

Exploring the implications of low growth in electricity demand



For

2014 NYISO Energy Conference

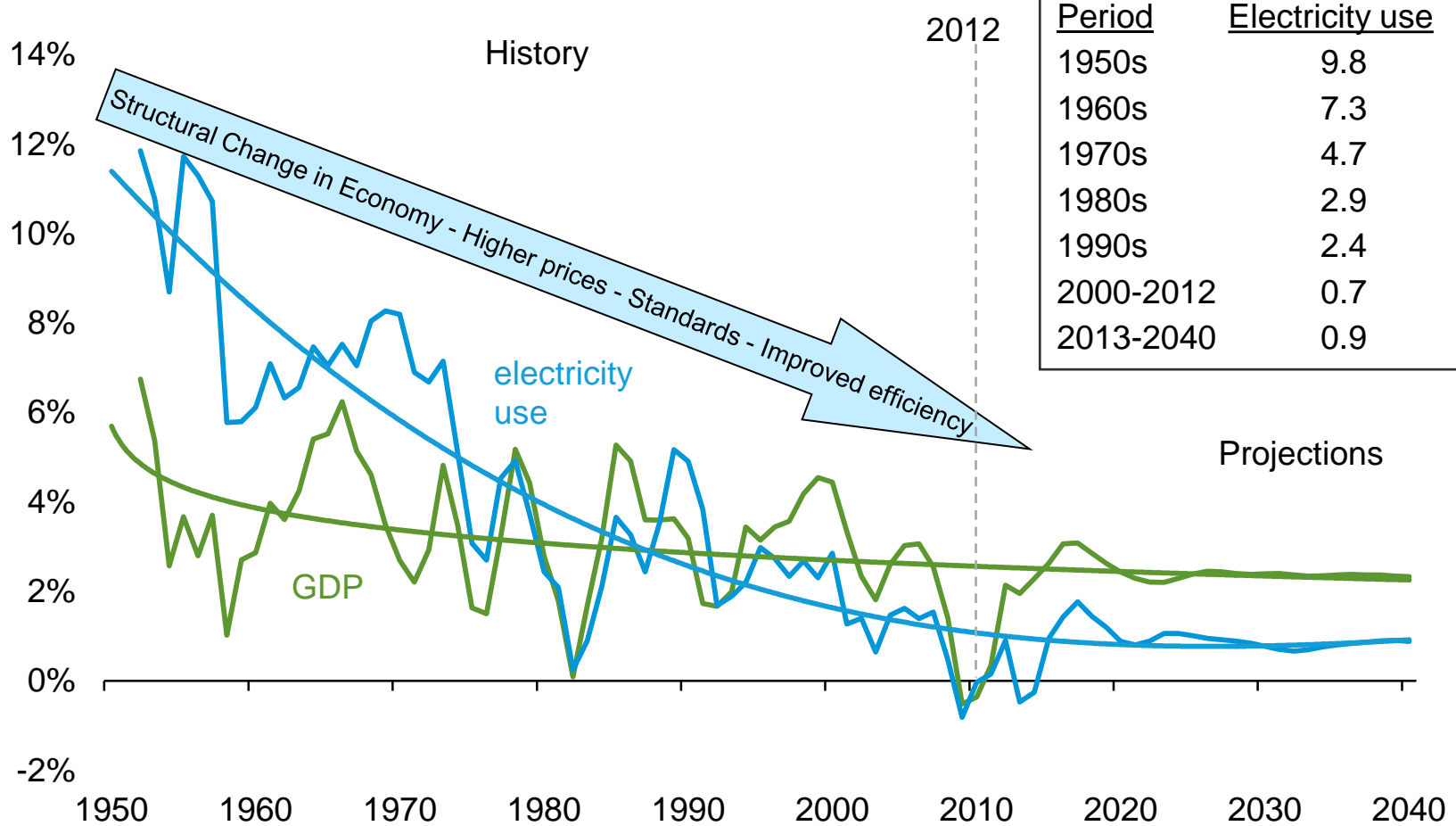
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By

Adam Sieminski, EIA Administrator

In EIA's AEO2014 Reference Case, growth in electricity use slows, but still increases by 29% from 2012 to 2040

percent growth
(3-year compounded annual growth rate)



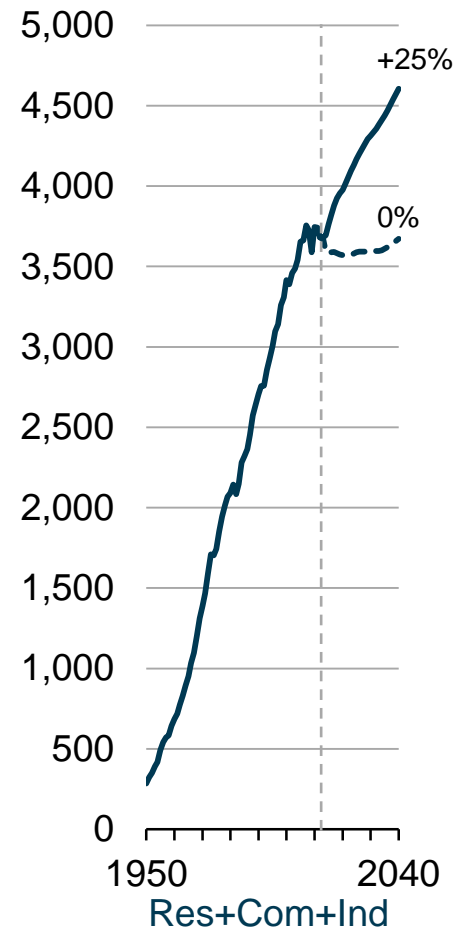
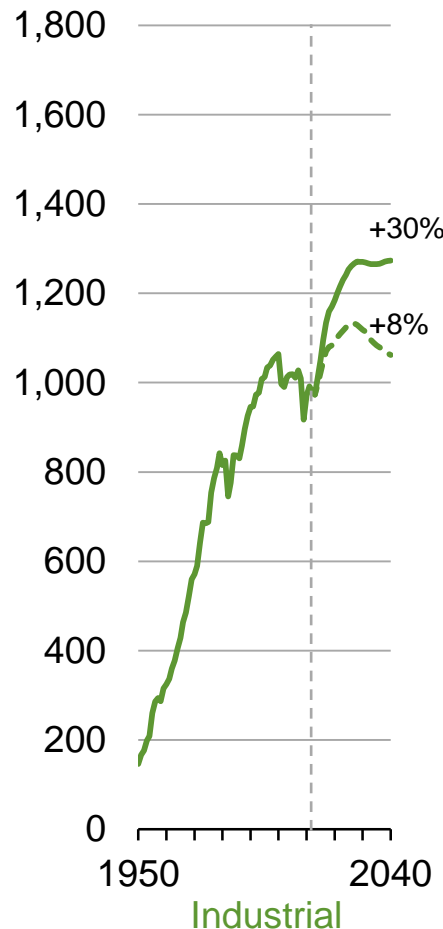
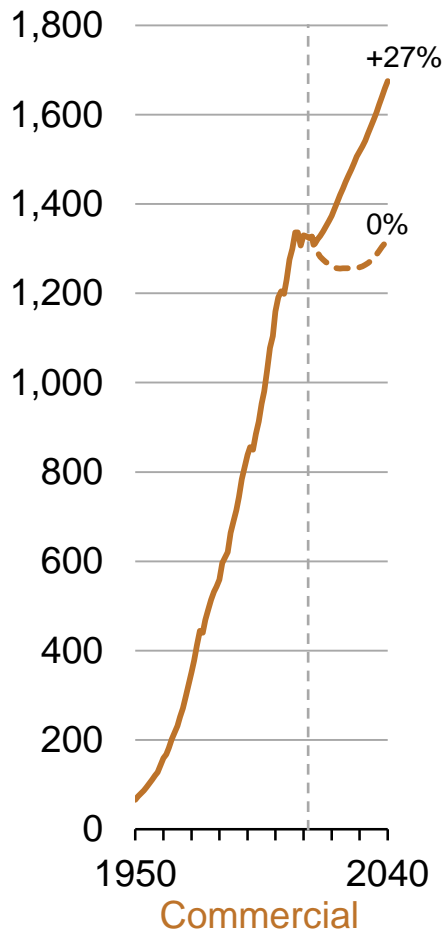
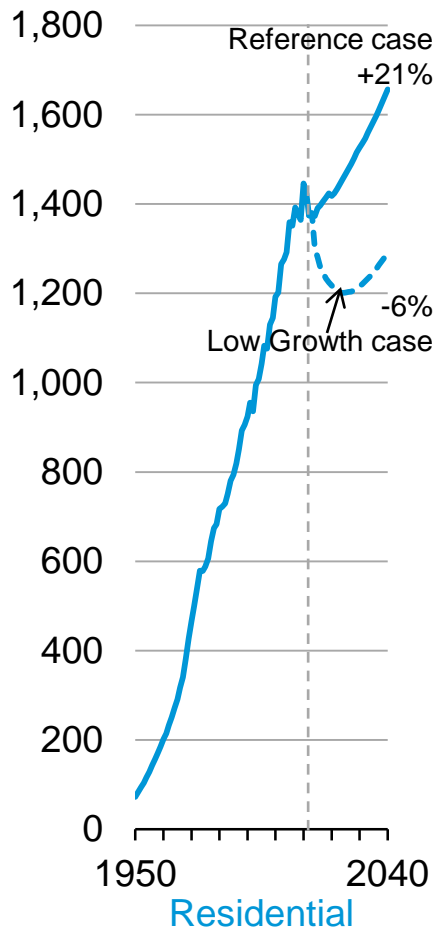
Source: EIA, Annual Energy Outlook 2014

What might a low electricity demand growth future look like?

- Assumptions used to achieve low electricity demand growth:
 - Applied best available technology to buildings, and layered on greater industrial motor efficiency
 - Assumptions are technically achievable but not necessarily cost-effective at this time
- Shifts in demand are accompanied by changes in patterns of investment and prices
 - Consumers spend less for electricity, and utility bill savings nearly balance households' increased costs for more efficient equipment, insulation, etc.
 - From 2012-2040, electricity generation capacity additions decline by about 50% relative to the *AEO2014* Reference case, while retirements of fossil fuel-fired capacity more than double relative to the *AEO2014* Reference case
 - Lower marginal energy prices in competitive wholesale electricity markets, relative to the *AEO2014* Reference case
 - Declines in residential electricity generation prices are partially offset by near-term increases in transmission and distribution prices

Historical and projected end-use electricity sales

billion kilowatthours (with percent change, 2012-2040)



