

# Factors affecting adoption of renewable and other electricity generation technologies



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*for*

*Business Environmental Leadership Council*

*Center for Climate and Energy Solutions*

*November 9, 2011 | Washington, DC*

*by*

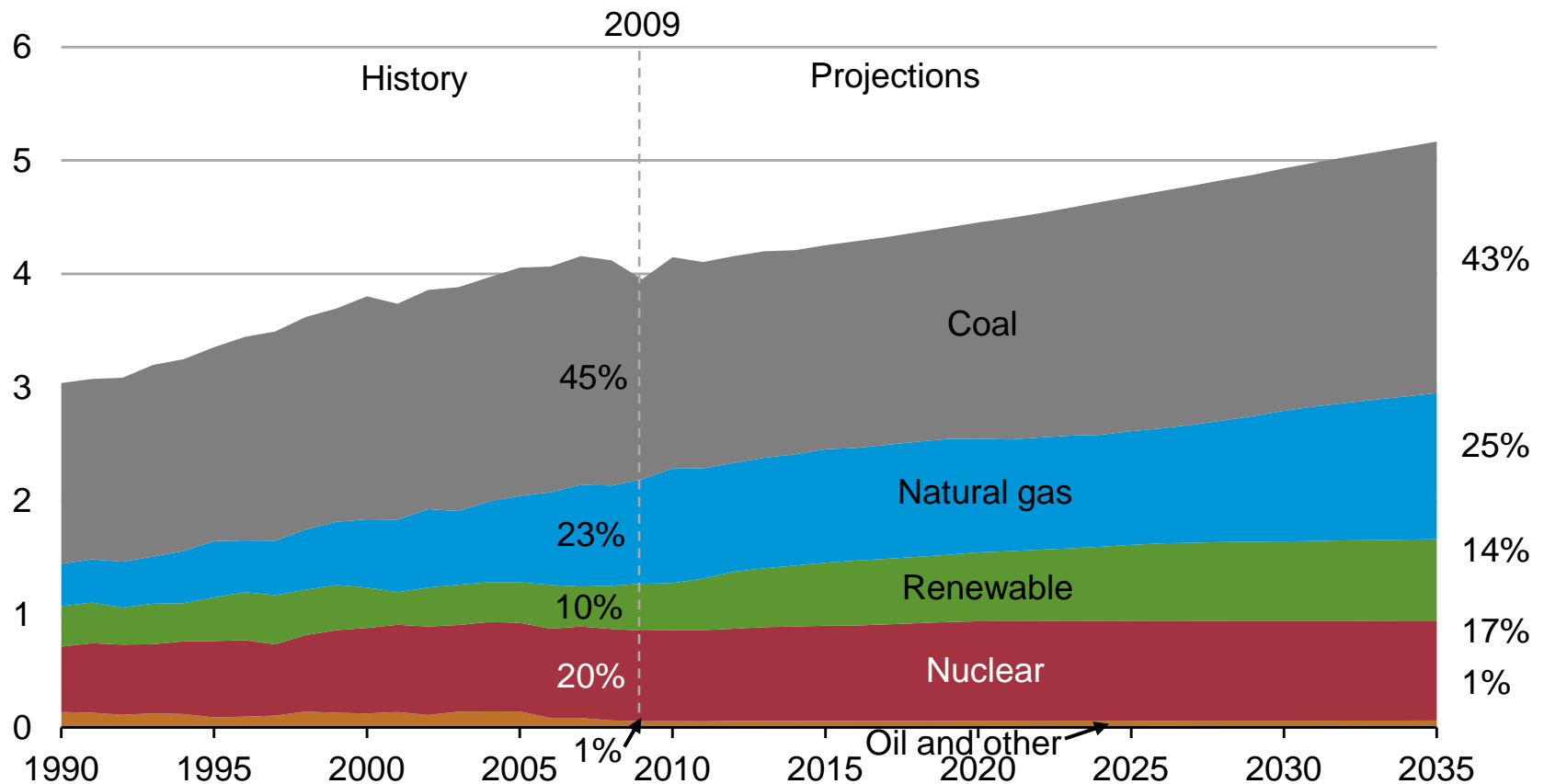
*Howard Gruenspecht, Acting Administrator*

# Overview

- AEO 2011 electricity supply projections (and thoughts for AEO2012)
- Electricity demand growth
- Impact of natural gas prices
- Impact of new environmental regulations
- Analysis of a Clean Energy Standard

# The Reference case electricity mix gradually shifts to lower-carbon options, with generation from natural gas rising 40% and renewables rising 75%

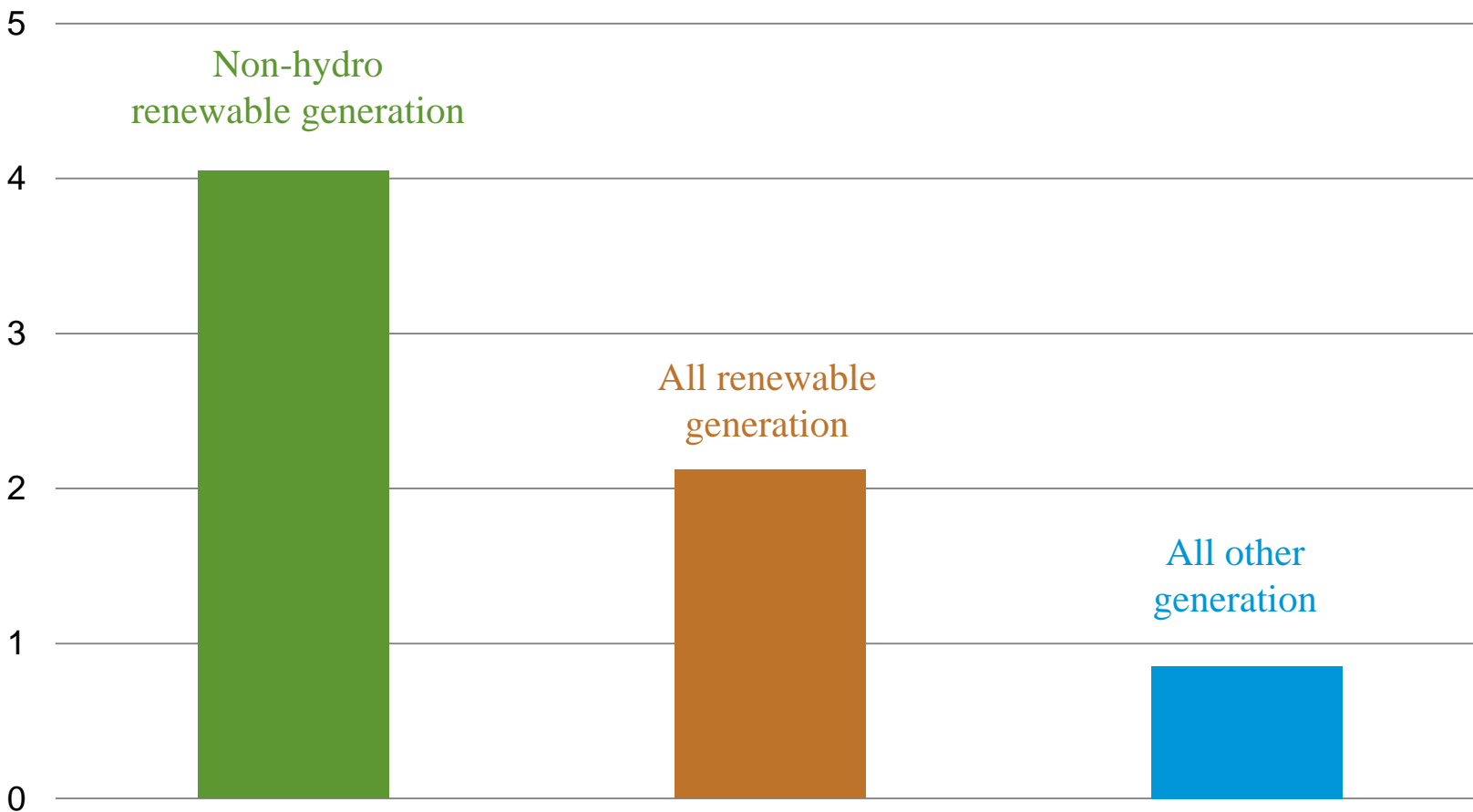
electricity net generation  
trillion kilowatthours per year



