Renewable Generation Technologies: Costs and Market Outlook

for

Harvard Electricity Policy Group

June 3, 2016 | Cambridge, MA

by

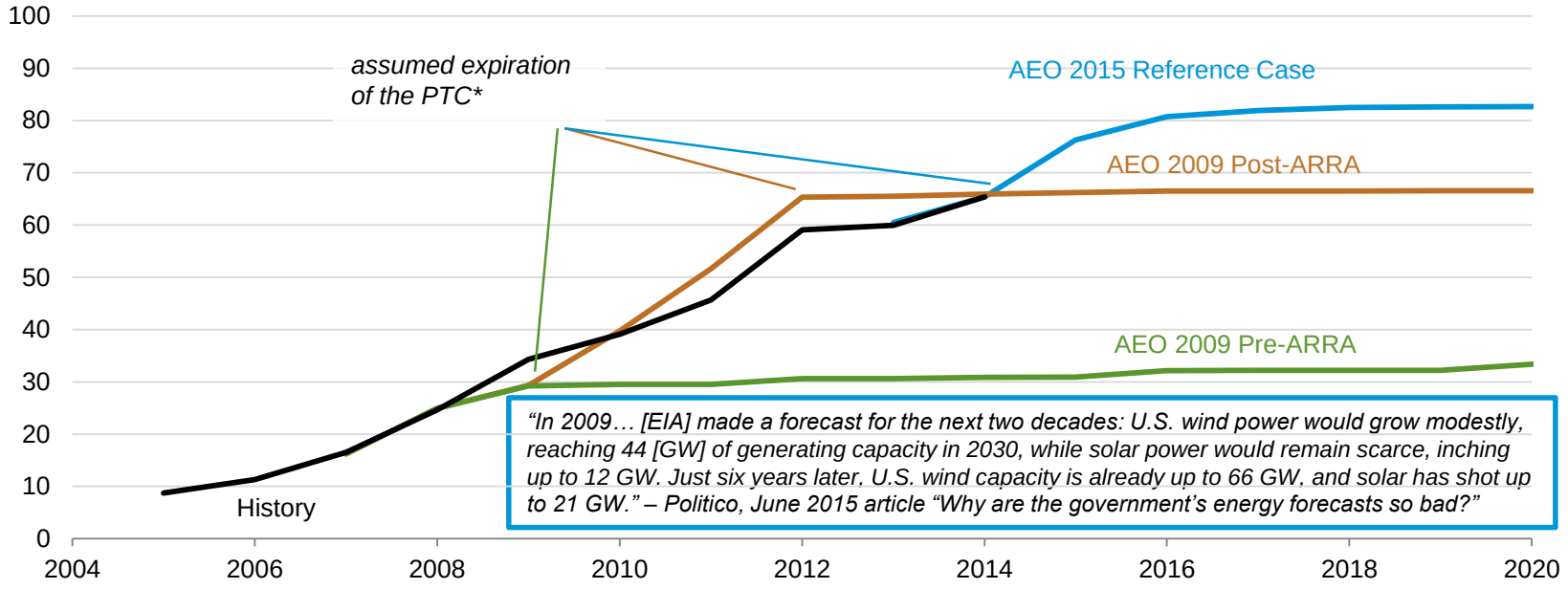
Howard Gruenspecht, Deputy Administrator

Key takeaways

- EIA has a great interest in both data and analysis issues surrounding renewable electricity generation and has recently extended its work in these areas
- Policies at both the state and federal levels have been the main drivers of growth in non-hydro renewable capacity and generation since 2009
- Looking forward, support from recently extended tax credits as well as reductions in renewable technology costs (especially solar) are important to the growth of renewable generation through the early 2020s; the Clean Power Plan is an important driver beyond the early 2020s.
- Slow/no electricity load growth and low natural gas prices are factors that tend to limit the opportunity for cost-effective renewable generation growth, although low natural gas prices may create “headroom” for regulators to choose renewables even when they engender higher costs
- The levelized cost of electricity (LCOE) is not a good metric for choosing generation technologies to minimize system cost; avoided cost is a more useful concept

When the PTC assumption is properly aligned with realized policy, EIA's wind projections have proven to be reasonably accurate

Total wind capacity projections in various Reference cases
gigawatts (GW)

