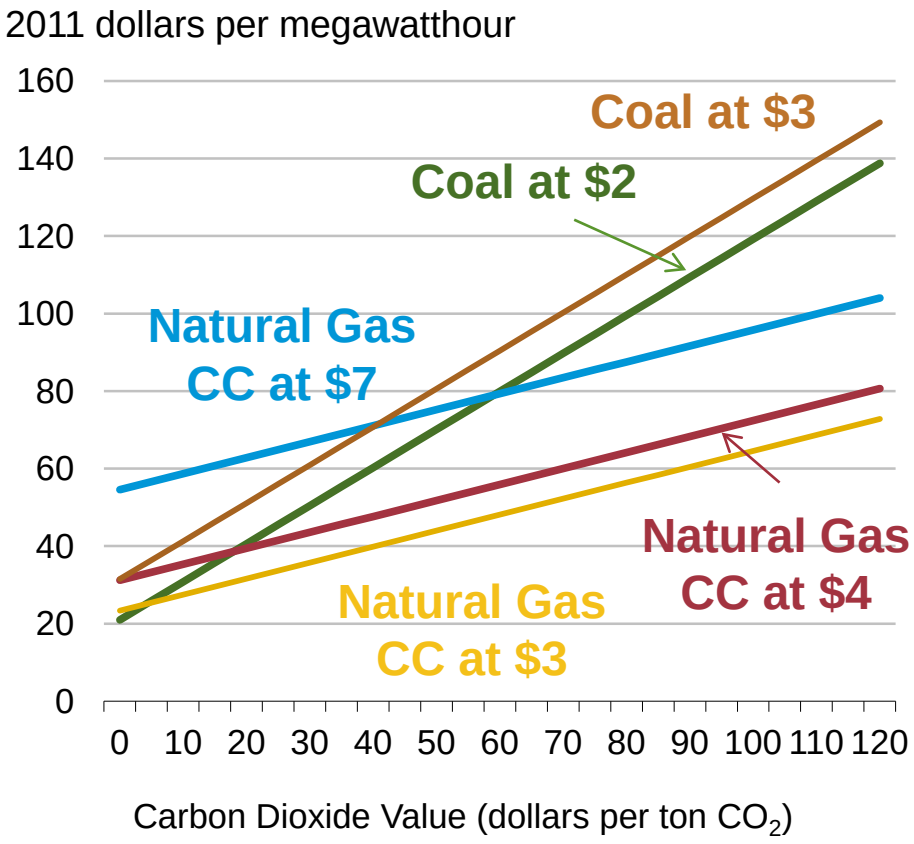
Monthly Energy Review | www.eia.gov/totalenergy/data/monthly