Source: EIA, Annual Energy Outlook 2011

# Renewable electricity generation is projected to grow far more robustly to 2035 than other generation categories

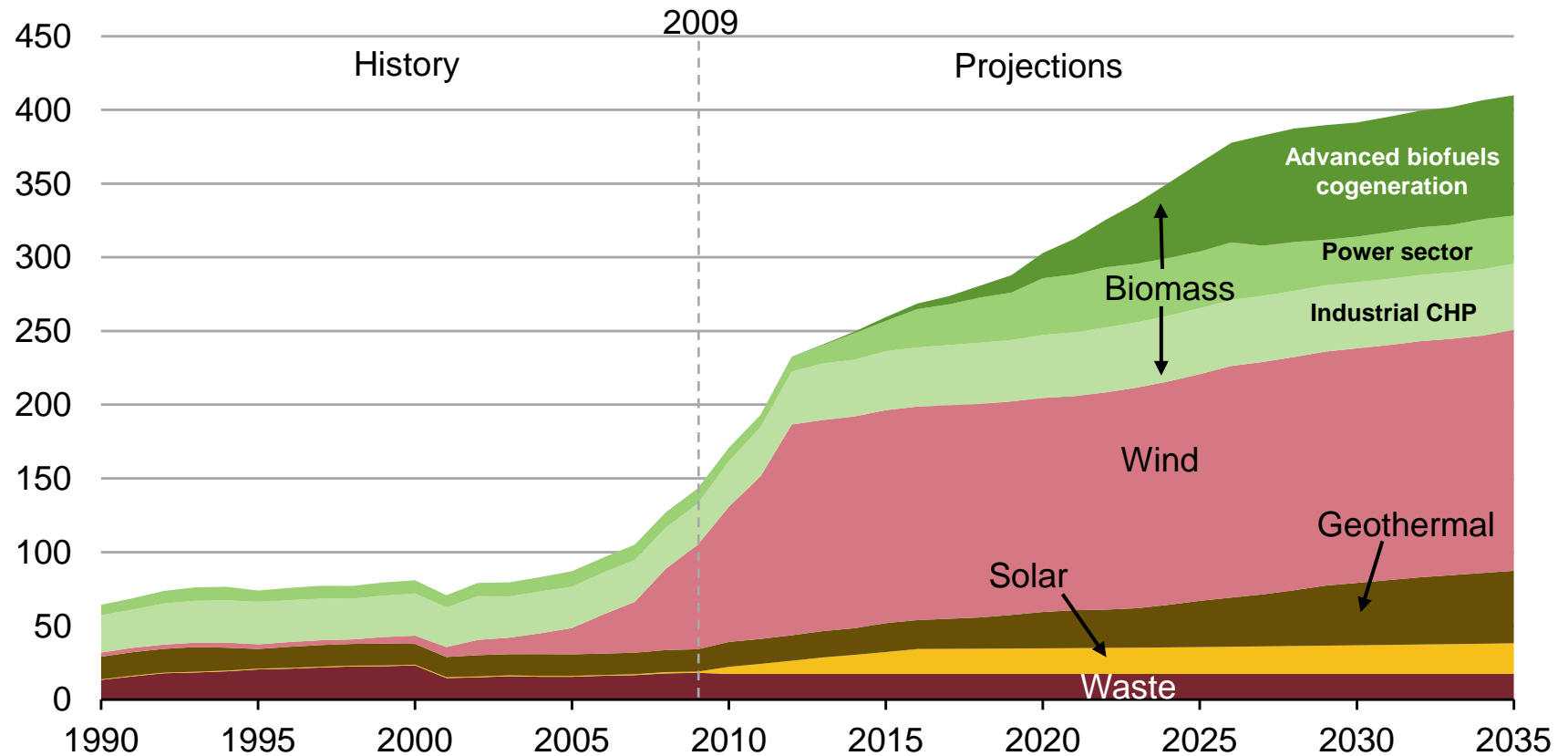
Average annual growth rates, 2009-2035  
percent per year



Source: EIA, Annual Energy Outlook 2011

# U.S. nonhydropower renewable electricity generation, 1990-2035

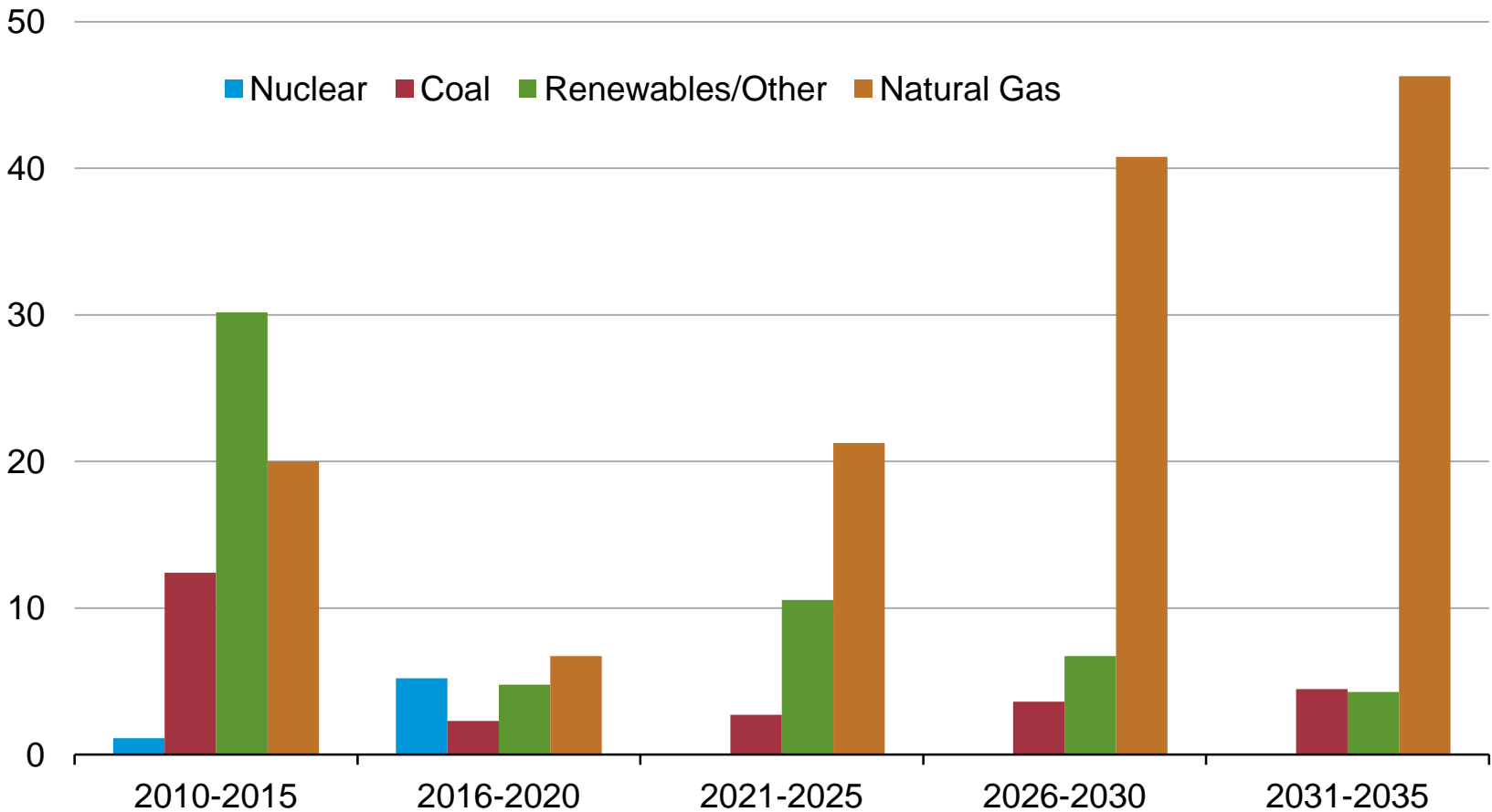
nonhydropower renewable generation  
billion kilowatthours per year



Source: EIA, Annual Energy Outlook 2011

# Electricity generation capacity additions by fuel type, 2010-2035

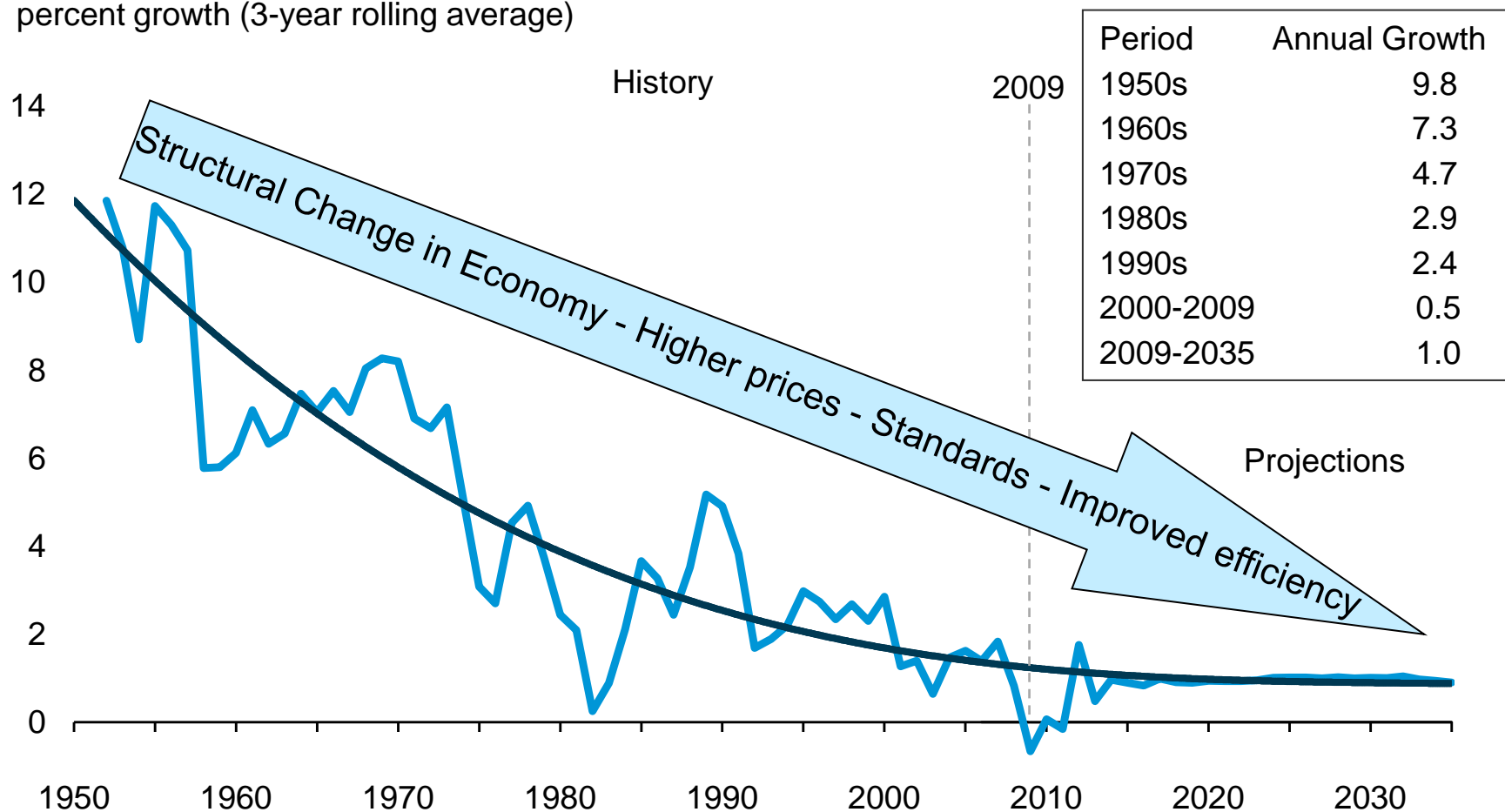
U.S. electricity generation capacity  
gigawatts