Source: EIA, Monthly Energy Review and Annual Energy Outlook 2014

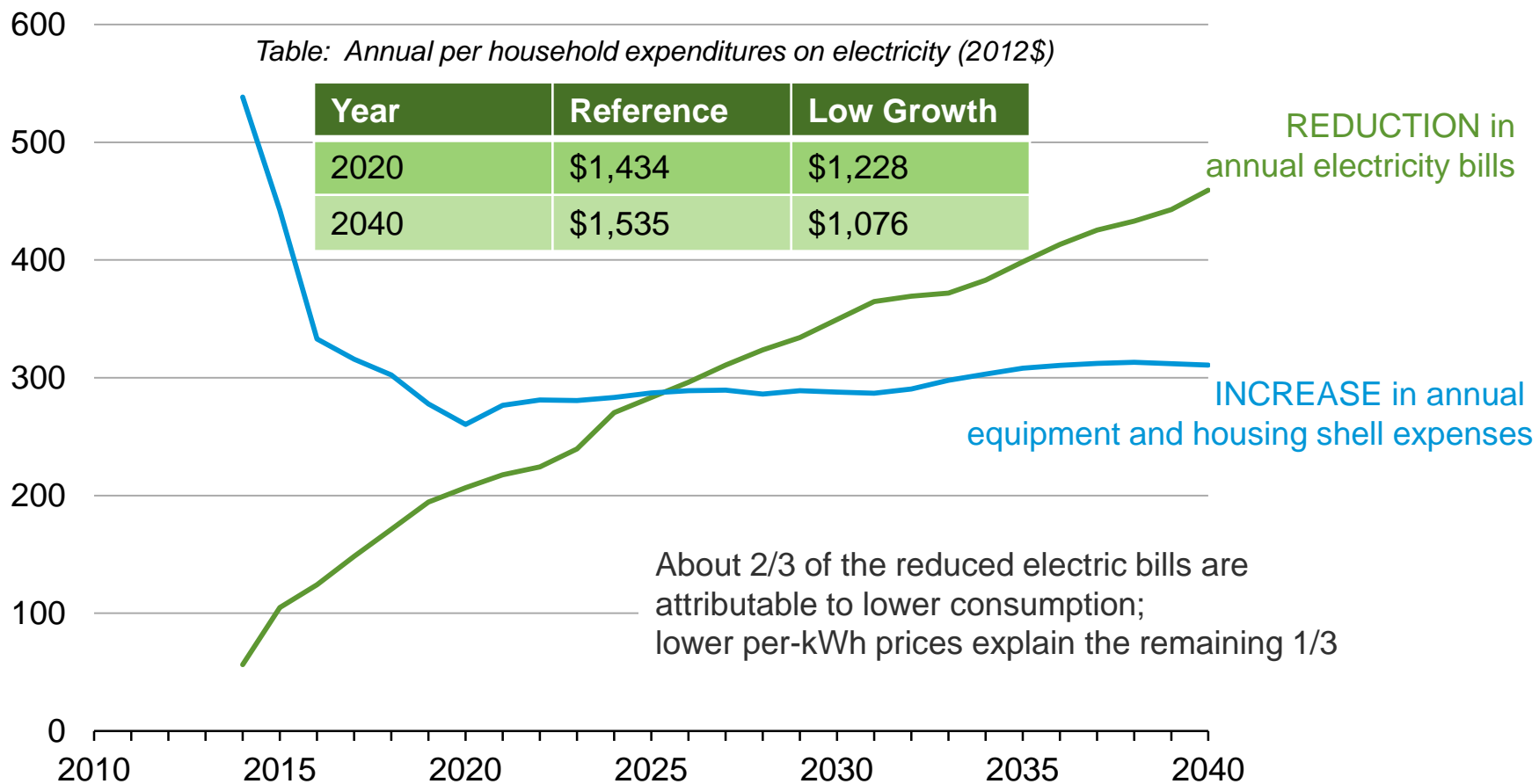
Average electricity demand growth rates vary across regions

	2012 - 2040
Region	Reference case
Total U.S.	0.80%
New York City	0.10%
Long Island	0.10%
Upstate New York	0.20%
New England	0.30%
Eastern Wisconsin	0.50%
Mid Atlantic	0.50%
Lower Michigan	0.50%
Great Lakes	0.60%
Mississippi Basin	0.60%
Northern Plains	0.70%
Central Plains	0.70%
California	0.90%
Texas	1.00%
Florida	1.00%
Mississippi Delta	1.00%
Alabama/Georgia	1.00%
Tennessee Valley	1.00%
Virginia Carolina	1.00%
Southern Plains	1.00%
Northwest	1.00%
Arizona/New Mexico	1.30%
Rocky Mountain	1.30%

	2012 - 2040
Region	Low Growth case
Total U.S.	0.00%
New York City	-0.70%
Long Island	-0.70%
New England	-0.60%
Upstate New York	-0.60%
Lower Michigan	-0.40%
Eastern Wisconsin	-0.30%
Mid Atlantic	-0.30%
Great Lakes	-0.30%
Mississippi Basin	-0.20%
Northern Plains	-0.10%
Central Plains	-0.10%
Florida	0.10%
Alabama/Georgia	0.10%
Virginia Carolina	0.10%
Texas	0.20%
Mississippi Delta	0.20%
Tennessee Valley	0.20%
Southern Plains	0.20%
California	0.20%
Northwest	0.40%
Arizona/New Mexico	0.50%
Rocky Mountain	0.50%

Utility bill savings nearly balance households' increased costs for more efficient equipment, insulation

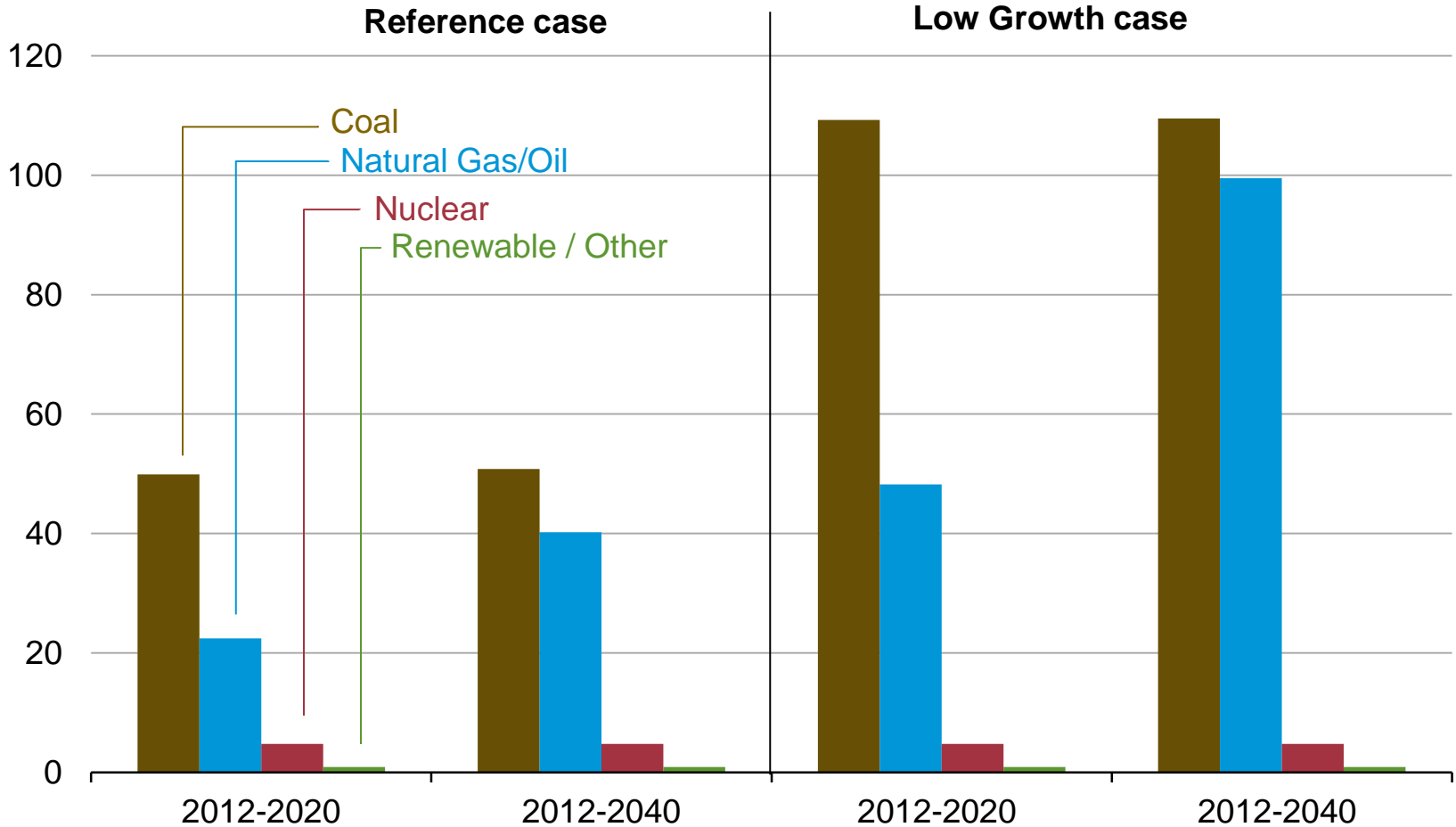
Change in per-household expenditures and electric bills relative to Reference case
2012\$ per year



Source: EIA, Annual Energy Outlook 2014

More fossil capacity is retired in the Low Growth case

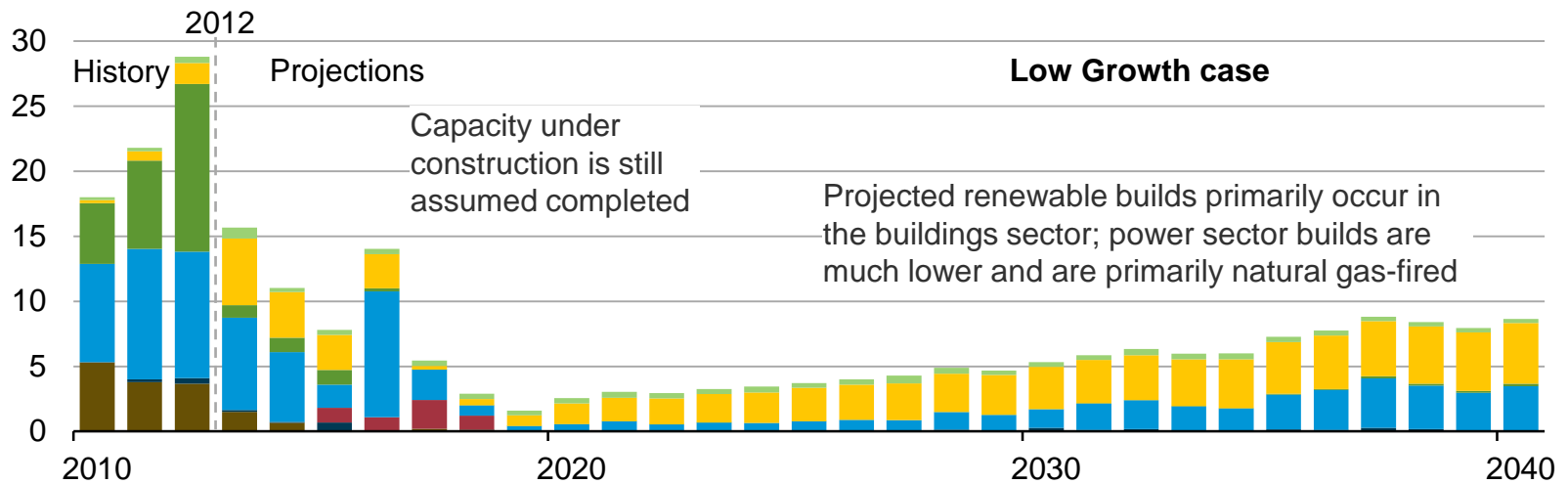
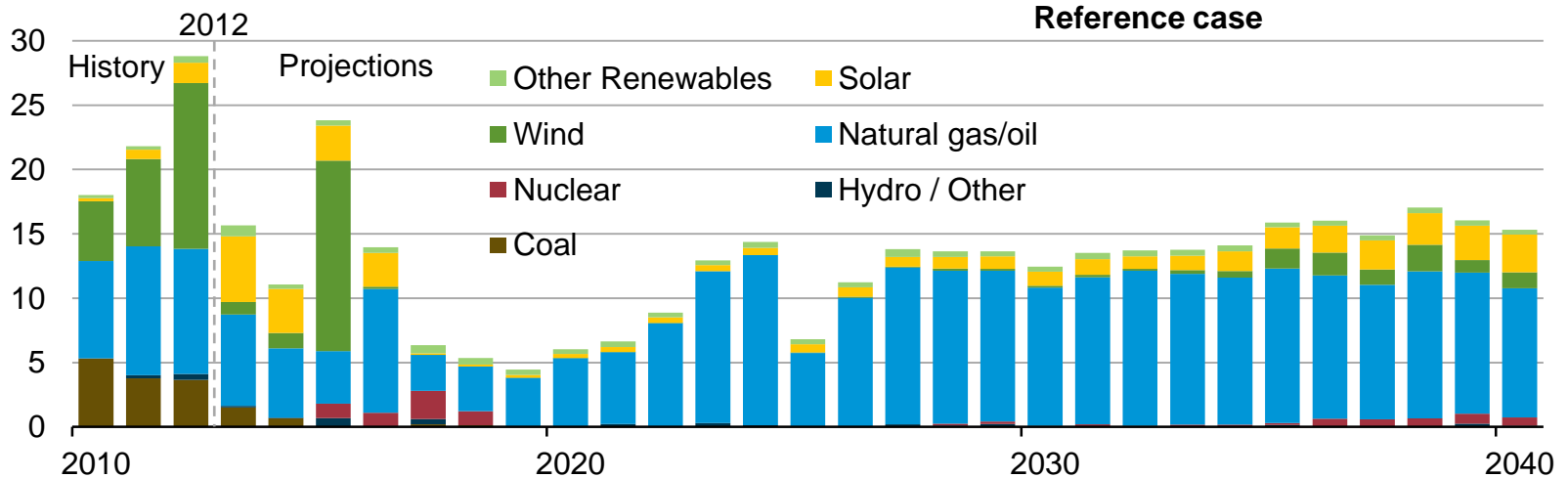
U.S. electric power sector capacity retirements
gigawatts (cumulative)