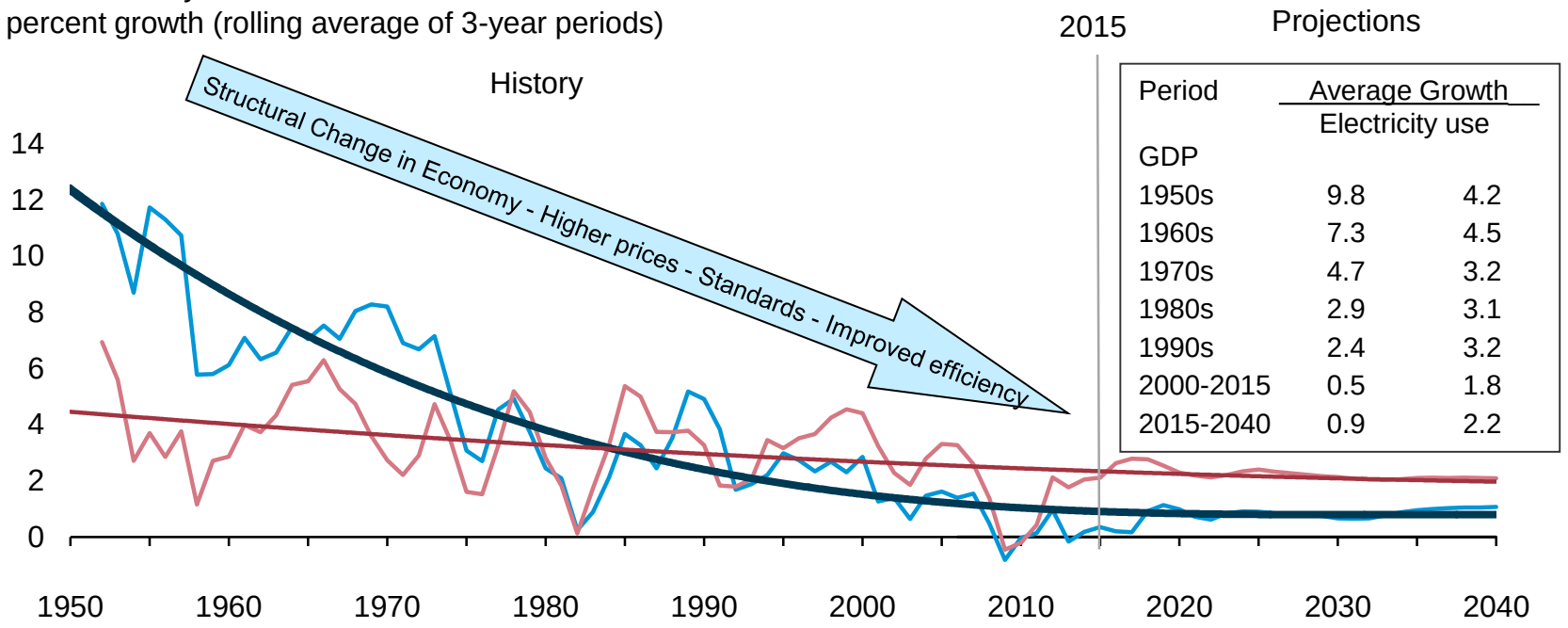


Source: EIA, Form EIA-860, AEO 2009 [Pre- and Post-American Recovery and Reinvestment Act (ARRA)], and AEO 2015

Note: In 2013 the American Tax Payer Relief Act changed the Production Tax Credit (PTC) expiration from a placed-in-service deadline to a construction start date deadline for all qualifying technologies

Electricity use (including direct use) is expected to continue to grow, but the rate of growth slows over time as it has almost continuously over the past 60 years

U.S. electricity use and GDP
percent growth (rolling average of 3-year periods)