Source: EIA, Annual Energy Outlook 2011

# U.S. electricity consumption grows by 30% between 2009 and 2035, but the rate of growth has slowed dramatically in recent decades

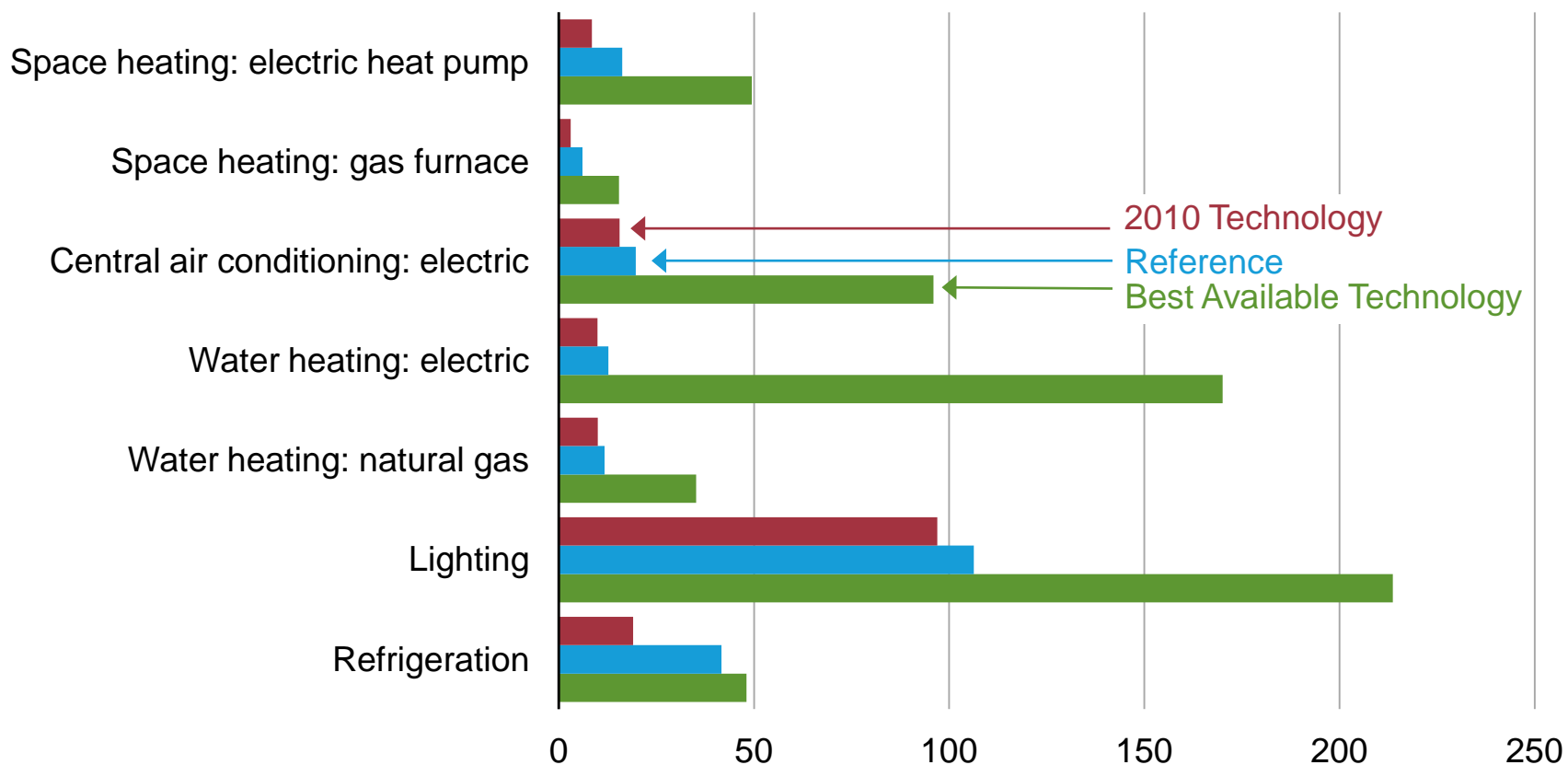
percent growth (3-year rolling average)



Source: EIA, Annual Energy Outlook 2011

# Efficiency gains for selected residential equipment in three cases, 2035

U.S. residential equipment efficiency gains  
percent change from 2009 installed stock efficiency