Source: EIA, Annual Energy Outlook 2014

Capacity additions decline dramatically in the Low Growth case

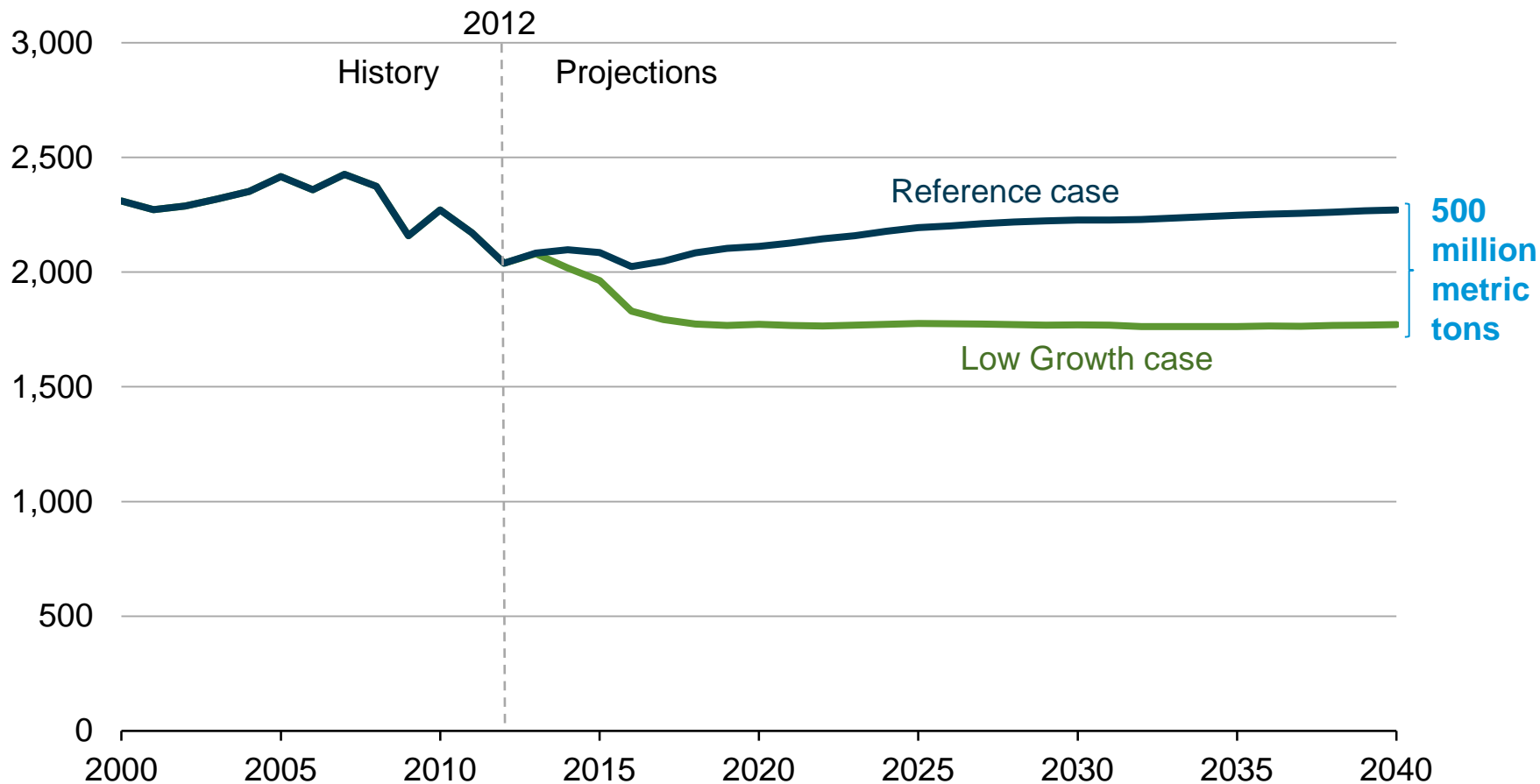
U.S. electricity generation capacity additions
gigawatts



Source: EIA, Annual Energy Outlook 2014

In the Low Growth case, total carbon dioxide emissions from the electric power sector in 2040 are 22% below the Reference case

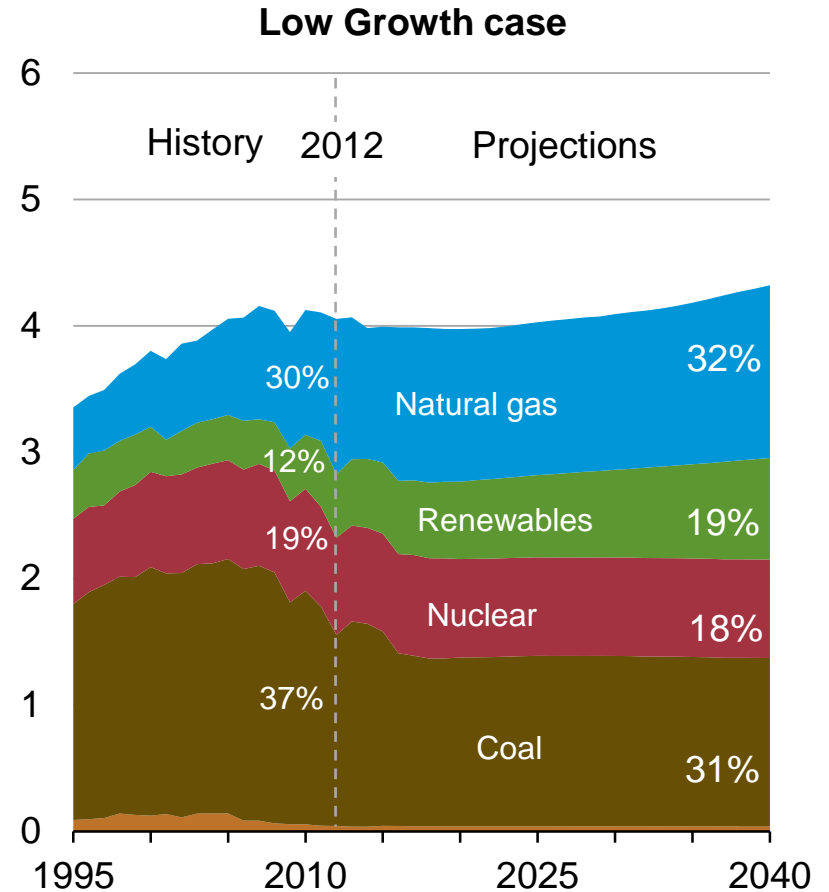
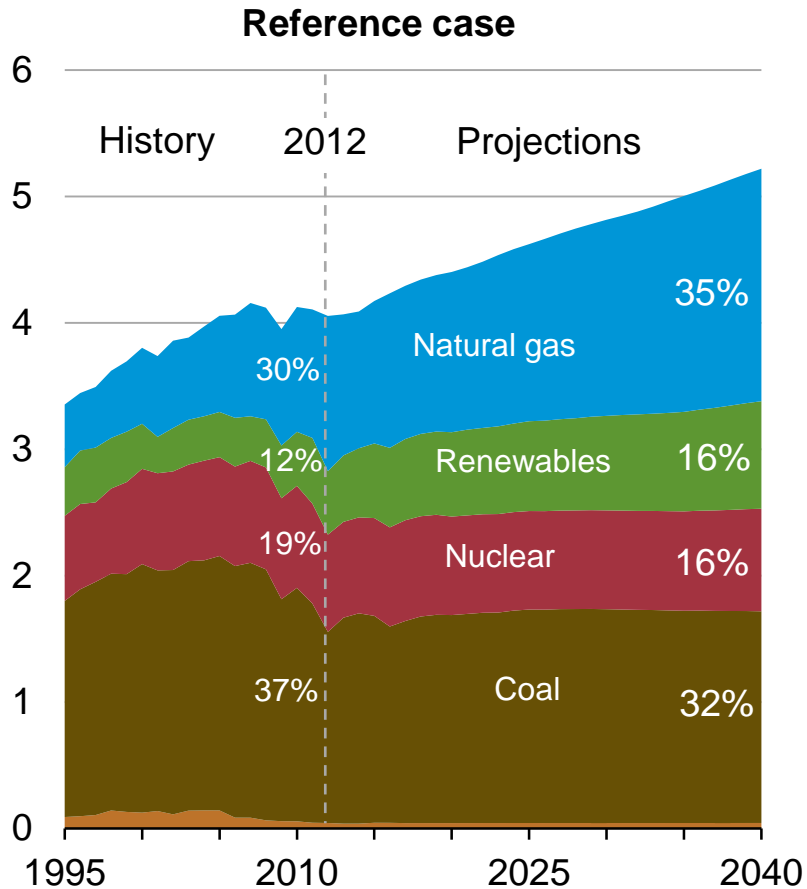
Total carbon dioxide emissions
million metric tons CO₂



Source: EIA, Annual Energy Outlook 2014

Gas generation grows much more slowly in the Low Growth case

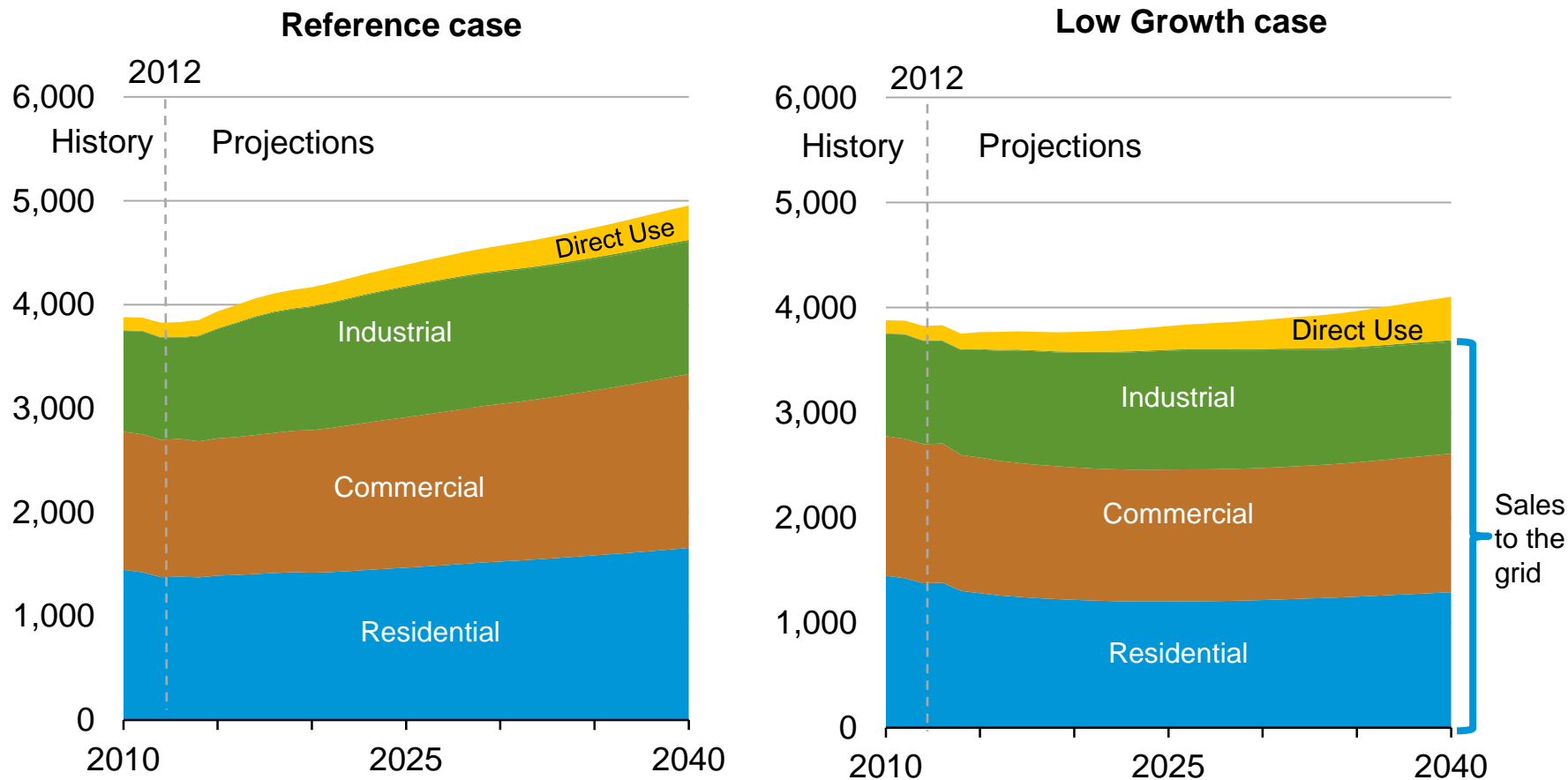
U.S. electricity net generation
trillion kilowatthours