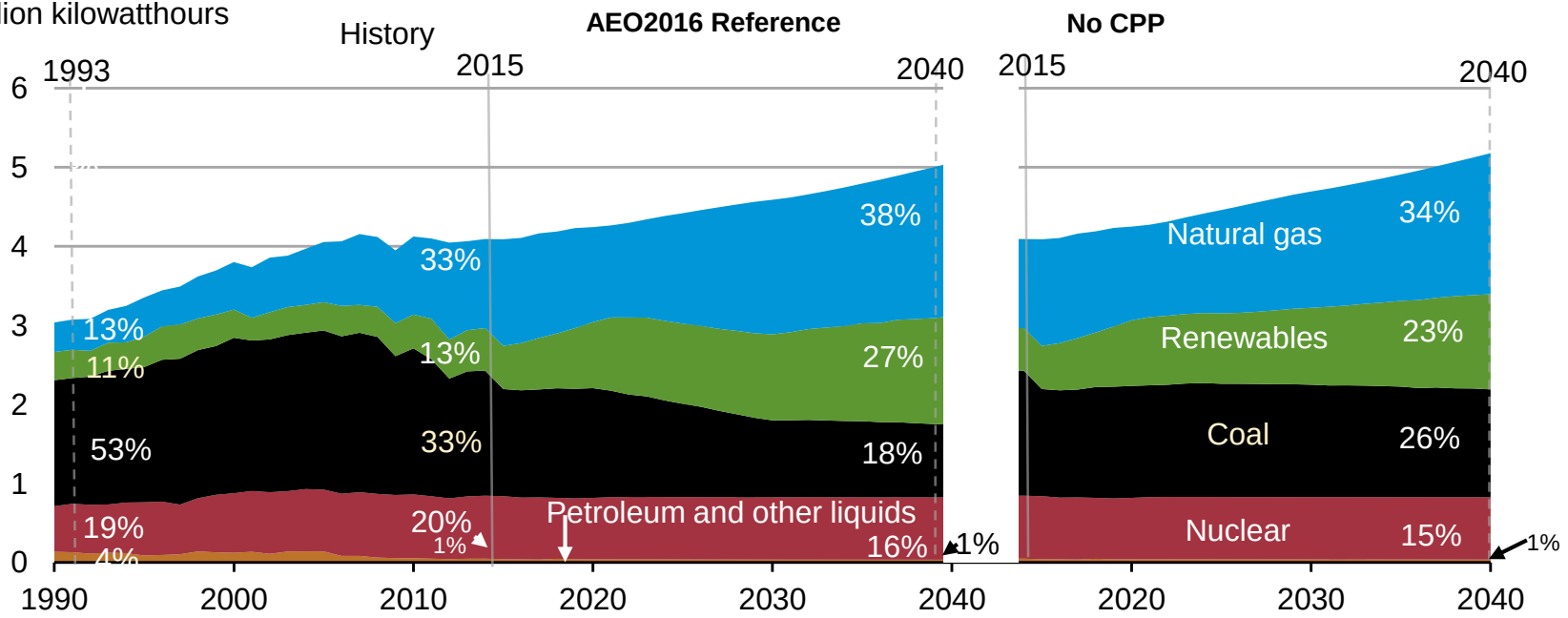


Period	Average Growth	
	Electricity use	GDP
1950s	9.8	4.2
1960s	7.3	4.5
1970s	4.7	3.2
1980s	2.9	3.1
1990s	2.4	3.2
2000-2015	0.5	1.8
2015-2040	0.9	2.2

Clean Power Plan accelerates shift to lower-carbon options for generation, led by growth in renewables and gas-fired generation; results are likely sensitive to CPP implementation approach