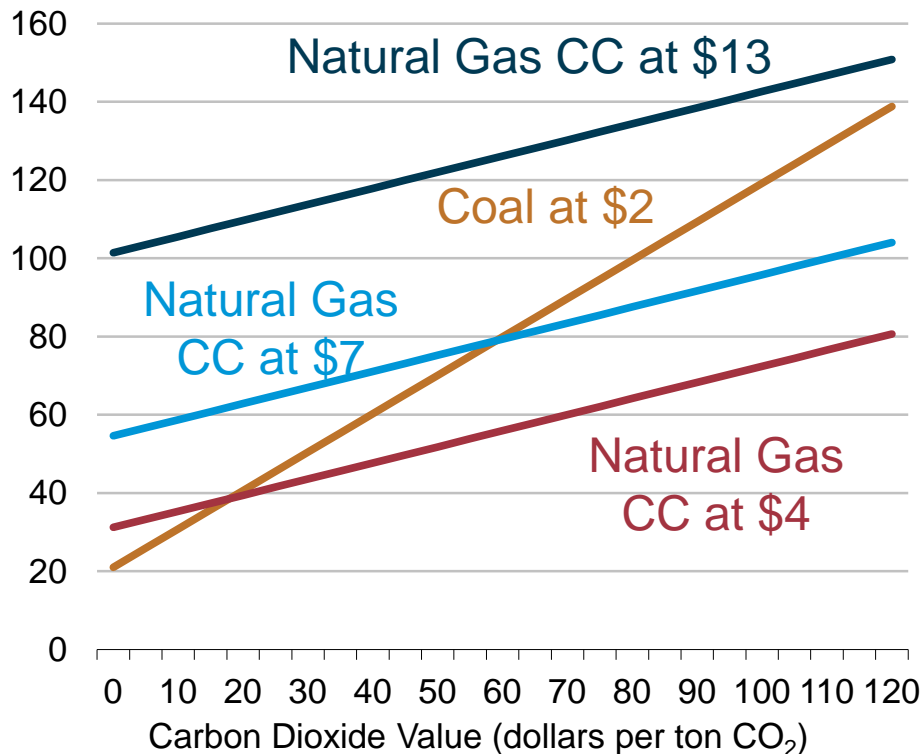
Source: EIA, Annual Energy Outlook 2011



# 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

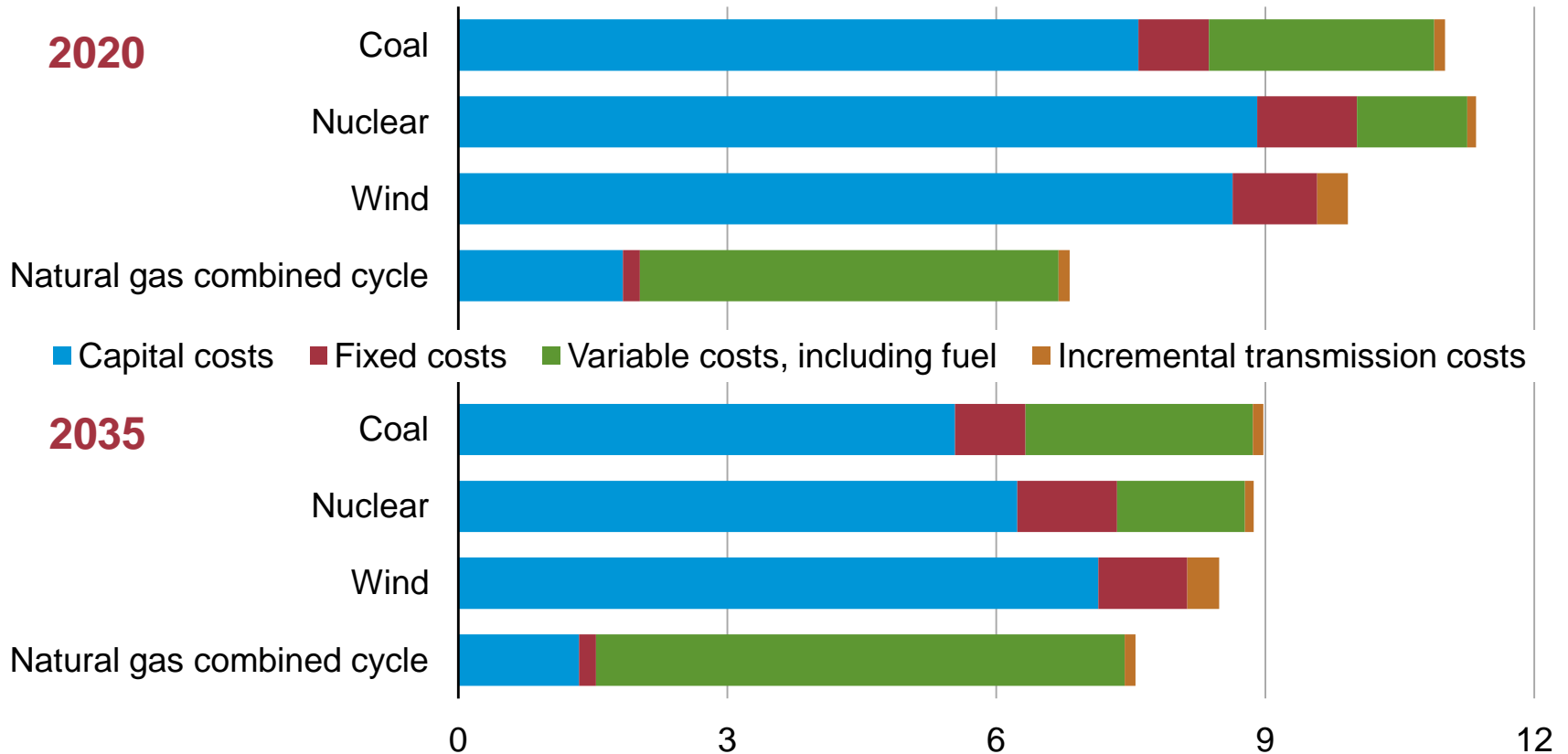
2009 dollars per megawatt-hour



- 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

# Levelized electricity costs for new power plants, 2020 and 2035

Costs for new U.S. electricity power plants  
real 2009 cents per kilowatthour

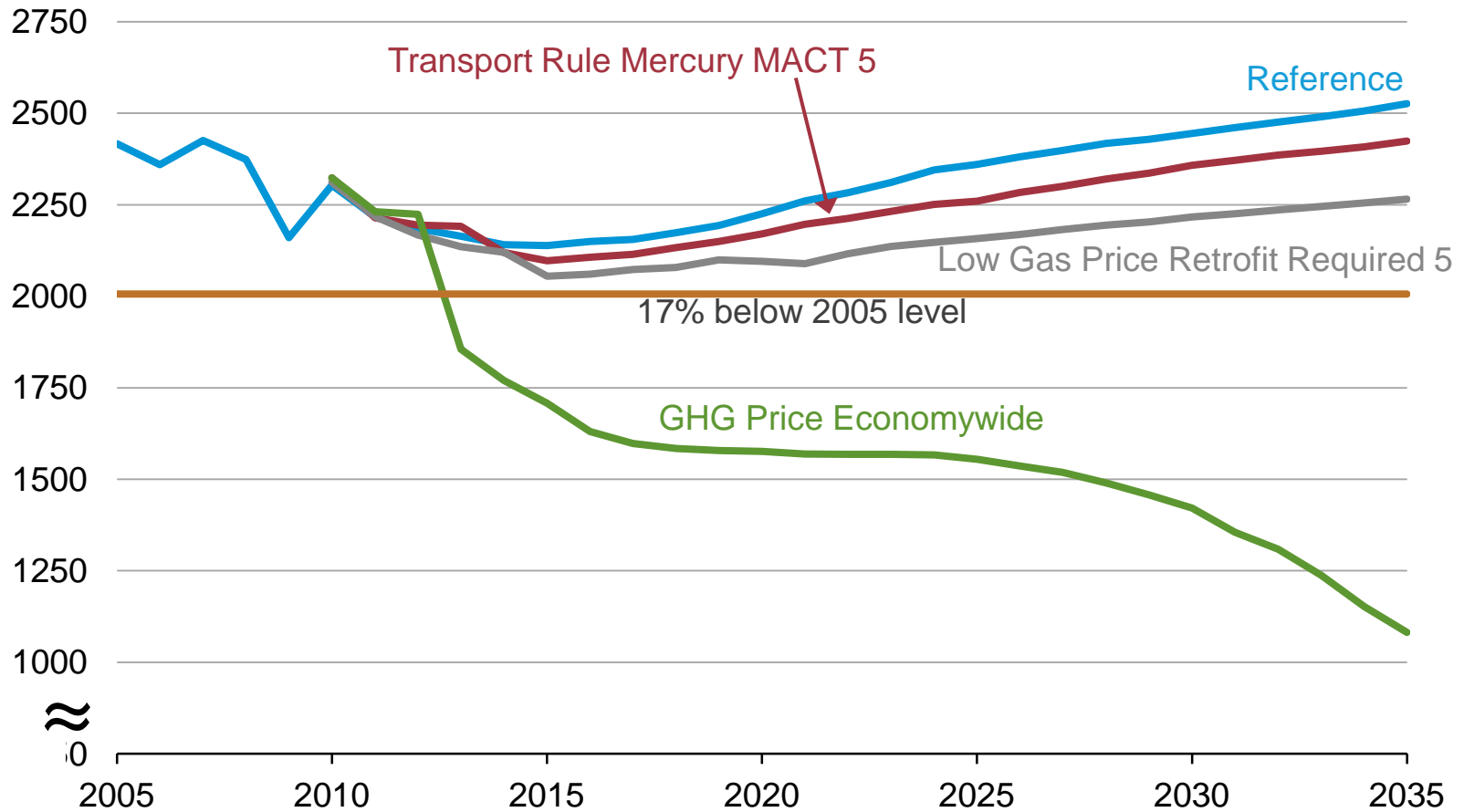


Source: EIA, Annual Energy Outlook 2011

# Possible impact of pending policies

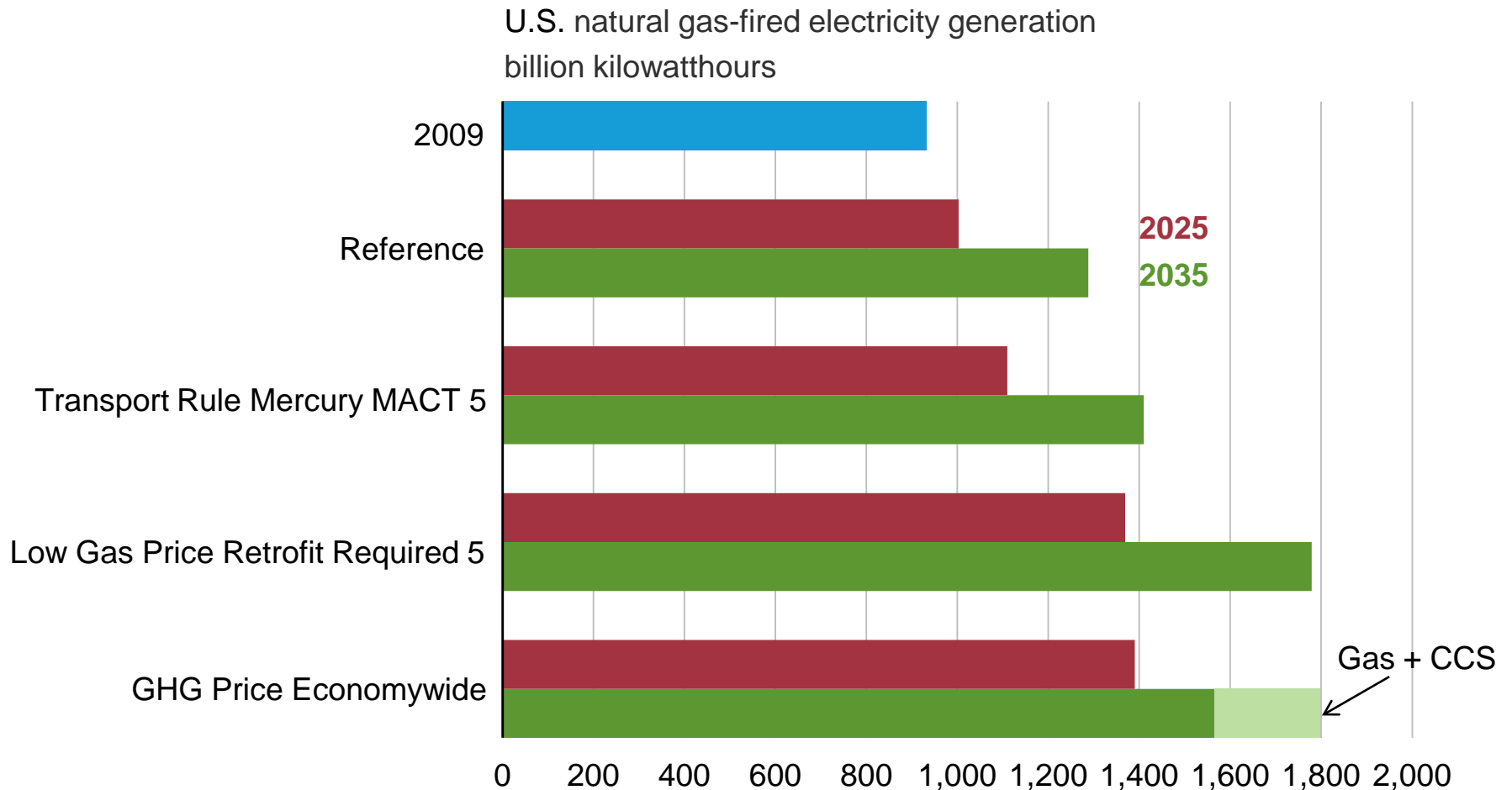
# Electric power sector carbon dioxide emissions in 4 AEO2011 sensitivity cases, 2005-2035