Source: EIA, Annual Energy Outlook 2014

End use sales are flat in the Low Growth case, but direct use grows due to technology assumptions

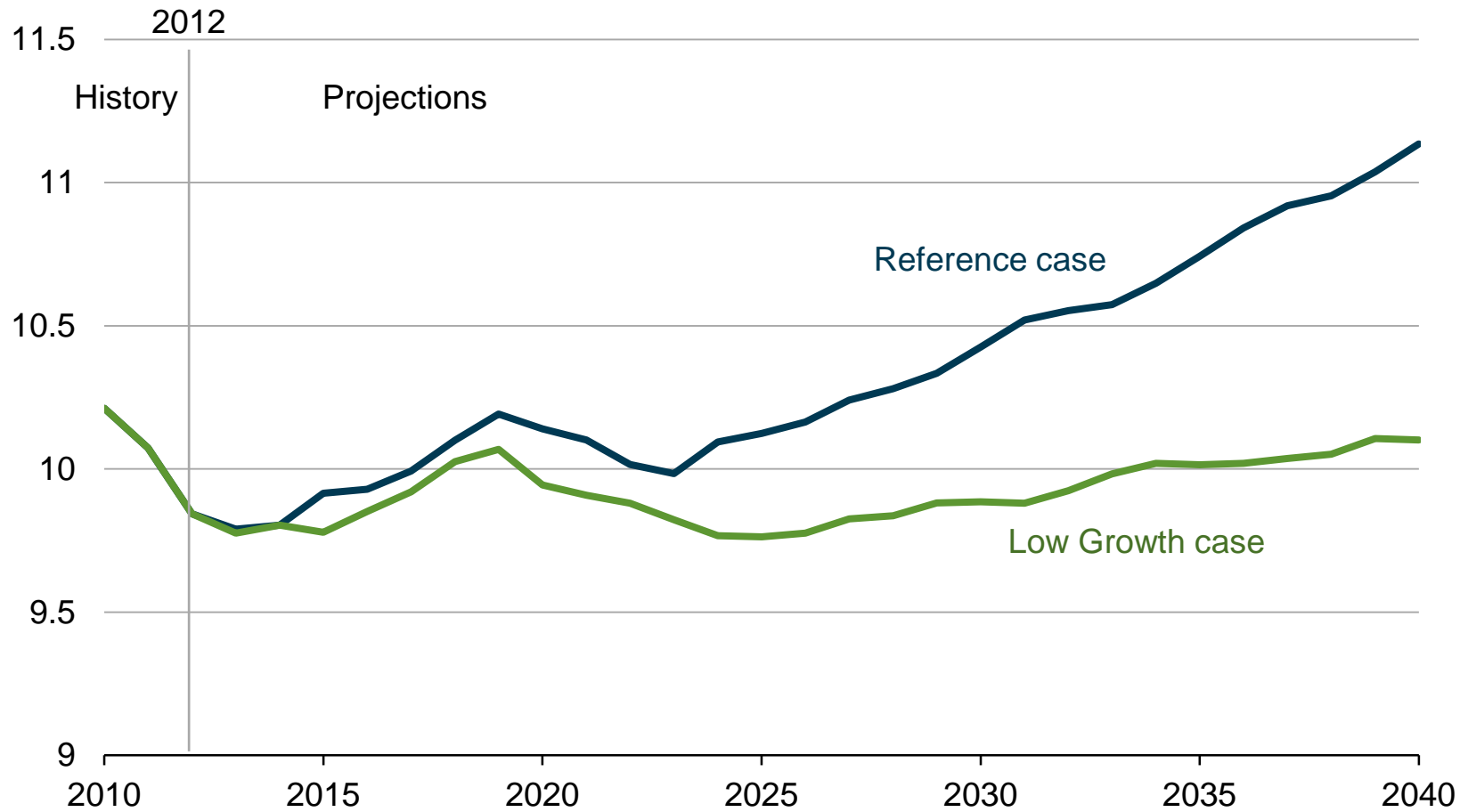
Total electricity use
billion kilowatthours



Source: EIA, Annual Energy Outlook 2014

Projected end-use electricity prices are lower in the Low Growth case

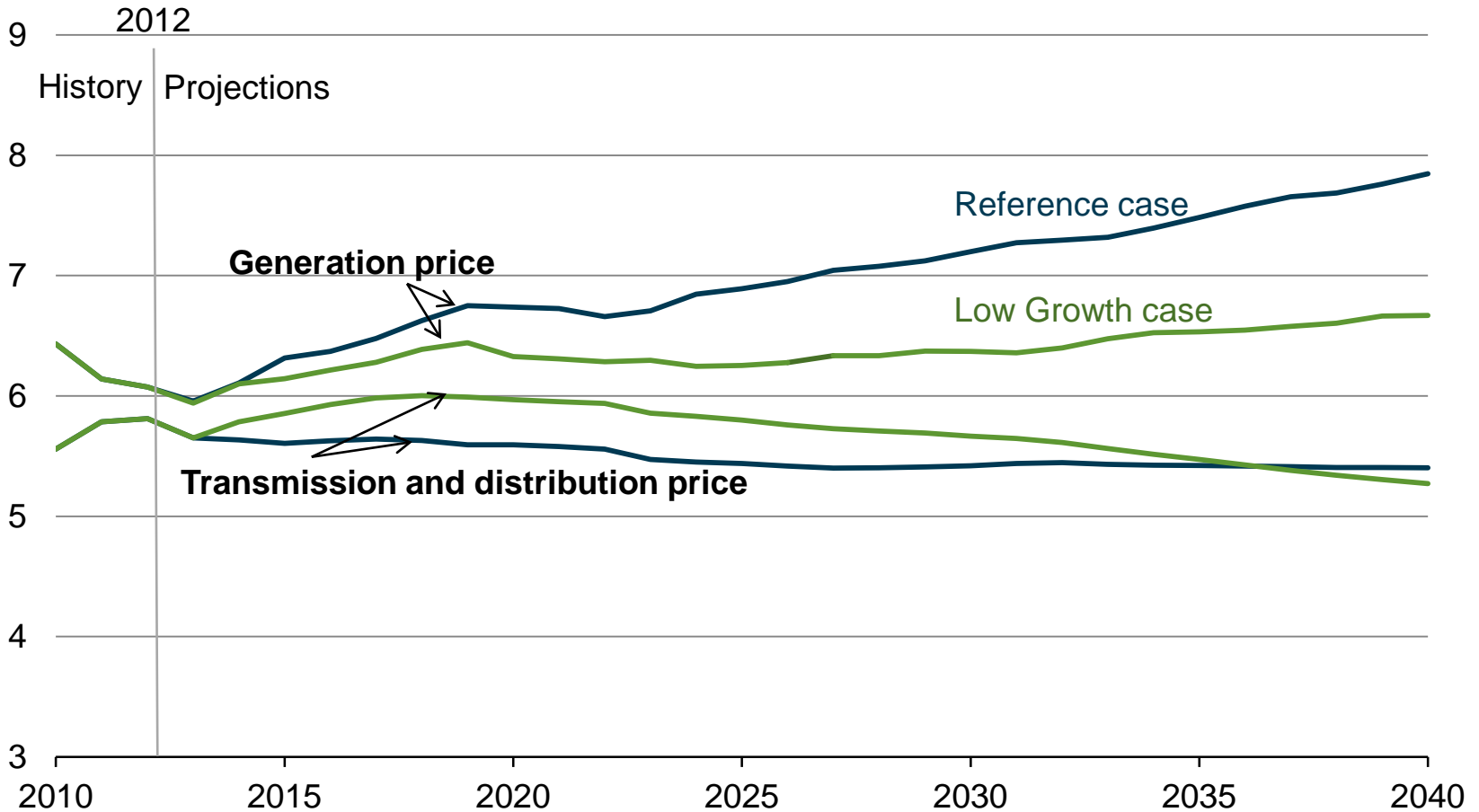
Average end-use electricity price, all sectors
2012 cents per kilowatthour



Source: EIA, Annual Energy Outlook 2014

Declines in residential electricity generation prices are partially offset by near-term increases in transmission and distribution prices