electricity net generation

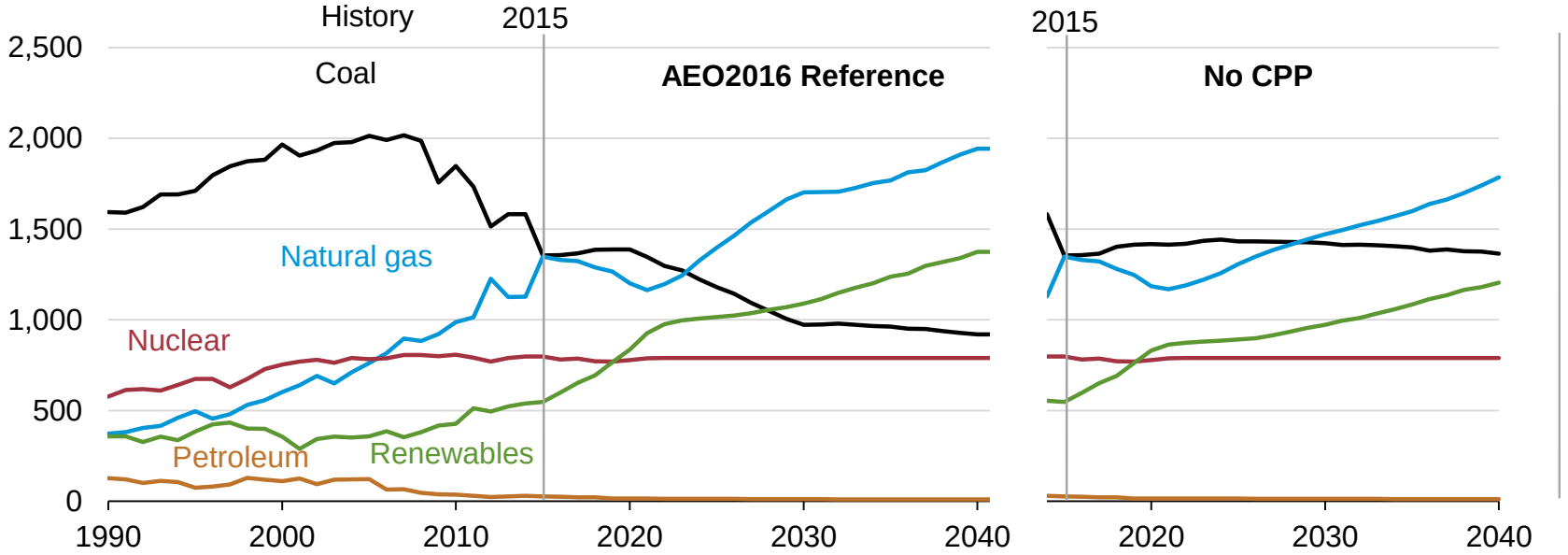
trillion kilowatthours



Source: EIA, Annual Energy Outlook 2016

Natural gas generation falls through 2021; both gas and renewable generation surpass coal by 2030 in the Reference case, but only natural gas does so in the No CPP case