U.S. carbon dioxide emissions  
million metric tons



Source: EIA, Annual Energy Outlook 2011

# Total natural gas-fired electricity generation in four cases, 2009, 2025, and 2035

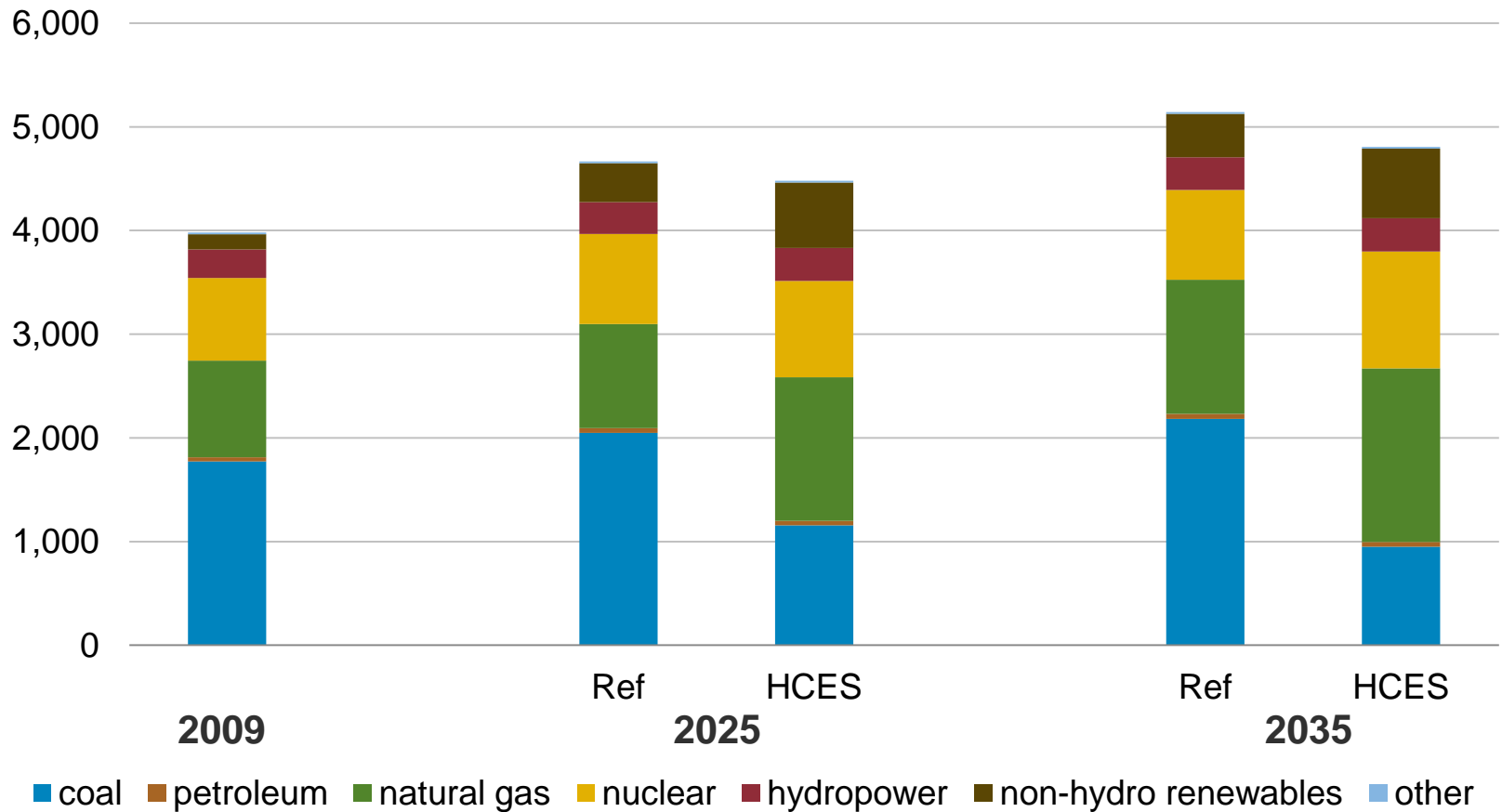


Source: EIA, Annual Energy Outlook 2011

# Possible new policies: recent analysis of a clean energy standard

# HCES: Generation impact

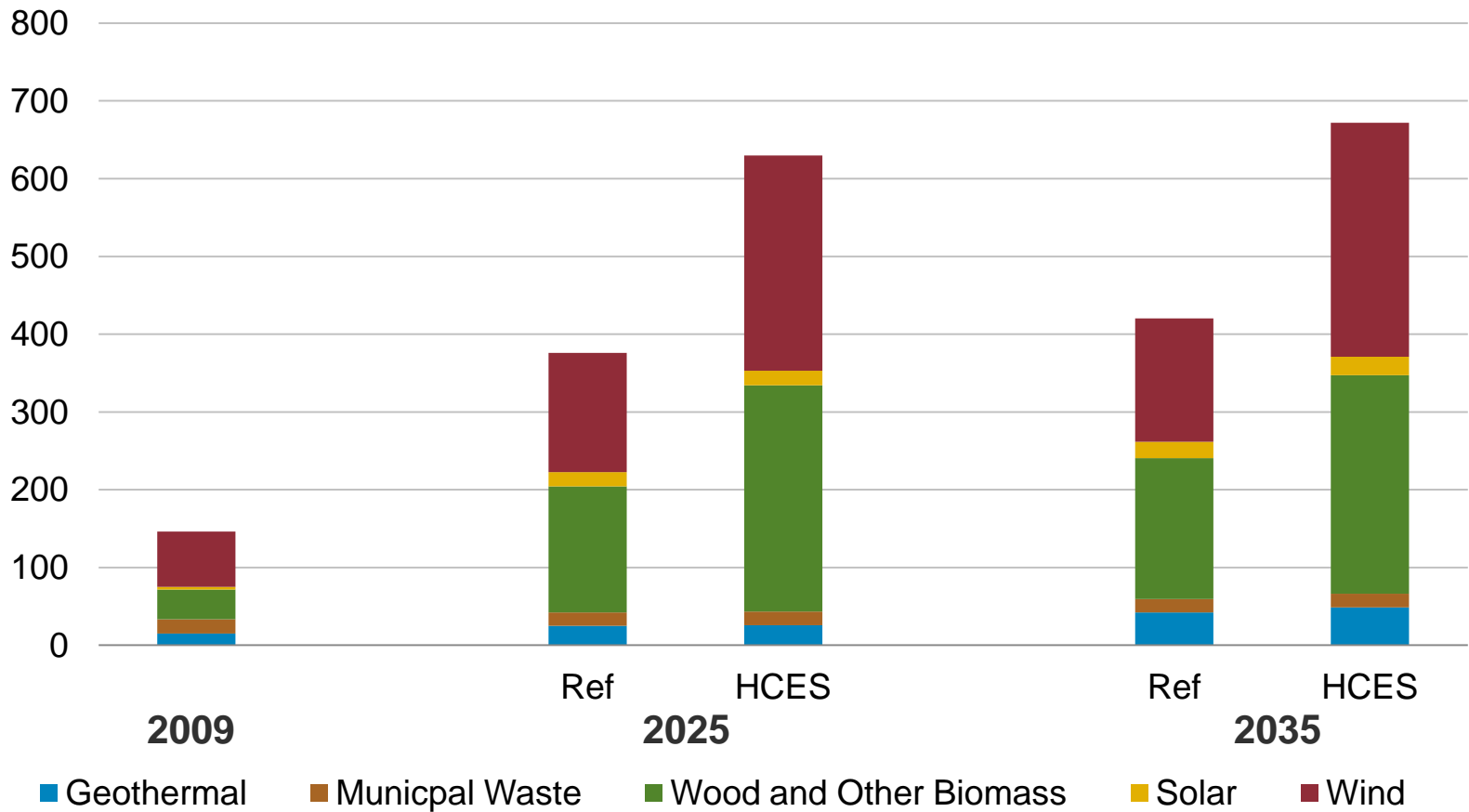
Total net electricity generation  
billion kilowatthours



Source: U.S. Energy Information Administration, National Energy Modeling System, runs refhall.d082611b and ceshallnb.d083011a

# HCES: Non-hydro renewable generation impact

Total non-hydroelectric renewable generation  
billion kilowatthours



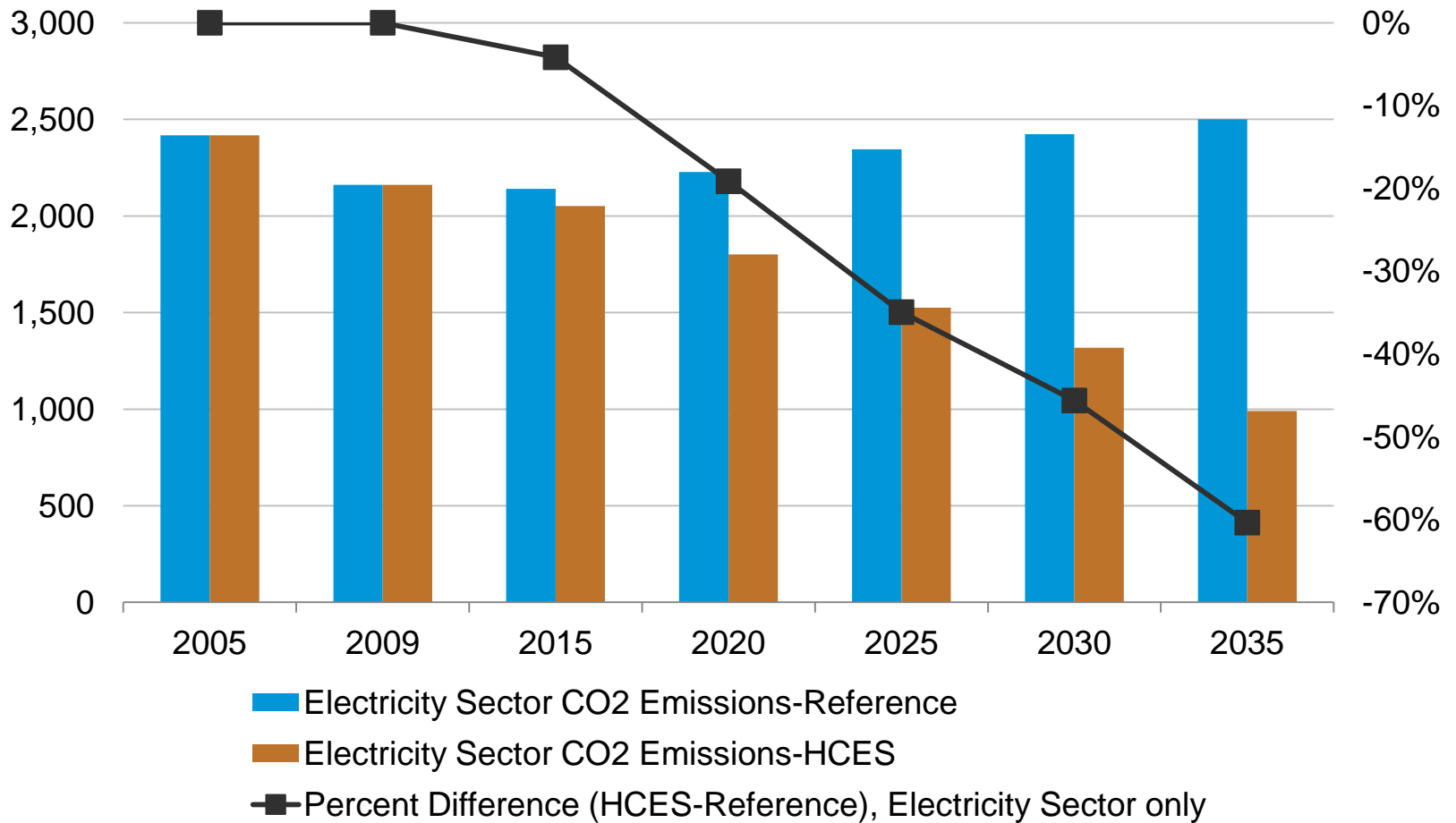
Source: U.S. Energy Information Administration, National Energy Modeling System, runs refhall.d082611b and ceshallnb.d083011a