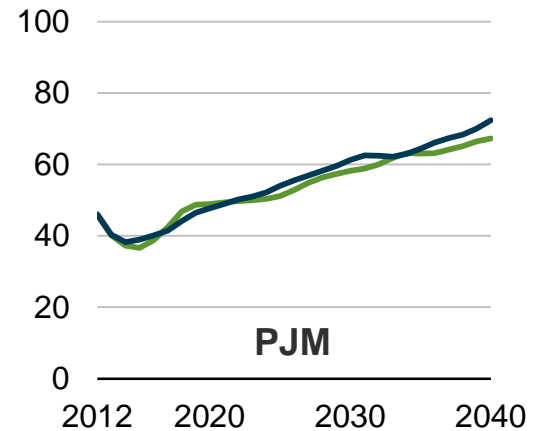
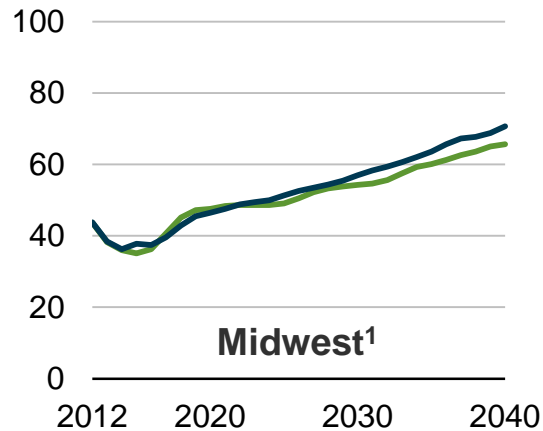
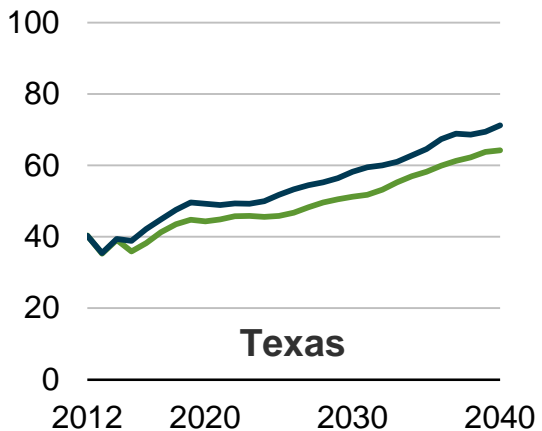
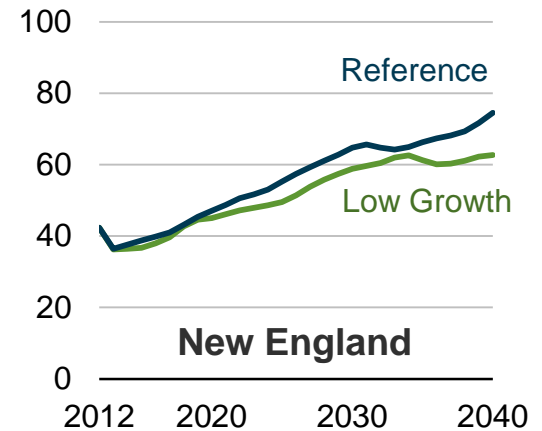
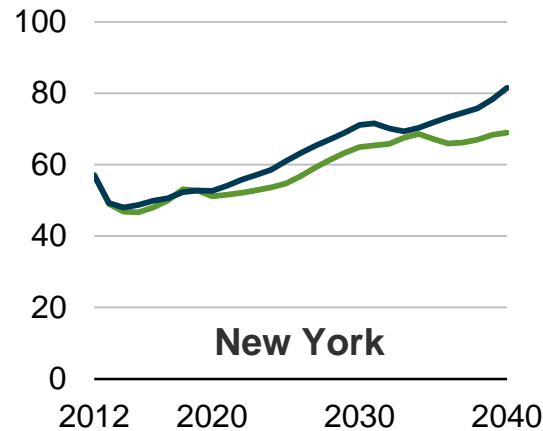
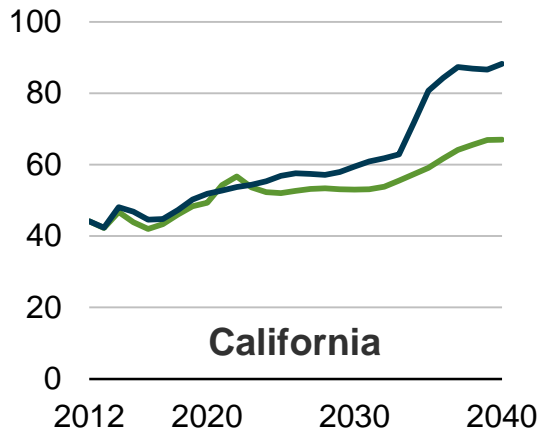
Average electricity price components, residential sector
2012 cents per kilowatthour



Source: EIA, Annual Energy Outlook 2014

In the long term, lower demand growth leads to lower energy prices in competitive wholesale electricity markets

Average marginal energy prices
2012\$ per megawatthour

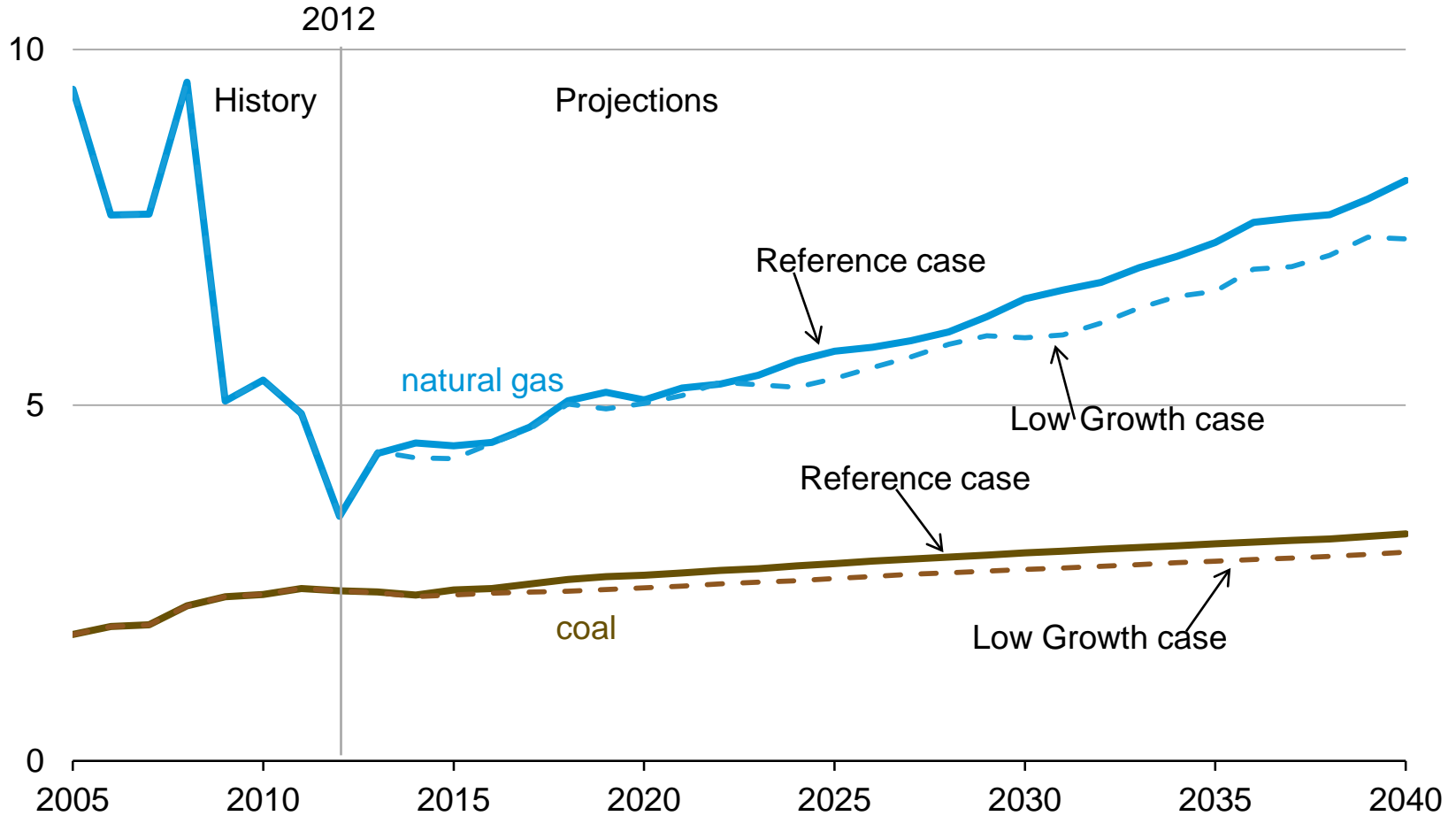


Source: EIA, Annual Energy Outlook 2014, electricity model regions averaged to approximate existing ISOs/RTOs

¹ The "Midwest" region combines the electricity model regions used to approximate the Midcontinent ISO (MISO) and the Southwest Power Pool (SPP).

Delivered coal and natural gas prices are reduced in the Low Growth case

Average delivered fuel prices to electric power plants
2012\$ per million Btu



Source: EIA, Annual Energy Outlook 2014

EIA can run what-if scenarios and analyses which can help explore the various implications of grid modernization and fuel switching

- Fuel Switching

- Drivers

- Levelized electricity costs
 - Plant retirements – Accelerated retirements cases
 - Changes in demand – Low demand growth case
 - Policies – Reference case vs. Extended Policies case

- Implications

- Projected changing electricity mix
 - Projected capacity additions

- Grid Modernization

- The NEMS model includes regional T&D with capacity limits and implicit cost assumptions
 - T&D losses could be varied

For more information

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

Annual Energy Outlook | www.eia.gov/aeo

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

International Energy Outlook | www.eia.gov/ieo

Monthly Energy Review | www.eia.gov/mer

Today in Energy | www.eia.gov/todayinenergy

State Energy Portal | www.eia.gov/state

Drilling Productivity Report | www.eia.gov/petroleum/drilling/

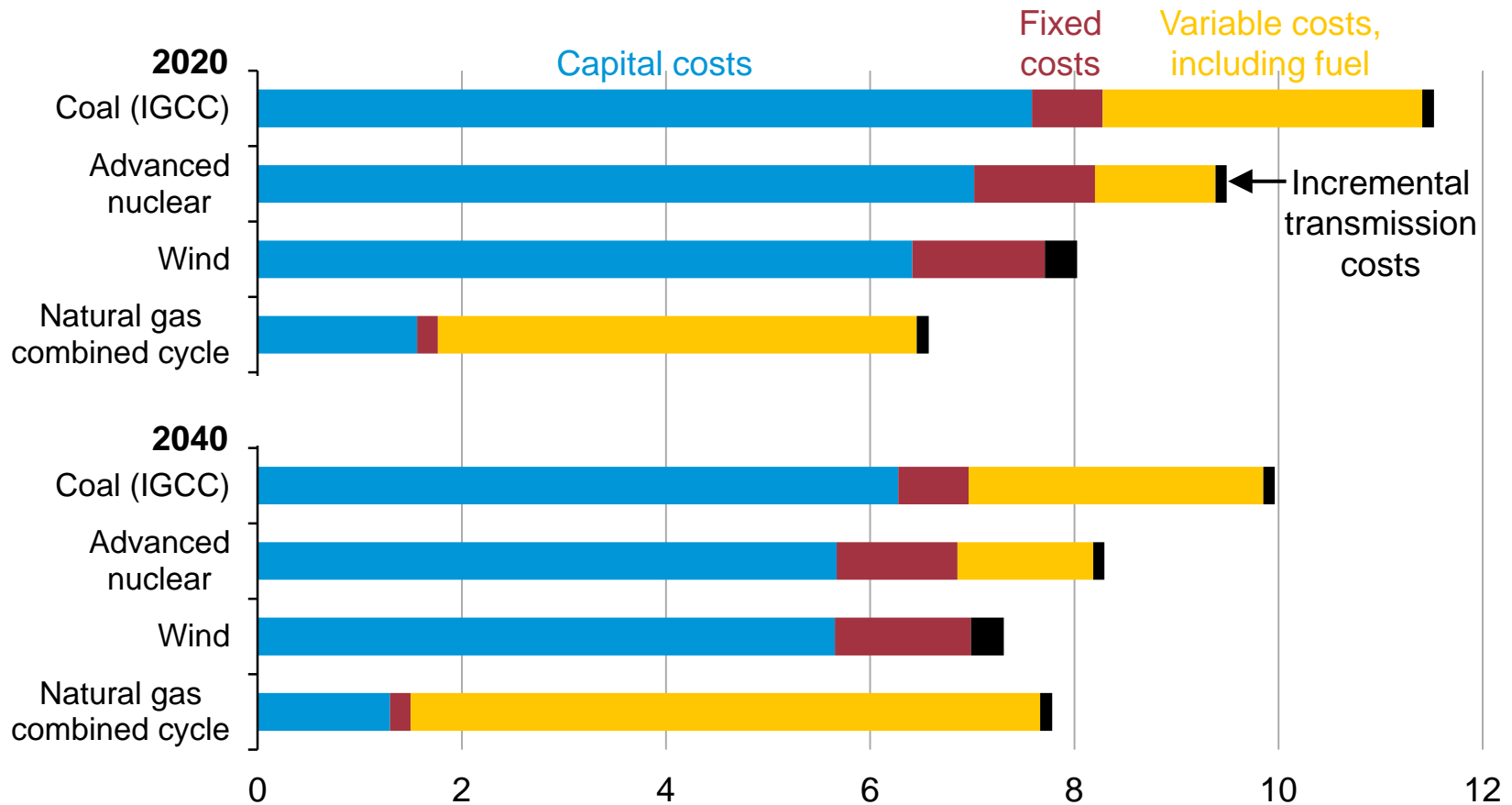
Supplementary slides

Low Growth case uses a combination of assumptions that result in zero growth in end-use electricity sales