Annual Energy Review | www.eia.gov/totalenergy/data/annual

Supplemental Slides

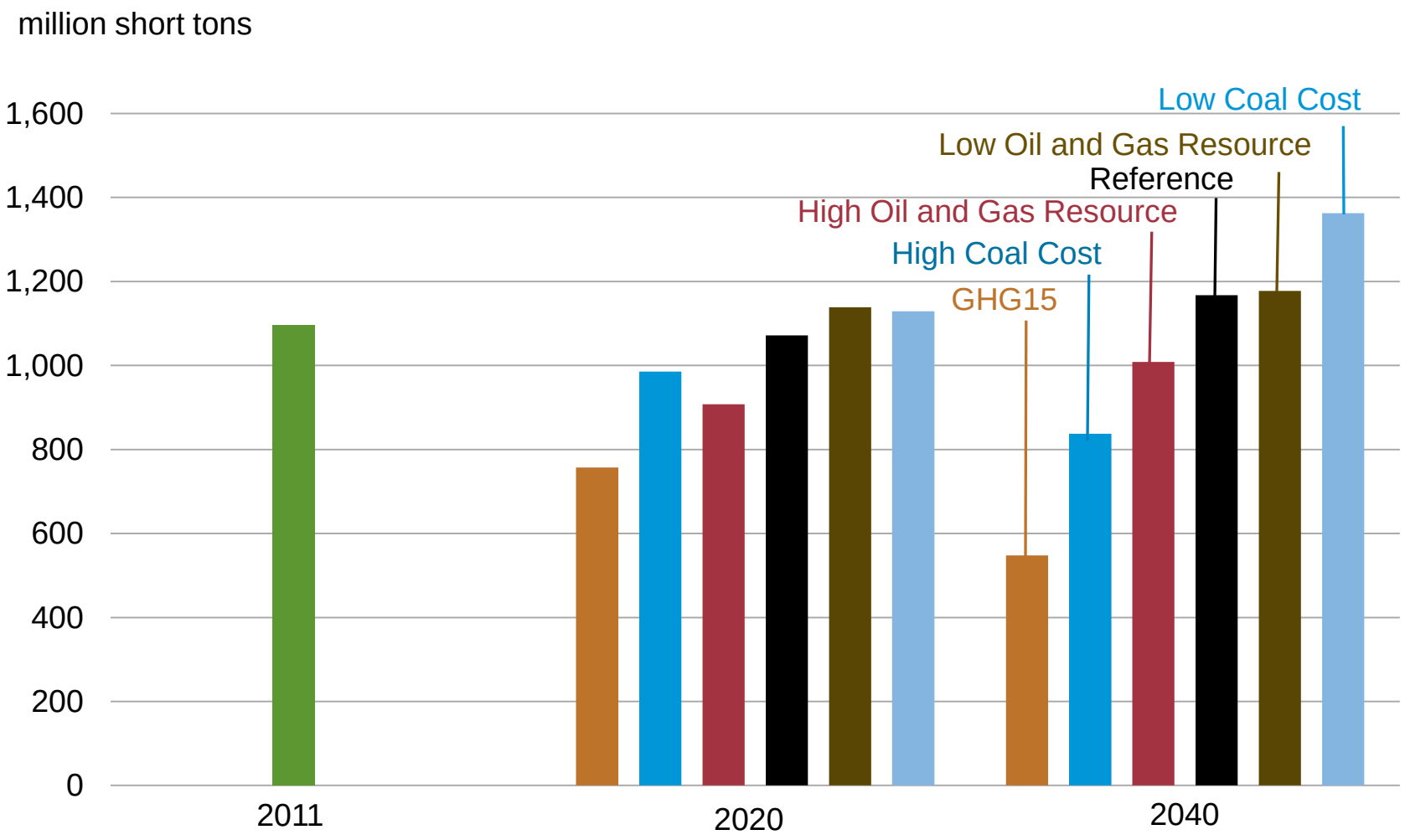
Operating costs: existing plants with and without a value on carbon

Fuel Cost for Existing Coal and Combined Cycle Natural Gas Units with a Value Placed on Carbon Dioxide Emissions