# HCES: Carbon dioxide impact

Electricity Sector Carbon Dioxide Emissions  
million metric tons CO<sub>2</sub>

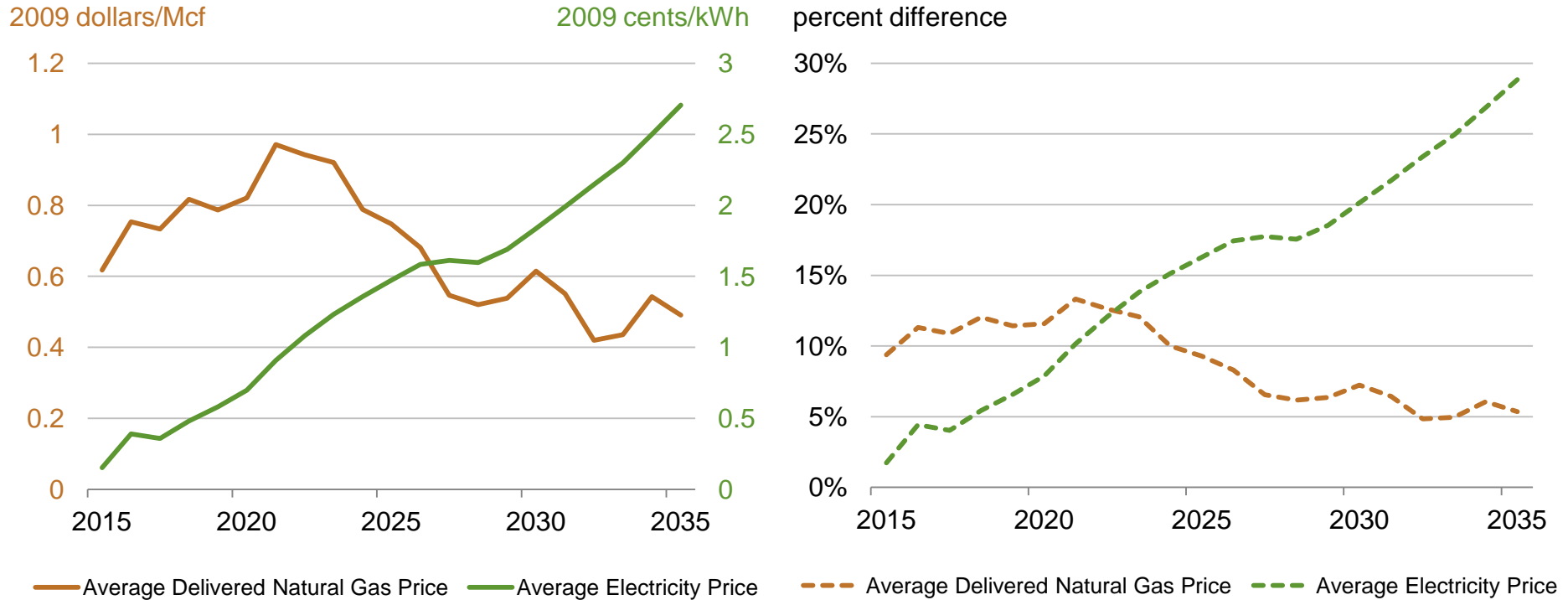
percent difference (HCES-Reference)



Source: U.S. Energy Information Administration, National Energy Modeling System, runs refhall.d082611b and ceshallnb.d083011a

# HCES: Price impact

HCES Impact on Electricity and Natural Gas Prices (HCES Difference from Reference Case)



Source: U.S. Energy Information Administration, National Energy Modeling System, runs rehall.d082611b and ceshallnb.d083011a

# For more information

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

Short-Term Energy Outlook | [www.eia.gov/steo](http://www.eia.gov/steo)

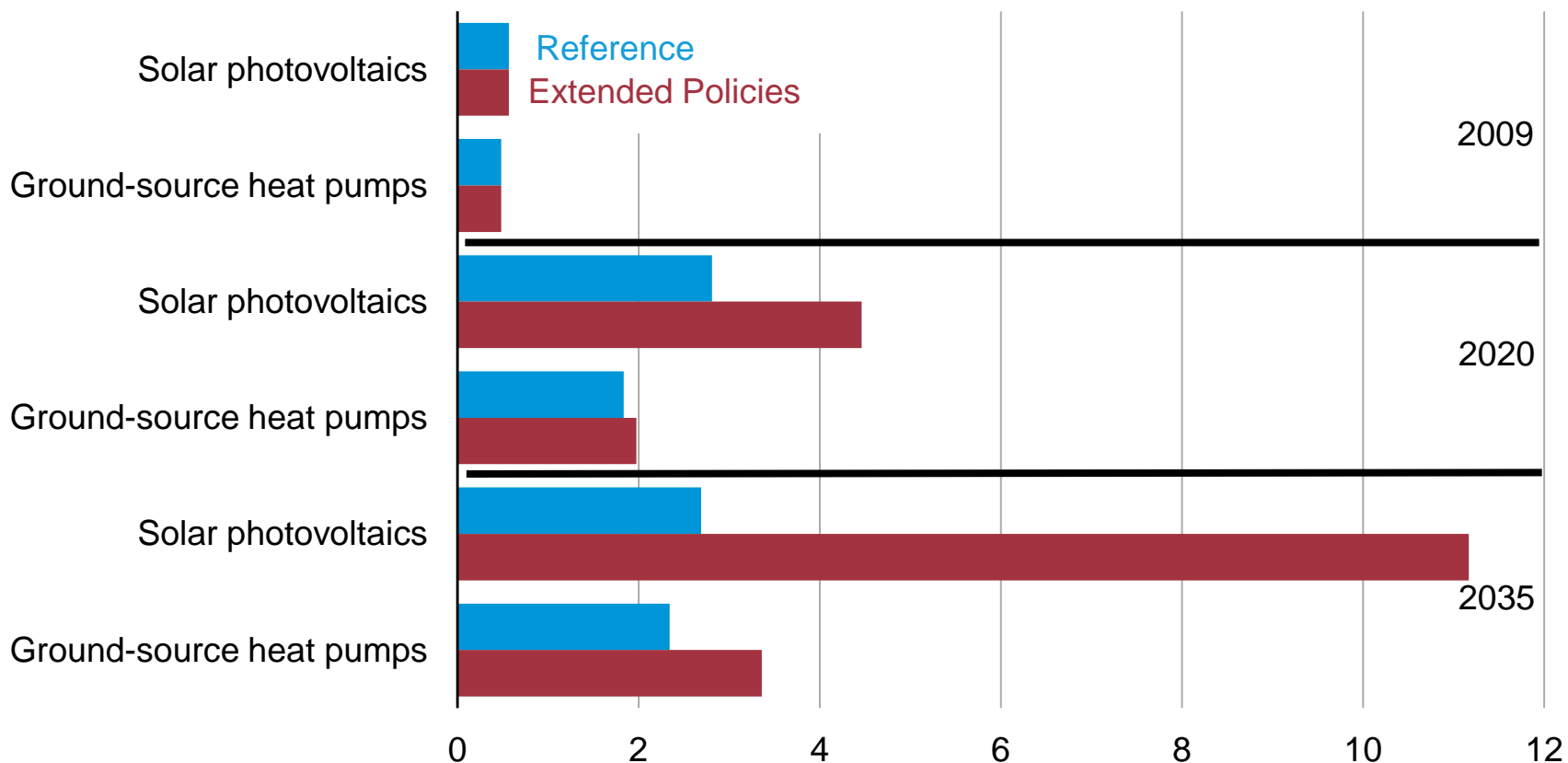
Annual Energy Outlook | [www.eia.gov/aeo](http://www.eia.gov/aeo)

International Energy Outlook | [www.eia.gov/ieo](http://www.eia.gov/ieo)

Monthly Energy Review | [www.eia.gov/mer](http://www.eia.gov/mer)