- **AE02014 Best Available Demand Technology case assumptions for the buildings sectors**
 - Future equipment purchases assume only the most efficient model is available for each technology
 - Consumers accept longer payback periods for efficiency investments
 - Residential new construction: shell efficiency is assumed to be code compliant and built to the most efficient specification after 2013
 - Residential existing housing stock: shell efficiency improves by 32% for heating and 12% for cooling by 2040 vs. 17% and 6% in the Reference case
 - Commercial: shell efficiency improves by 23% for new construction and 10% for existing buildings by 2040 vs. 15% and 7% in the Reference case
- **Reduction in industrial motor electricity use**
 - Industrial motors for compressors, fans, and pumps: assumed reduction in motor average energy usage ranges from 10% (for 1-5 hp class) up to 32% (for 101-200 hp class)

Average levelized electricity costs for new power plants, excluding subsidies, in the Reference case, 2020 and 2040

new power plant costs
2012 cents per kilowatthour



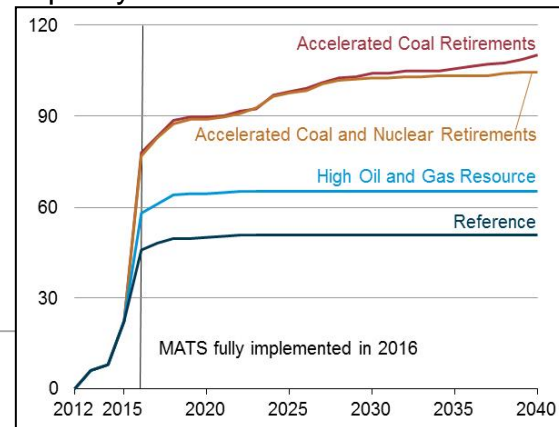
Source: EIA, Annual Energy Outlook 2014

Accelerated power plant retirements and nuclear side case assumptions

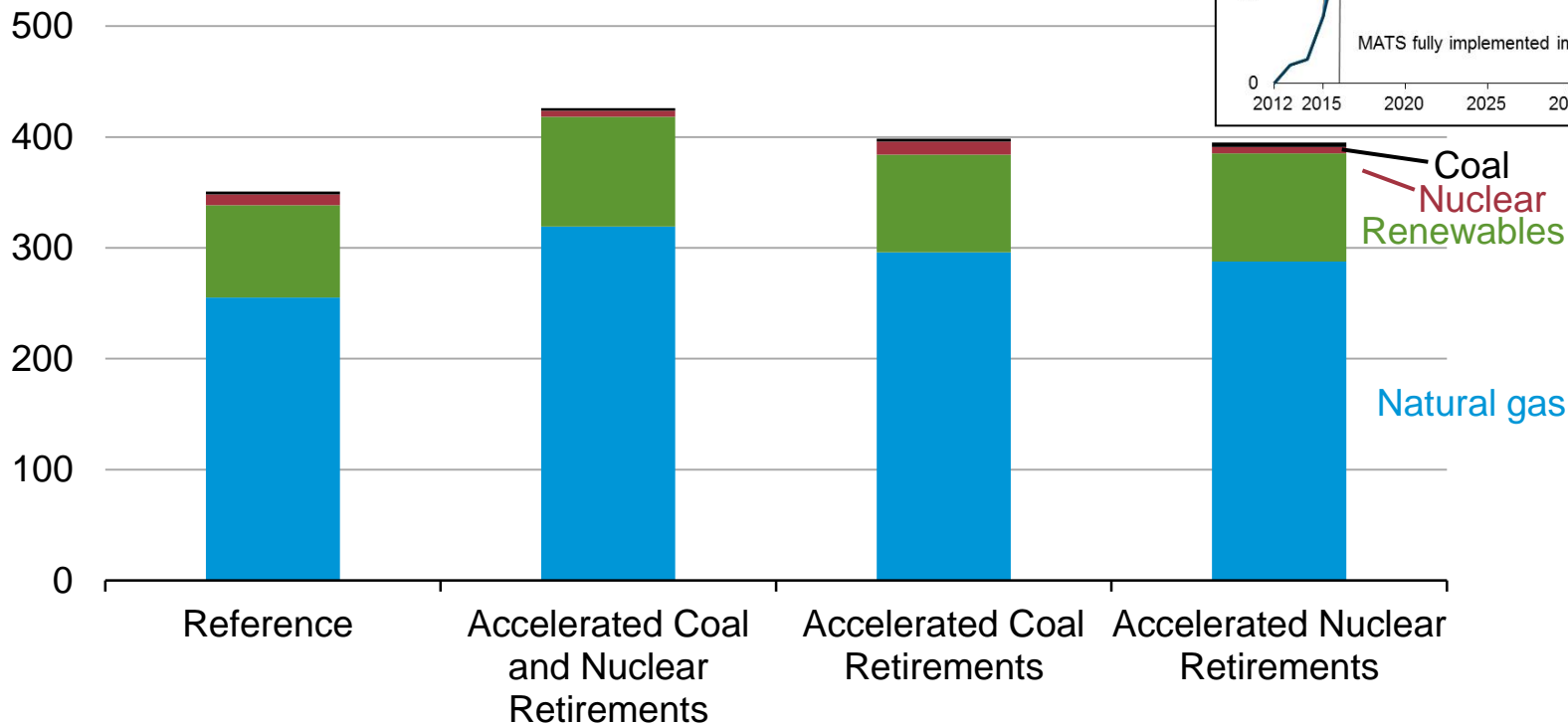
- **Accelerated Coal Retirements case**
 - Starts from AEO2014 High Coal Cost case, with coal prices 68% above Reference case in 2040
 - Annual O&M increase of 3% in real terms from 2012 to 2040, compared to no increase in the Reference case
- **Accelerated Nuclear Retirements case**
 - No subsequent license renewals for nuclear units past 60 years compared to the Reference case assumption that license renewals allow units to operate beyond 60 years
 - Annual O&M increase of 3% in real terms from 2012 to 2040, compared to no increase in the Reference case
- **Accelerated Coal and Nuclear Retirements case**
 - Combines assumptions from the previous two cases
- **Low Nuclear case**
 - Same assumptions as the Accelerated Nuclear Retirements case plus
 - High Oil and Gas Resource case assumptions, resulting in lower natural gas price trajectory
 - No Sunset case assumptions, resulting in more renewable energy generation

Natural gas and renewables capacity additions are expected to fill the void left by accelerated coal and nuclear retirements through 2040

Cumulative retirements of coal-fired generating capacity in four cases



cumulative capacity additions
gigawatts

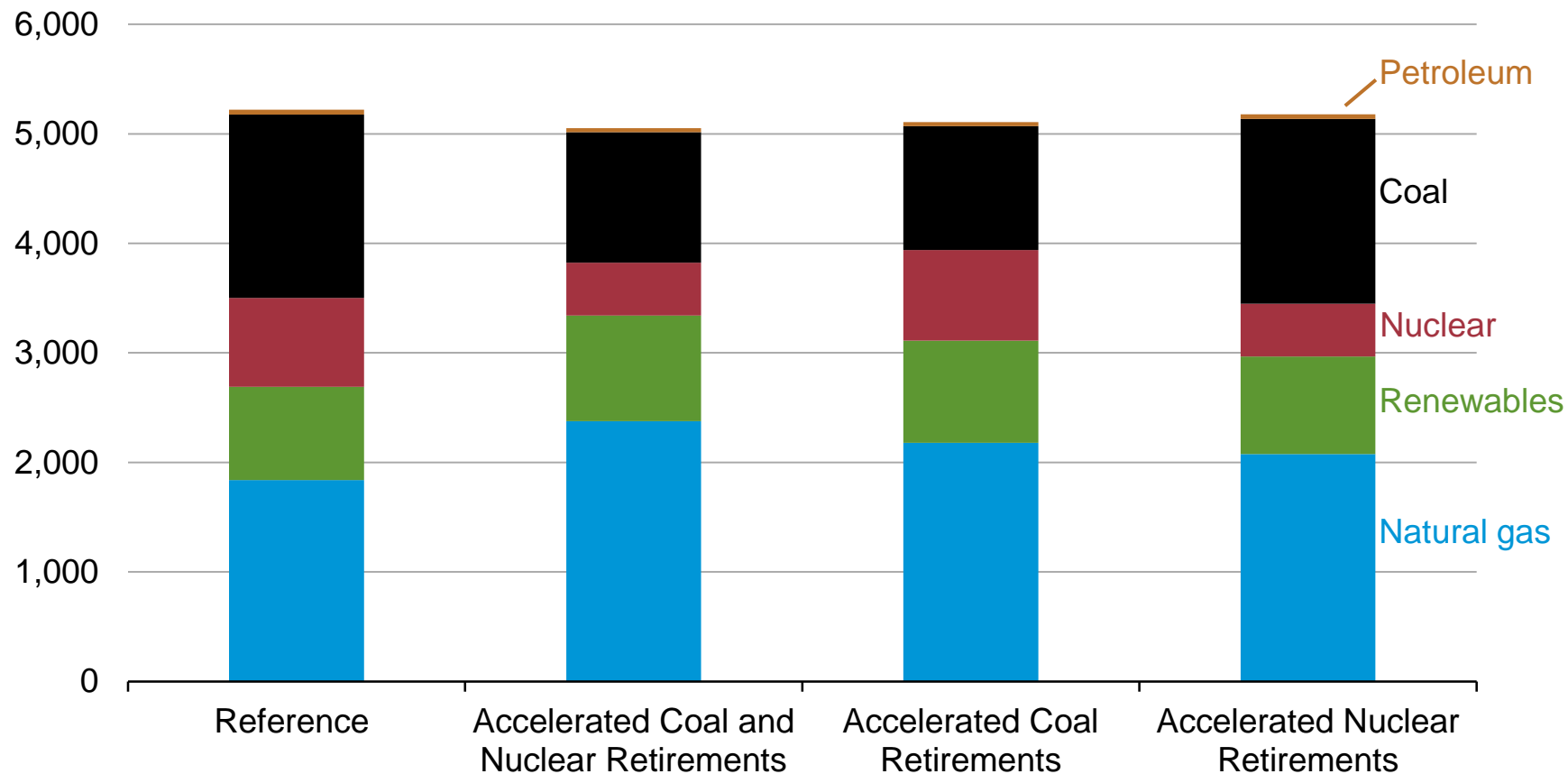


Source: EIA, Annual Energy Outlook 2014

Natural gas and renewables generation share increases through 2040 in accelerated retirement cases but overall electricity demand decreases slightly due to higher natural gas prices