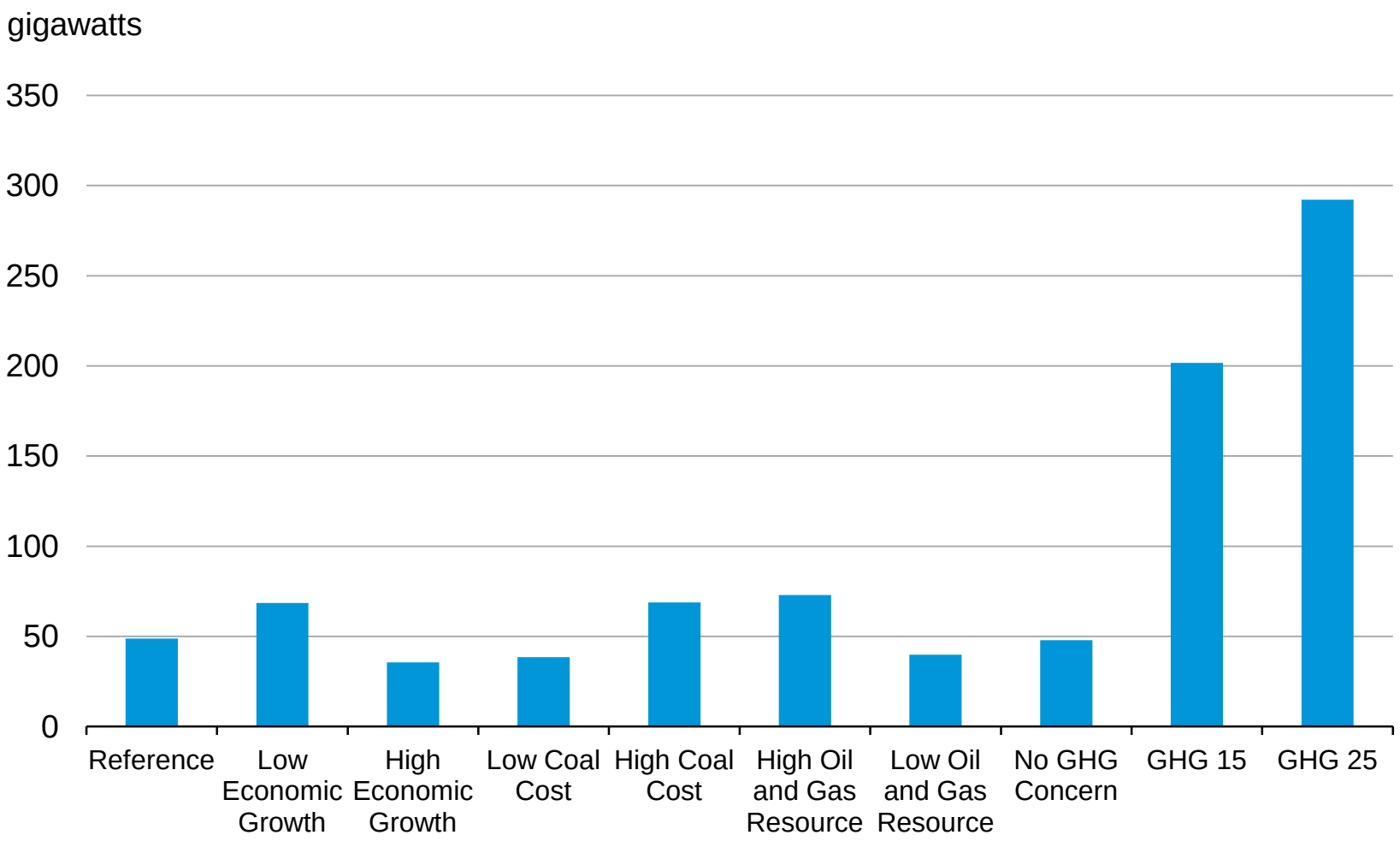
- The "crossover point" for least-cost dispatch of coal and natural gas capacity depends on both fuel prices and the carbon value. At lower natural gas prices, the "crossover" occurs at a lower carbon value.
- Environmental operating costs and retrofit costs for pollution controls at existing coal-fired plants can "raise the bar" for their continued operation.
  - For retrofit decisions, the unit's perceived "useful life," which plays a critical role, can be affected by views regarding future climate policies