# Residential market saturation by renewable technologies in two cases, 2009, 2020, and 2035

U.S. residential market saturation  
percent share of single-family homes

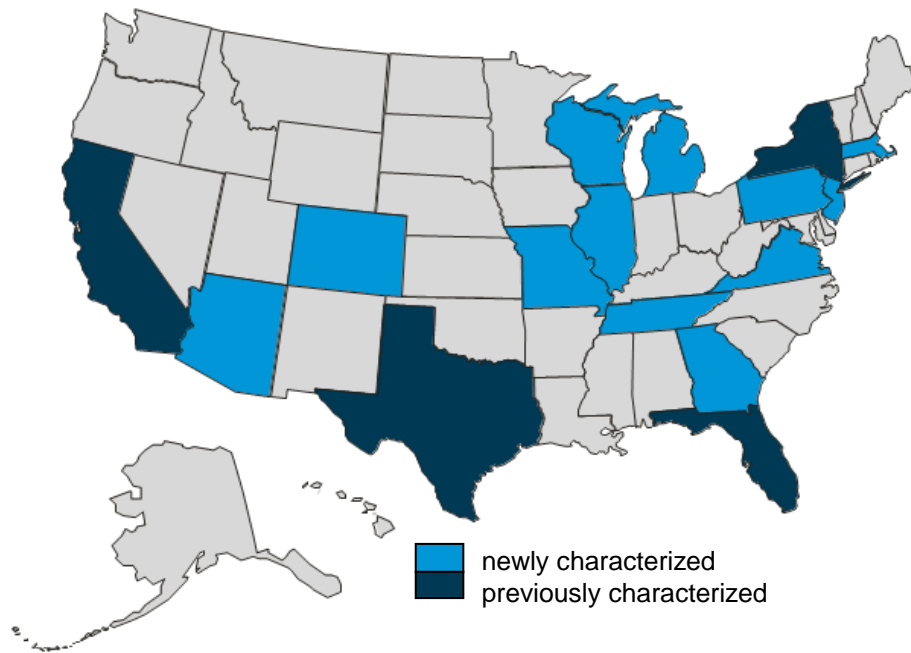


Source: EIA, Annual Energy Outlook 2011

# EIA Consumption Surveys, recent developments

2009 Residential  
Better State coverage, more information

Commercial Buildings  
Information gap developing



2003: last successful survey

2007: inconclusive

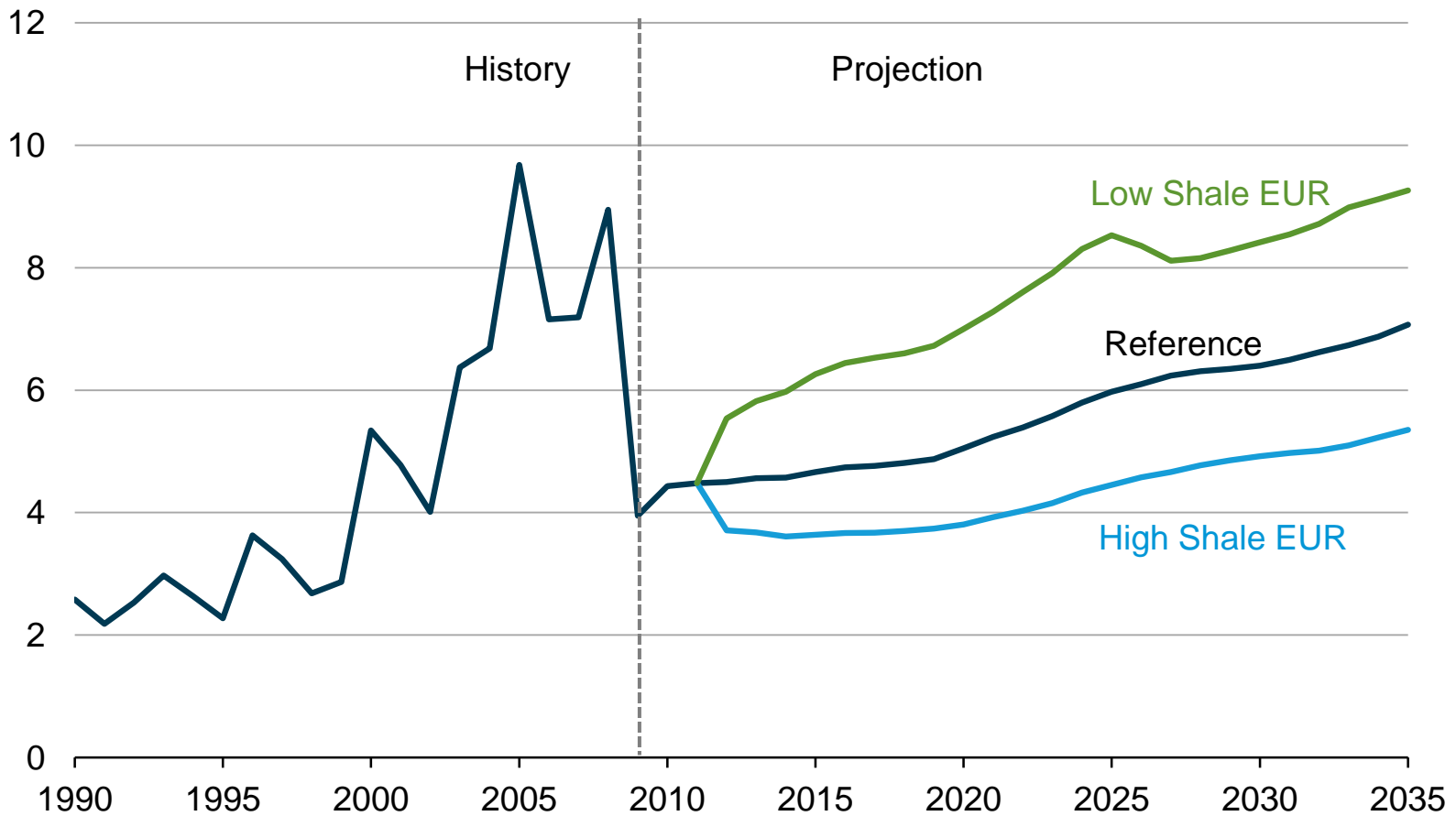
2011: suspended

2012: ?????

Source: *EIA Residential Energy Consumption Survey, 2009*

# Henry Hub natural gas spot prices in three cases, 1990-2035

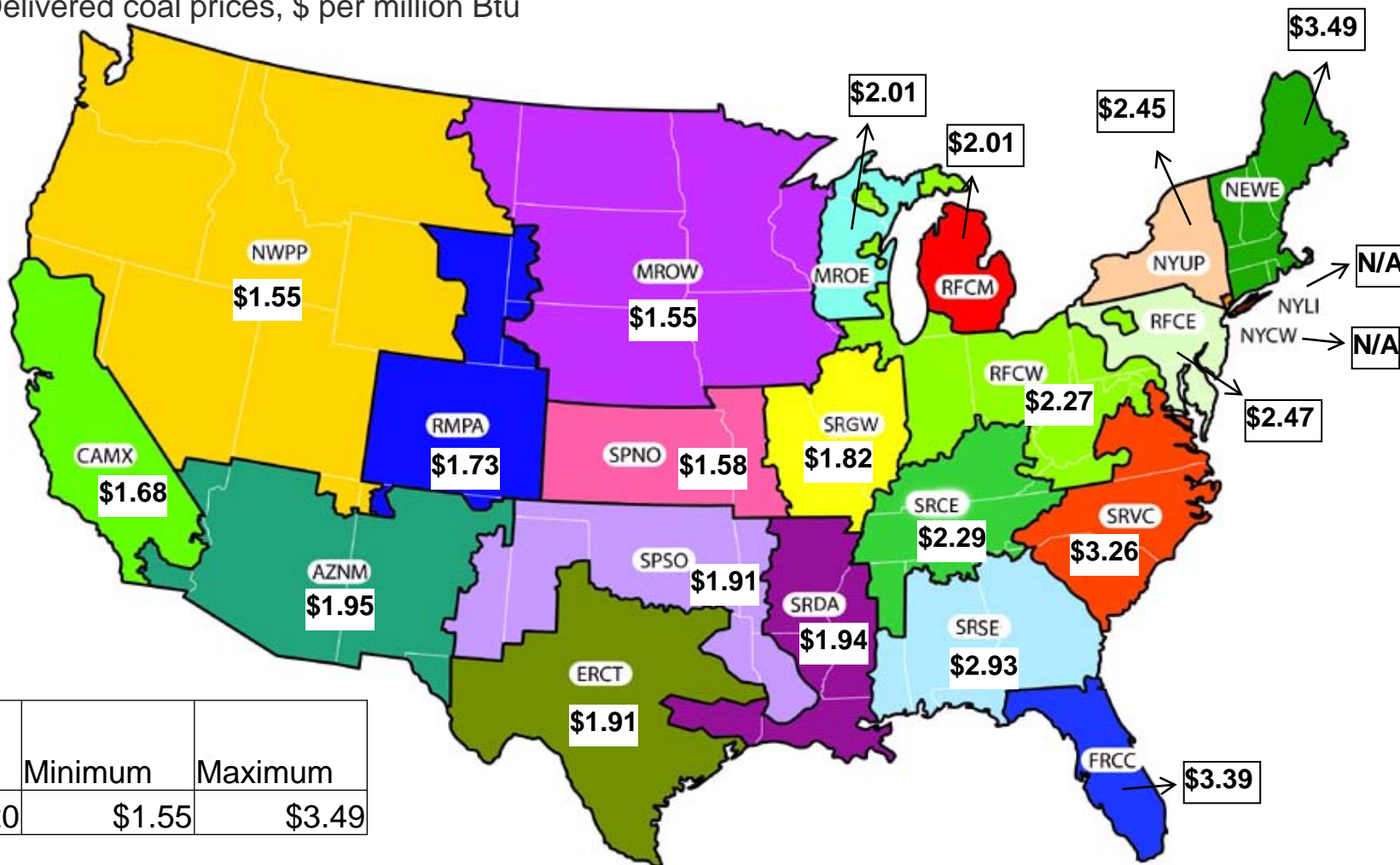
real 2009 dollars per million Btu



Source: EIA, Annual Energy Outlook 2011

# The average delivered price of coal to electricity generators varies widely across U.S. regions – transport costs are a key reason

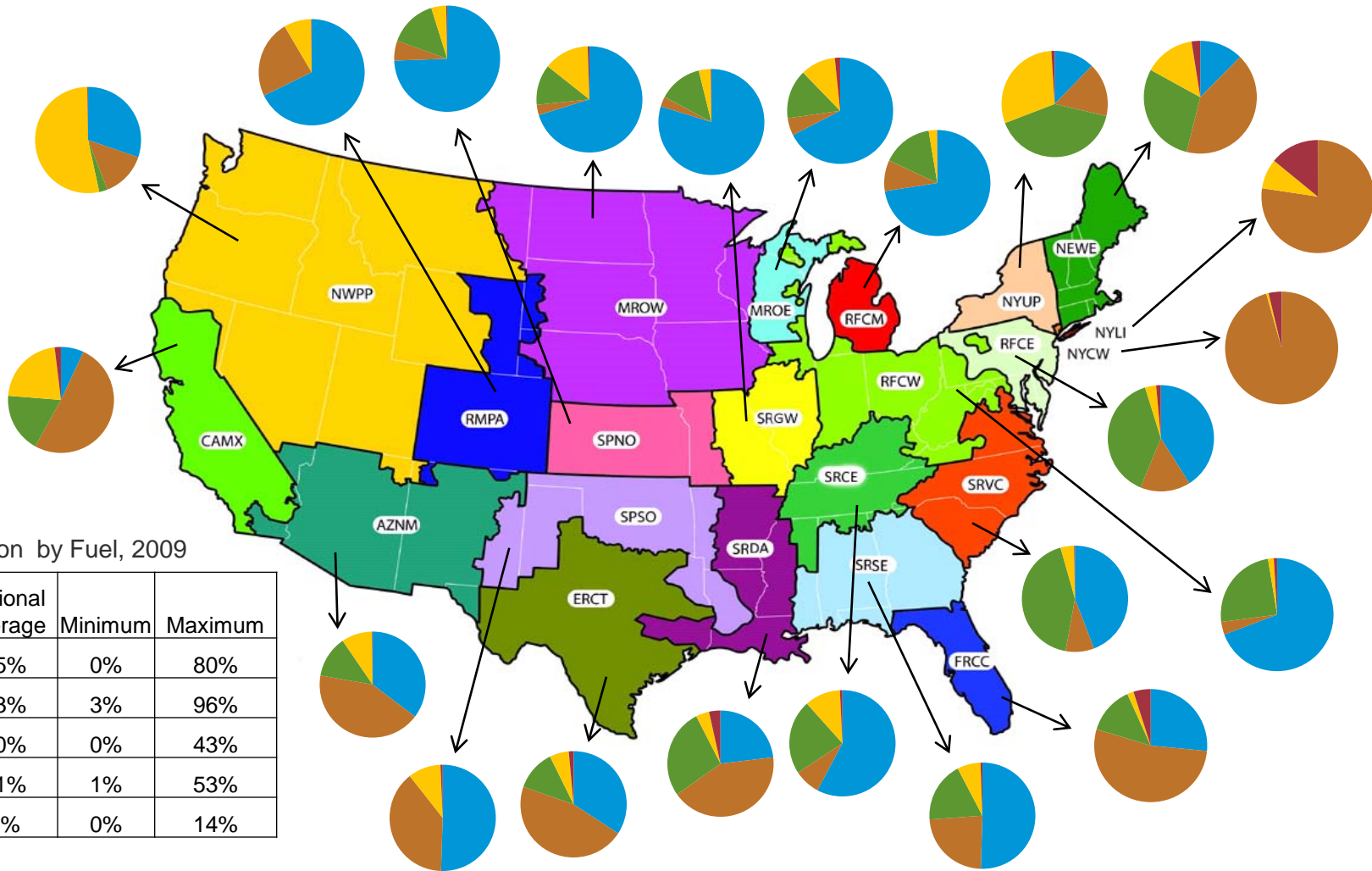
2009 Delivered coal prices, \$ per million Btu