net electricity generation

billion kilowatt-hours

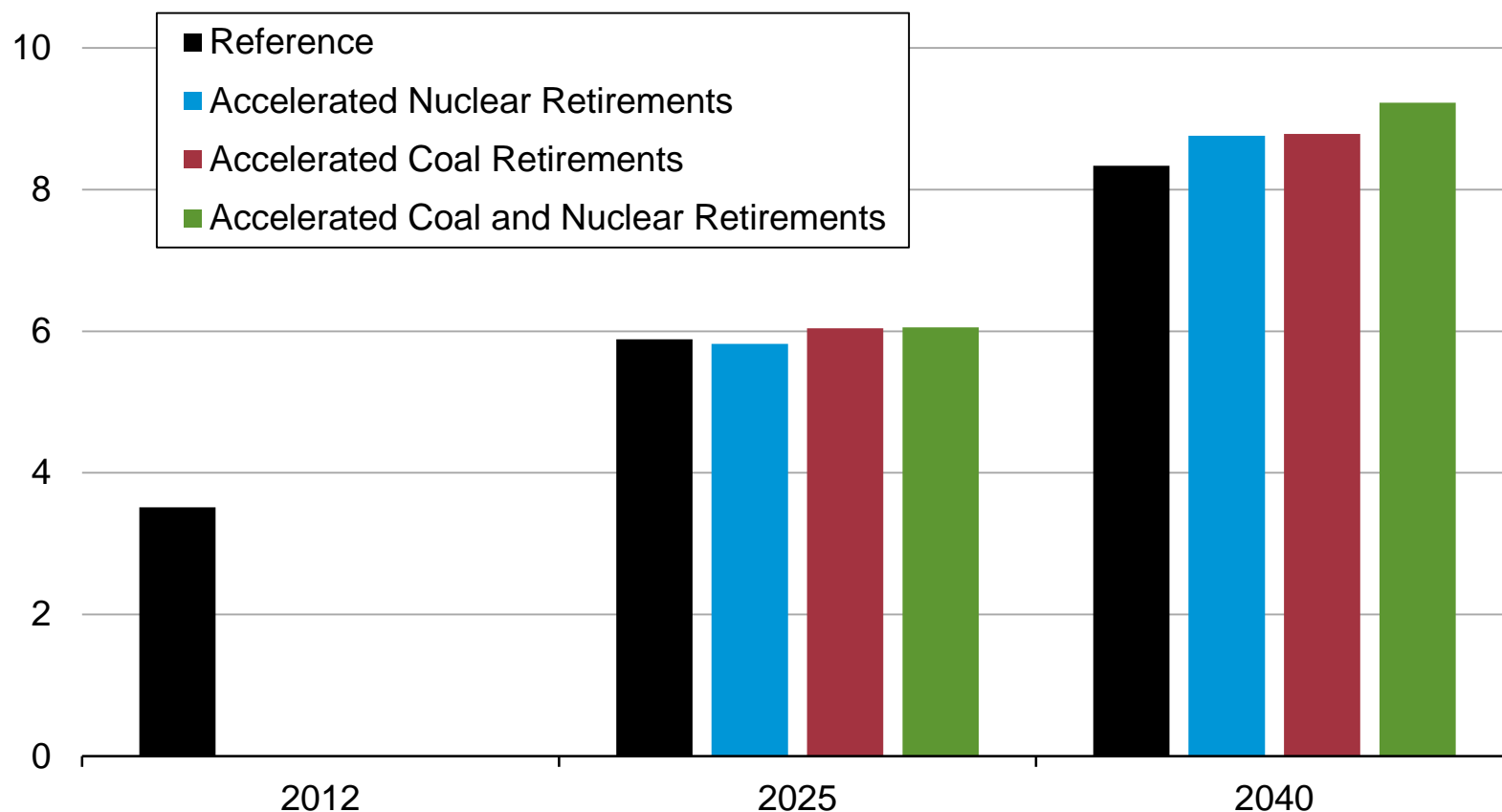


Source: EIA, Annual Energy Outlook 2014

Delivered natural gas increases modestly across all cases by 2040 due to increase in natural gas demand for generation

natural gas prices

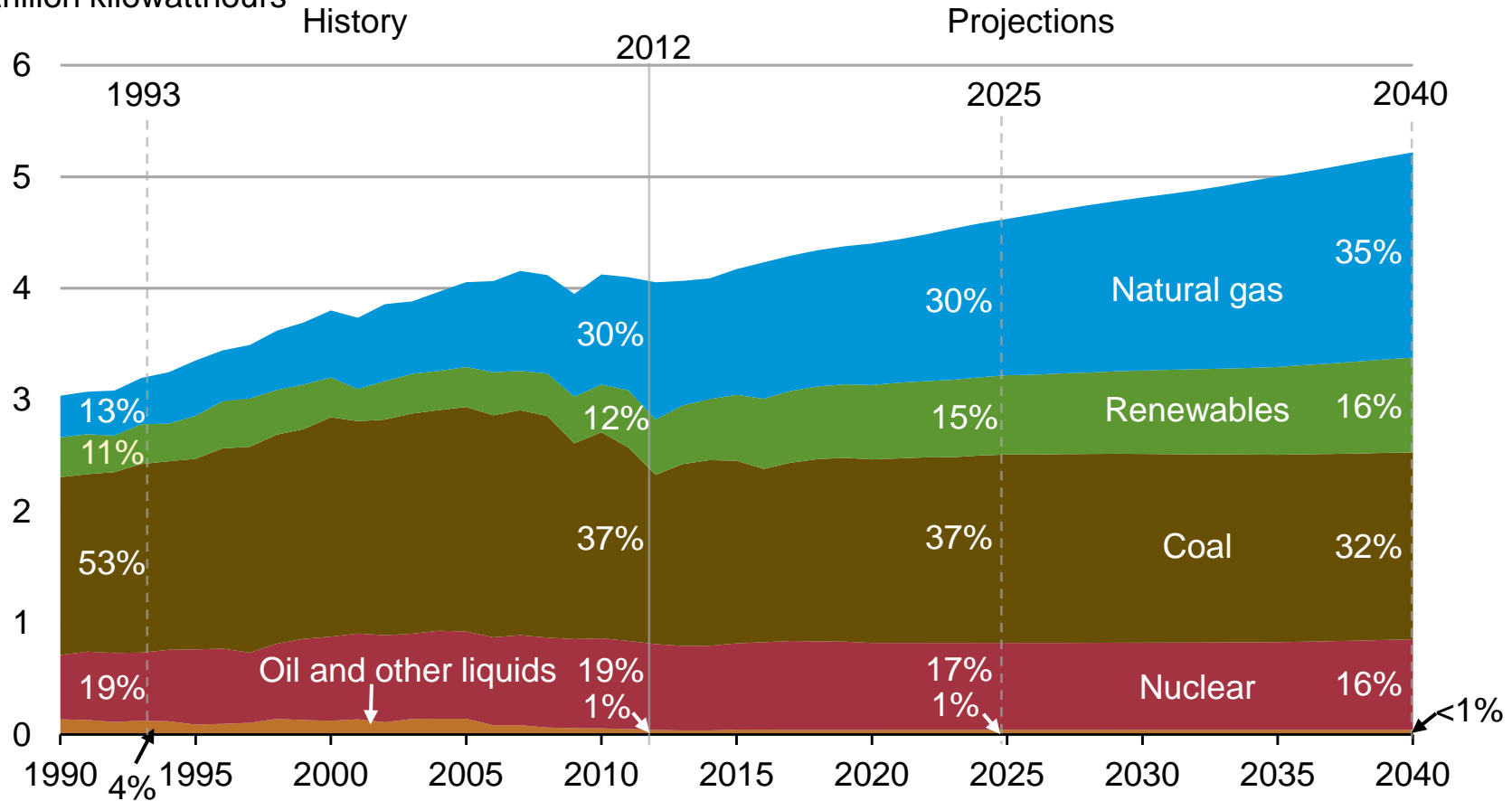
2012 dollars per thousand cubic feet



Source: EIA, Annual Energy Outlook 2014

Over time the electricity mix gradually shifts to lower-carbon options, led by growth in natural gas and renewable generation

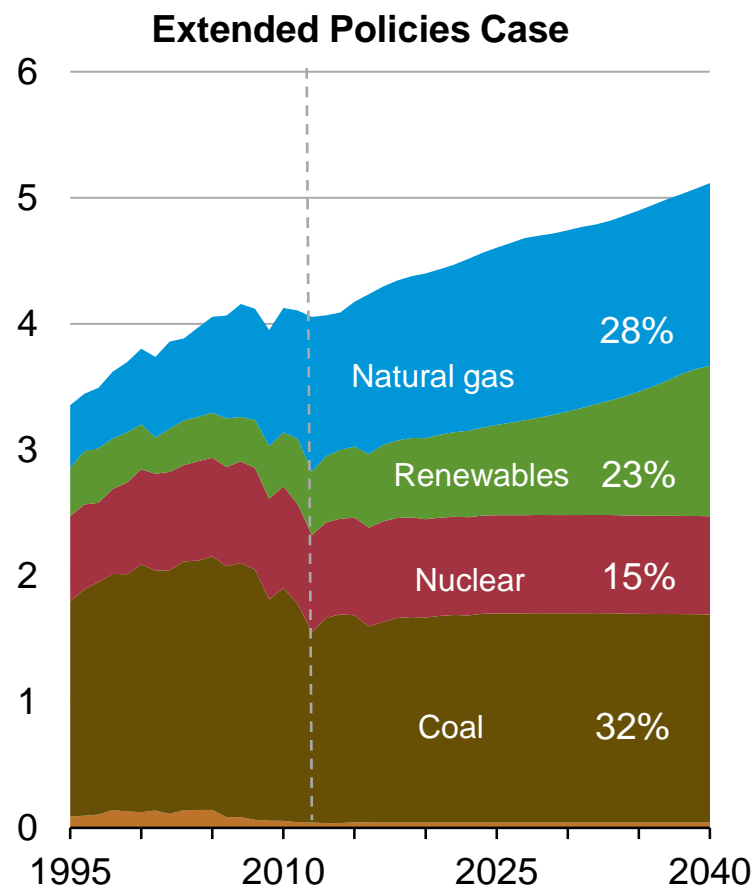
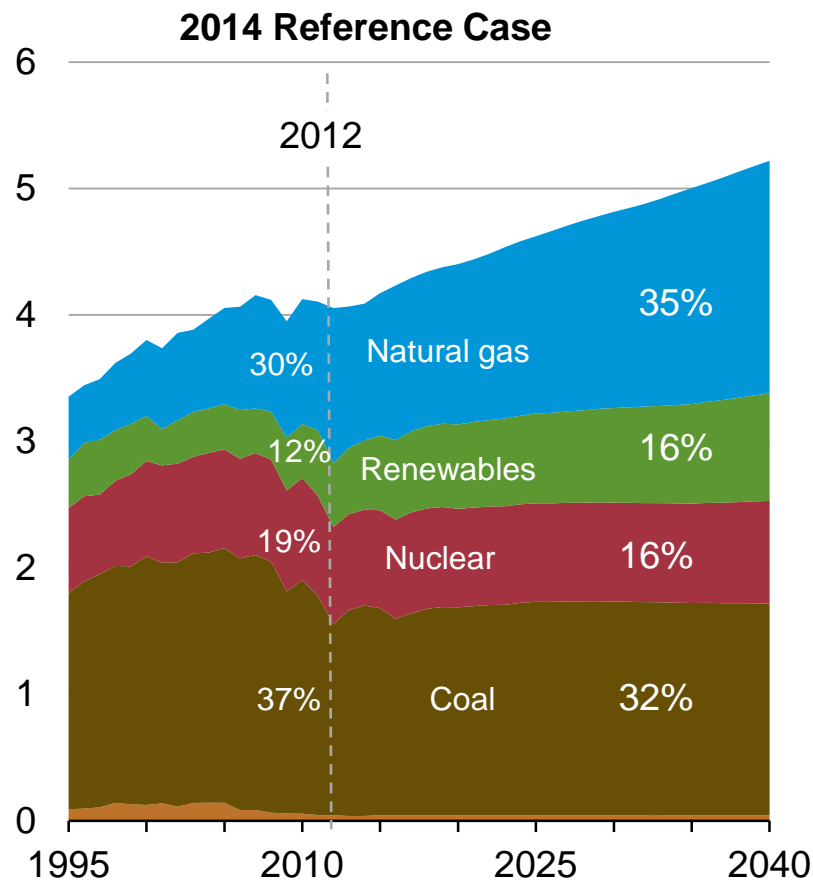
U.S. electricity net generation
trillion kilowatthours



Source: EIA, Annual Energy Outlook 2014 Early Release

Changing electricity generation mix in *AEO2014* reference case and extended policies side case

U.S. electricity net generation
trillion kilowatthours



Source: EIA, Annual Energy Outlook 2014 Early Release and Preliminary side cases

Additional Analysis Case Definitions

\$10 and \$25 Carbon Dioxide Allowance Fee Cases

Applies a price for CO₂ emissions throughout the economy, starting at \$10 or \$25 per metric ton in 2015 and rising by 5 percent per year through 2040.