U.S. coal production is very sensitive to both markets and policies



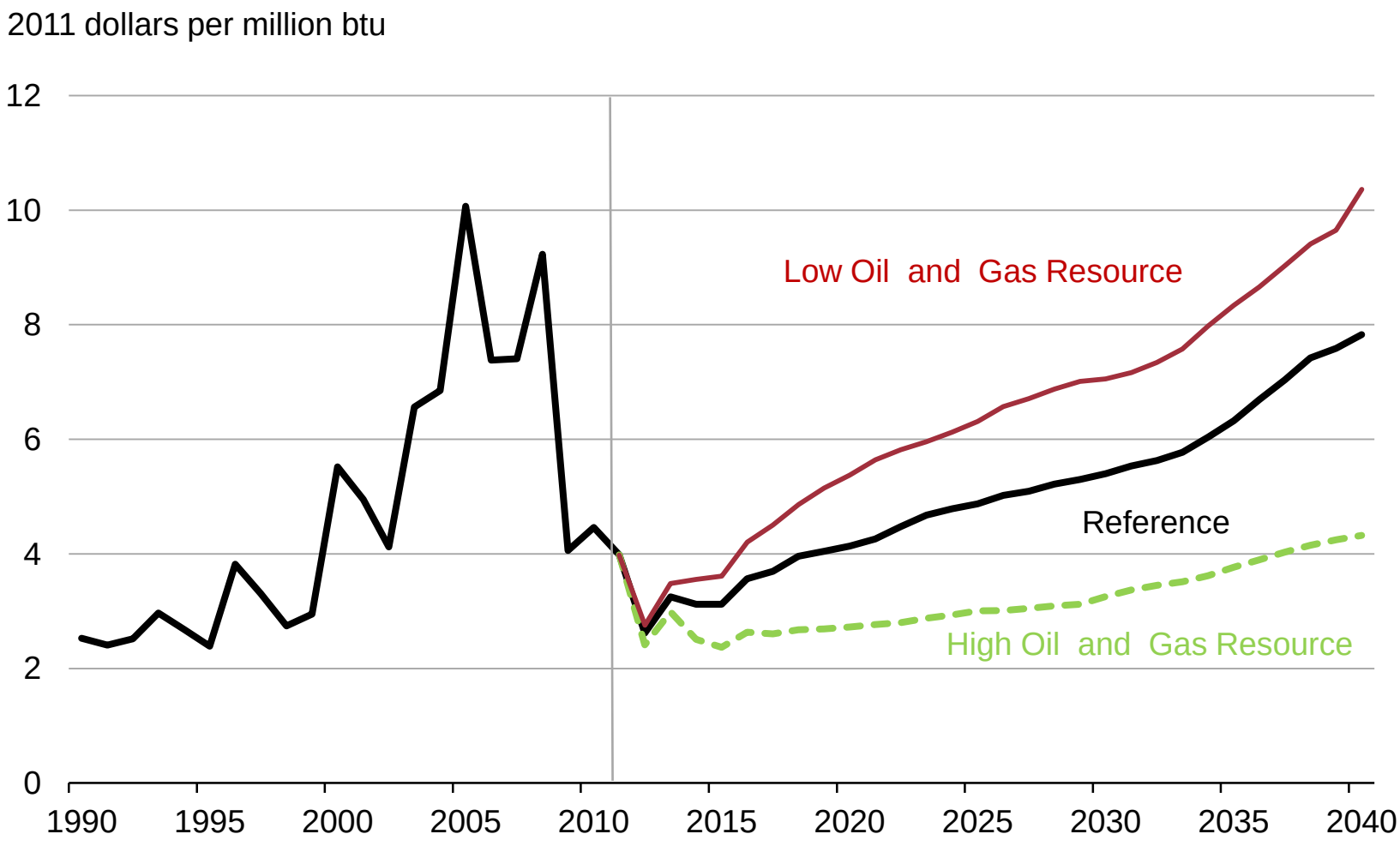
Source: EIA, Annual Energy Outlook 2013

Cumulative coal-fired capacity retirements, 2012-2040



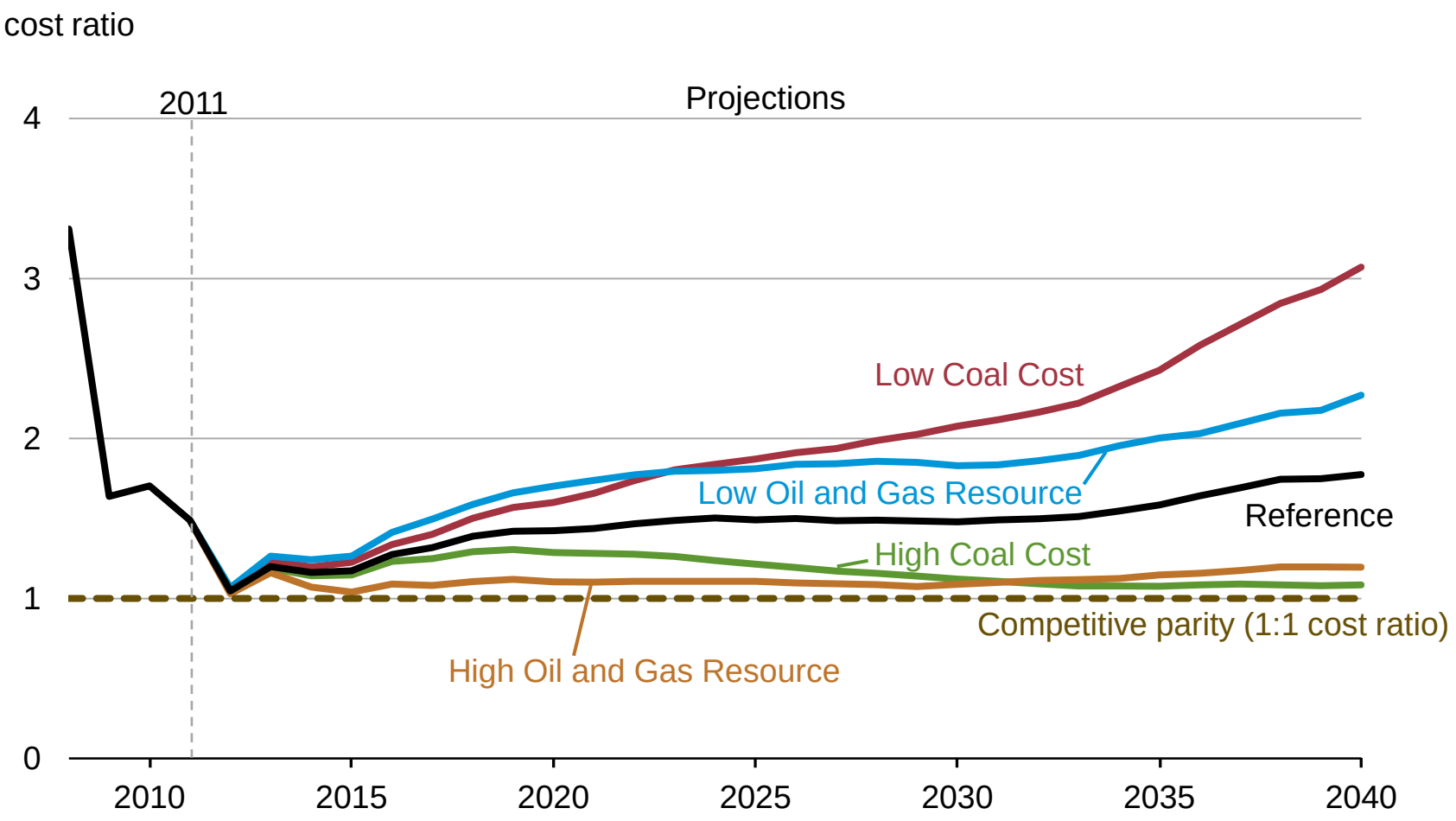
Source: EIA, Annual Energy Outlook 2013

Annual average Henry Hub spot prices for natural gas in alternative cases



Source: EIA, Annual Energy Outlook 2013

Dispatch competitiveness of natural gas relative to coal in the United States depends on both resource and cost/technology futures



Source: EIA, Annual Energy Outlook 2013

Dispatch competitiveness of natural gas relative to coal varies by region as well as across scenarios