National Average	Minimum	Maximum
\$2.20	\$1.55	\$3.49

Source: EIA, Annual Energy Outlook 2011

# The fuel mix for electricity generation varies widely across U.S. regions



Share of Generation by Fuel, 2009

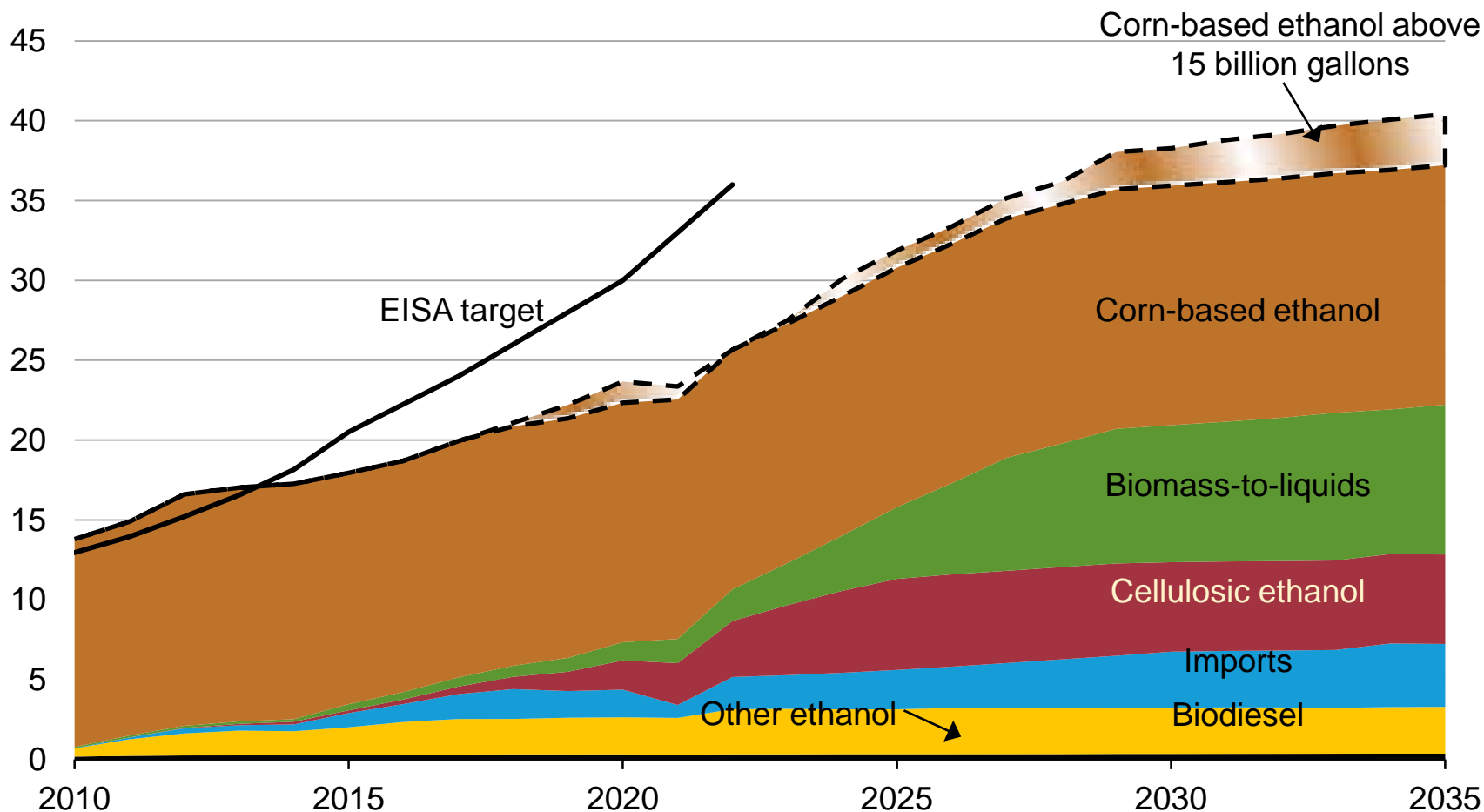
	National Average	Minimum	Maximum
Coal	45%	0%	80%
Natural Gas	23%	3%	96%
Nuclear	20%	0%	43%
Renewables	11%	1%	53%
Oil / Other	1%	0%	14%

Source: EIA



# Biomass: Interaction with EISA2007 renewable fuels standard, 2010-2035

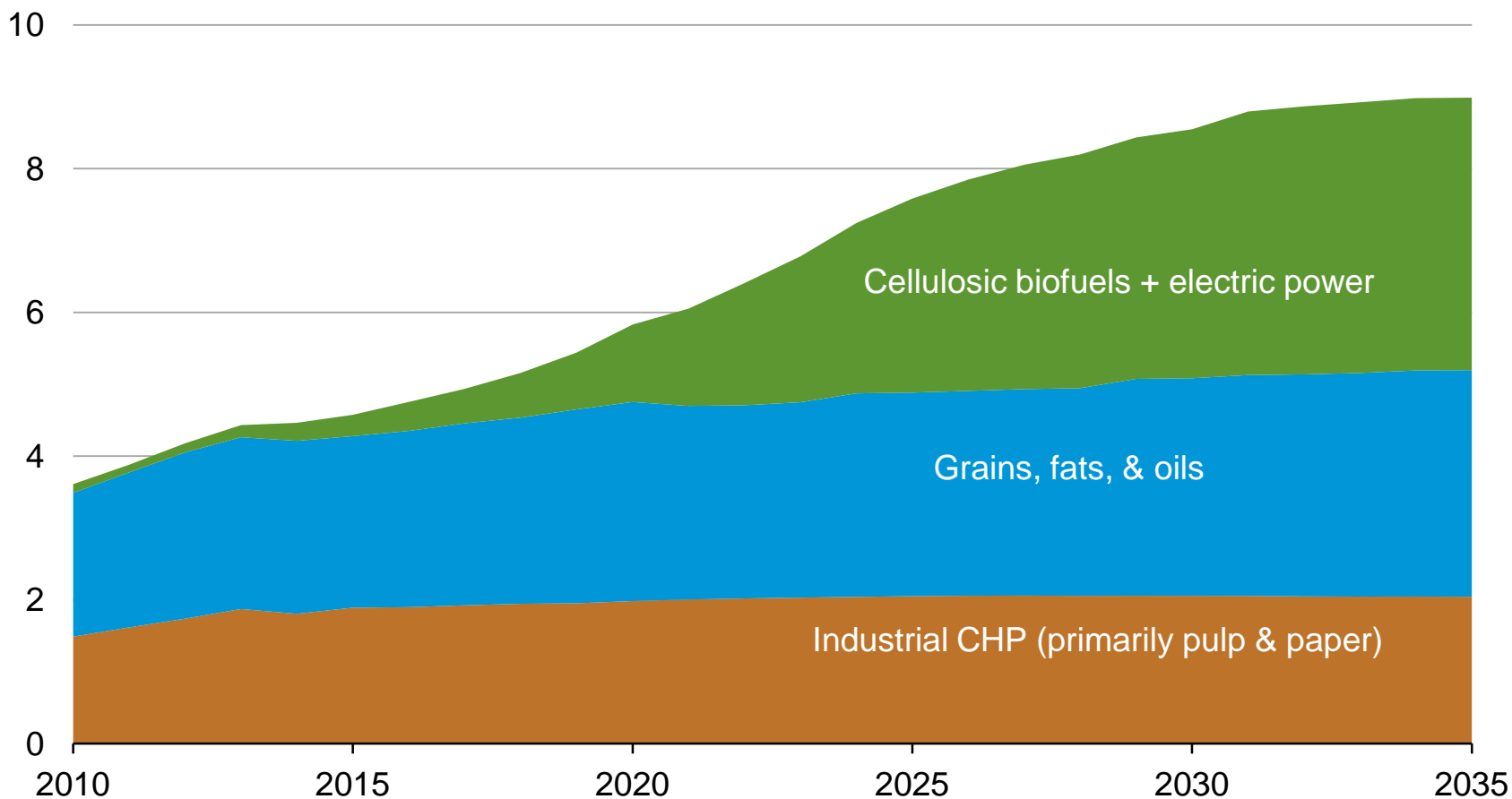
U.S. renewable fuels standard  
billion ethanol equivalent gallons



Source: EIA, Annual Energy Outlook 2011

# EIA projects that consumption of biomass for liquid fuels and power will increase significantly, driven primarily by cellulosic biofuels

US biomass supply  
quadrillion Btu per year



Source: EIA, Annual Energy Outlook 2011