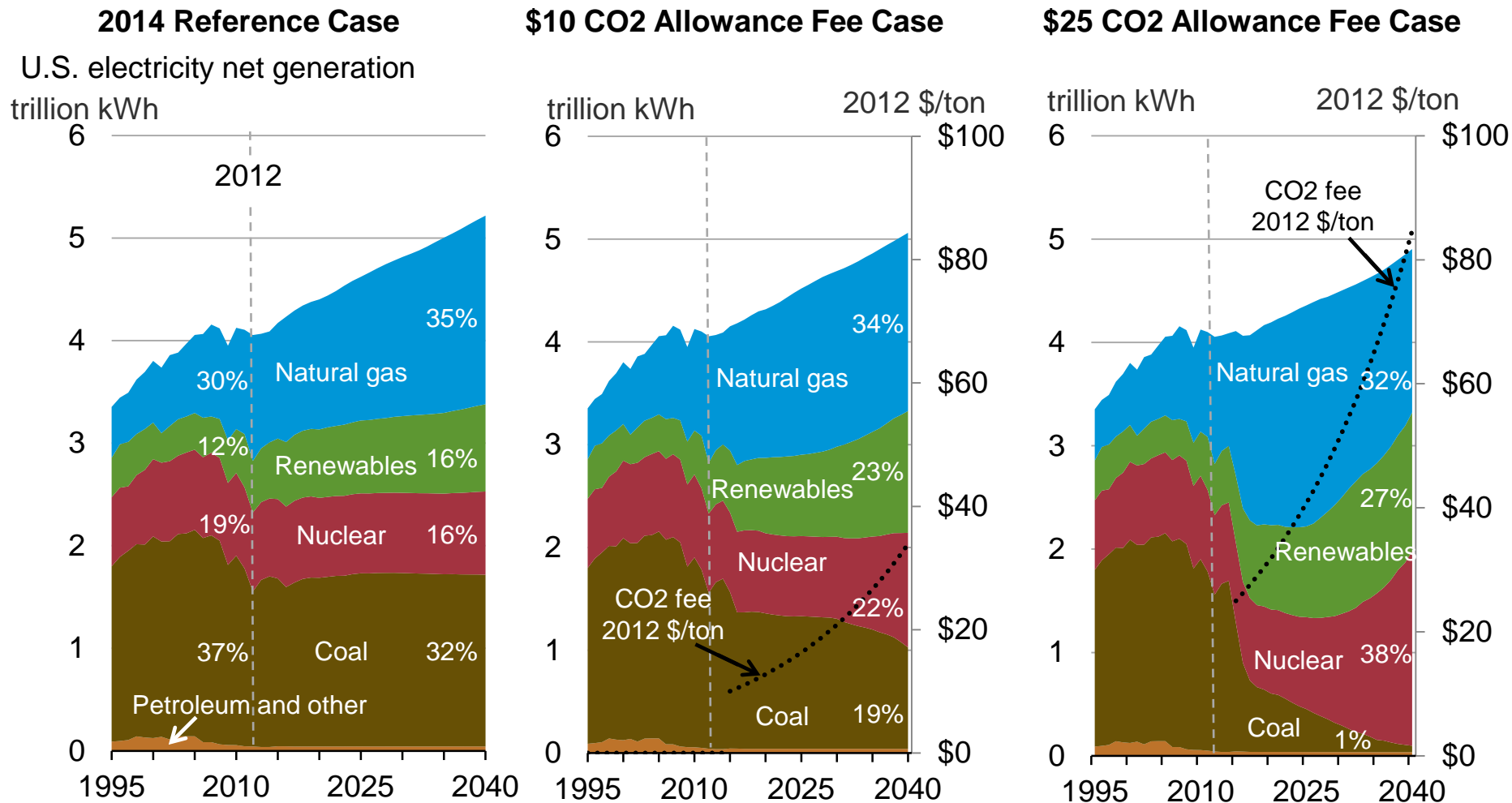
Extended Policies Case

Assumes extension of all existing energy policies and legislation that contain sunset provisions, except those requiring additional funding (e.g., loan guarantee programs) and those that involve extensive regulatory analysis, such as CAFE improvements and periodic updates of efficiency standards. Also includes extension of the \$1.01 per gallon ethanol subsidy and \$1.00 per gallon biodiesel subsidy to the end of the projection period.

Low Electricity Demand Growth Case

Assumes that all future equipment purchases in the residential and commercial sectors are made from a menu of technologies that includes only the most efficient models available in a particular year, regardless of cost. Residential building shells for new construction are all assumed to be code compliant and built to the most efficient specifications after 2013, and existing residential shells have twice the improvement of the Reference case. New and existing commercial building shell efficiencies improve 50 percent more than in the Reference case by 2040. Assumes greater improvement in industrial motor efficiency.

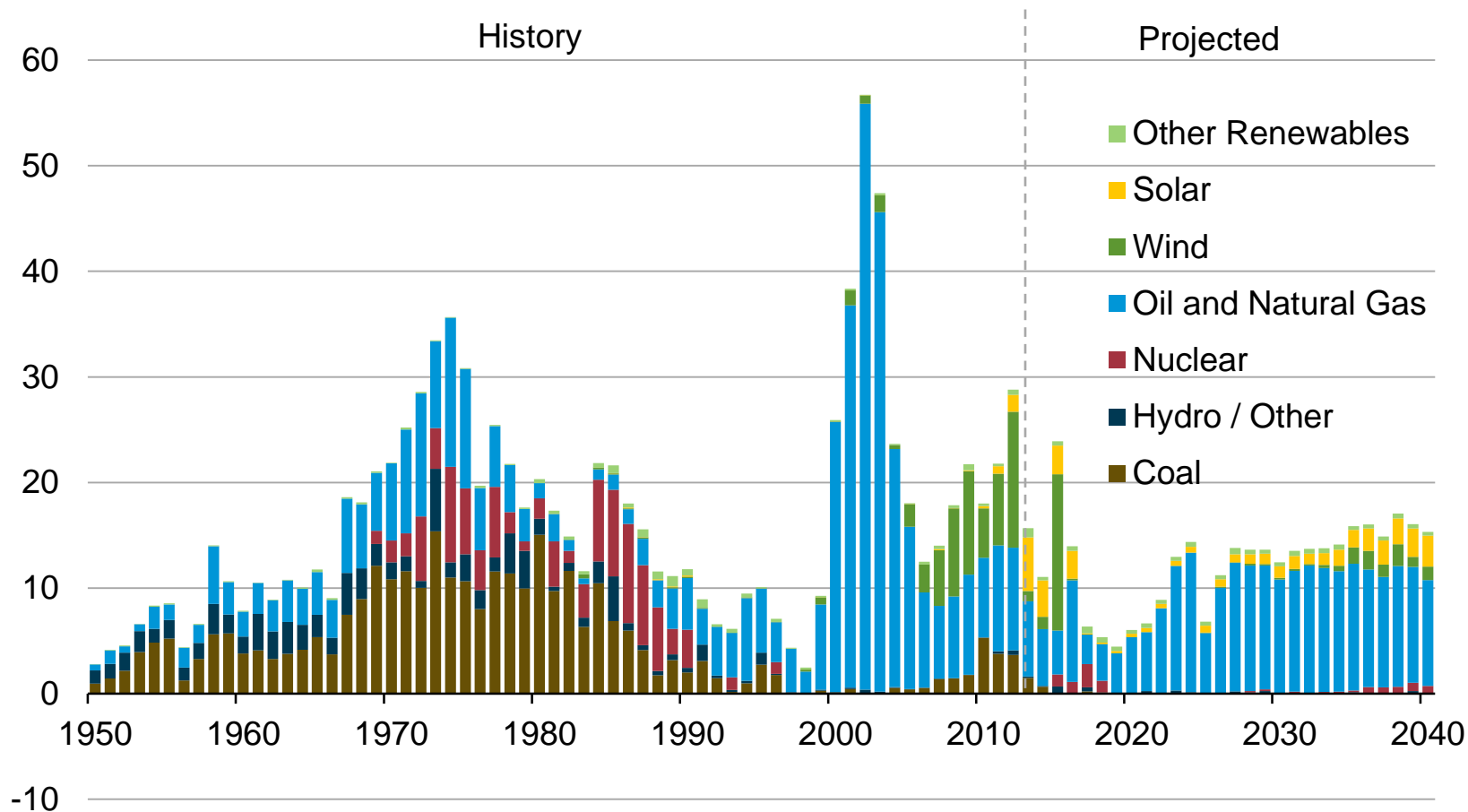
Changing electricity generation mix in Reference case and carbon dioxide fee allowance side cases



Source: EIA, Annual Energy Outlook 2014

Gas-fueled units account for most projected capacity additions in the AEO2014 Reference case

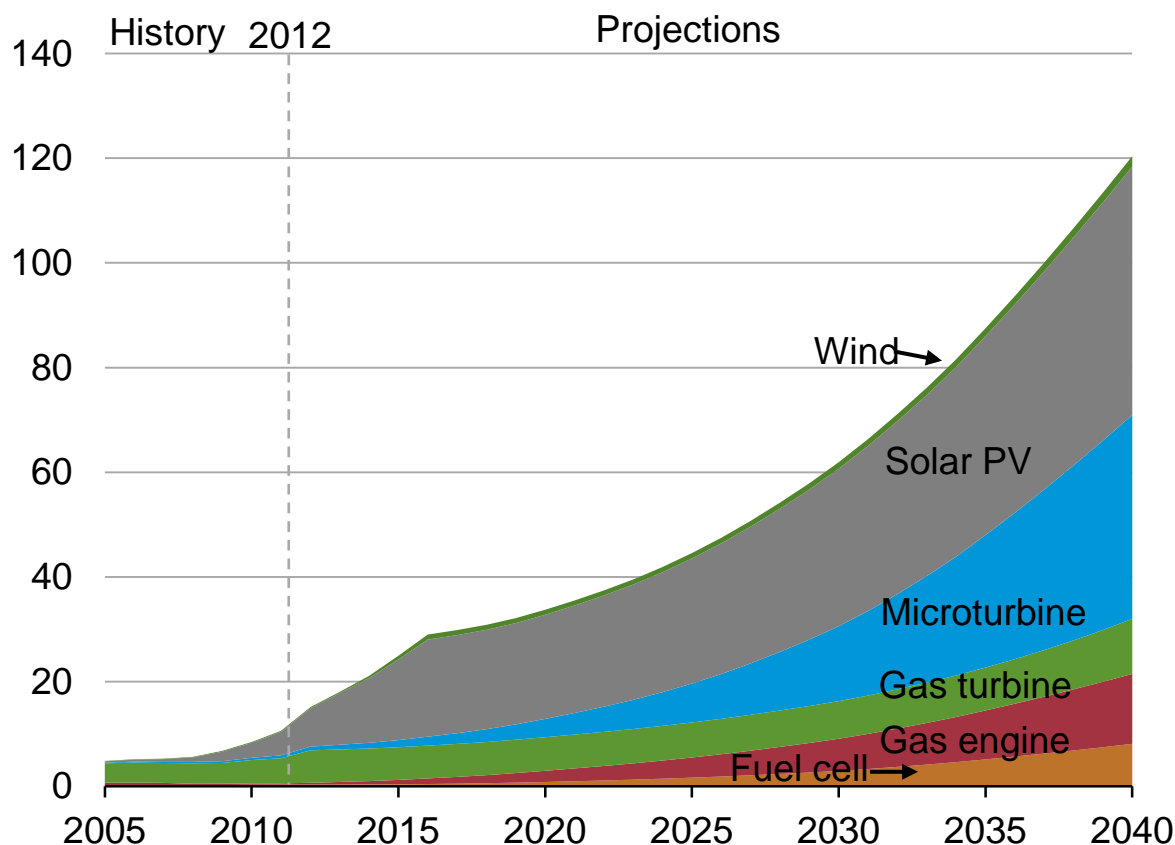
U.S. electricity generation capacity additions
gigawatts



Source: Form EIA-860 & EIA Annual Energy Outlook 2014

Growth in buildings sector distributed generation contributes to the shift toward natural gas and renewable generation

electricity net generation
billion kilowatthours per year



- Growth in PV generation expected to slow when the federal investment tax credit expires at the end of 2016
- Buildings sector natural gas distributed generation technologies are modeled as CHP systems
- Buildings PV averages 6.9% growth per year 2012-2040
- Natural gas-fired CHP generation experiences 8.3% growth per year bolstered by commercial sector use of microturbines

Source: EIA, Annual Energy Outlook 2014