net electricity generation
billion kilowatthours

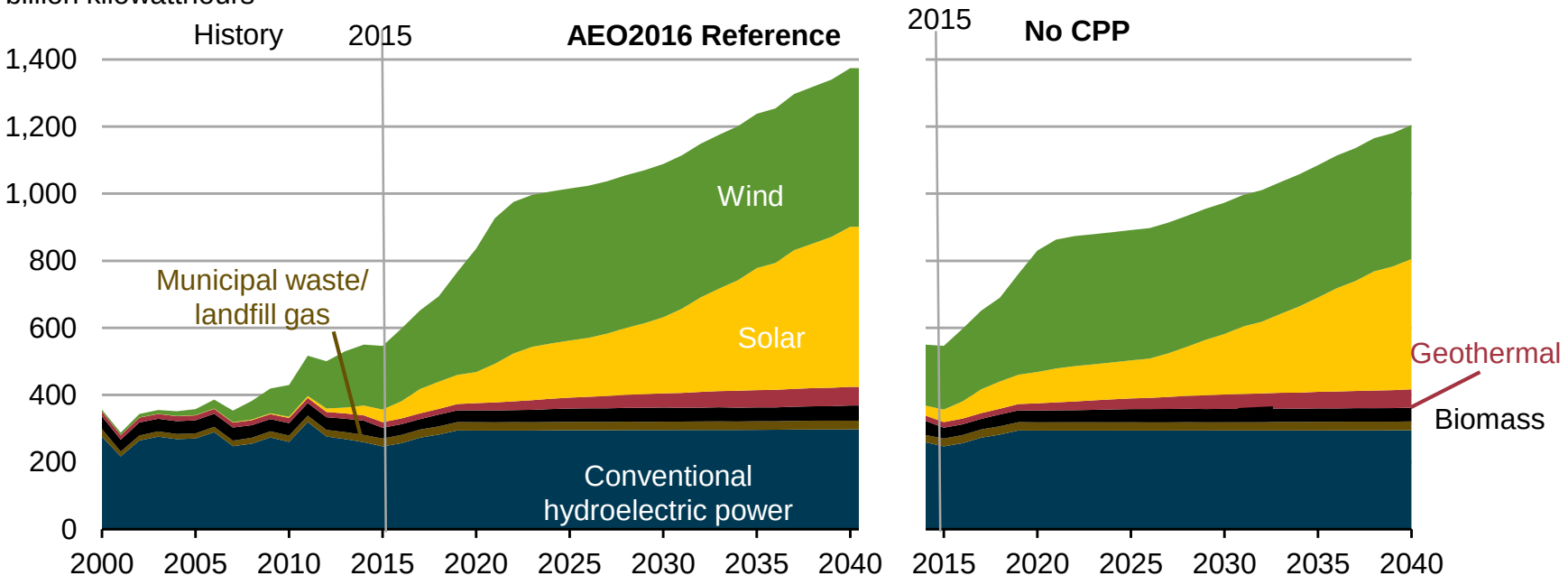


Source: EIA, Annual Energy Outlook 2016

Changing tax and cost assumptions contribute to stronger solar growth, with the Clean Power Plan providing a boost to renewables

renewable electricity generation by fuel type

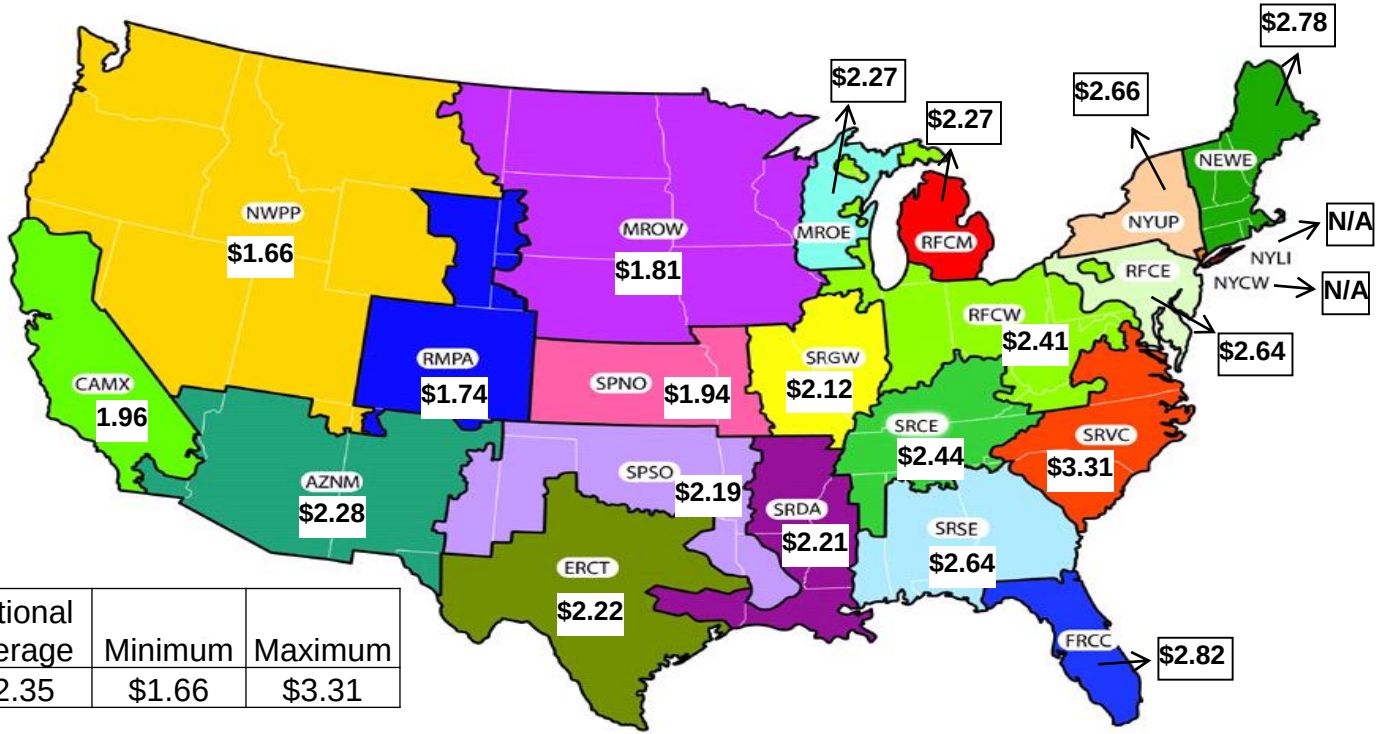
billion kilowatthours



Source: EIA, Annual Energy Outlook 2016

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

2014 delivered coal prices, nominal $ per million Btu

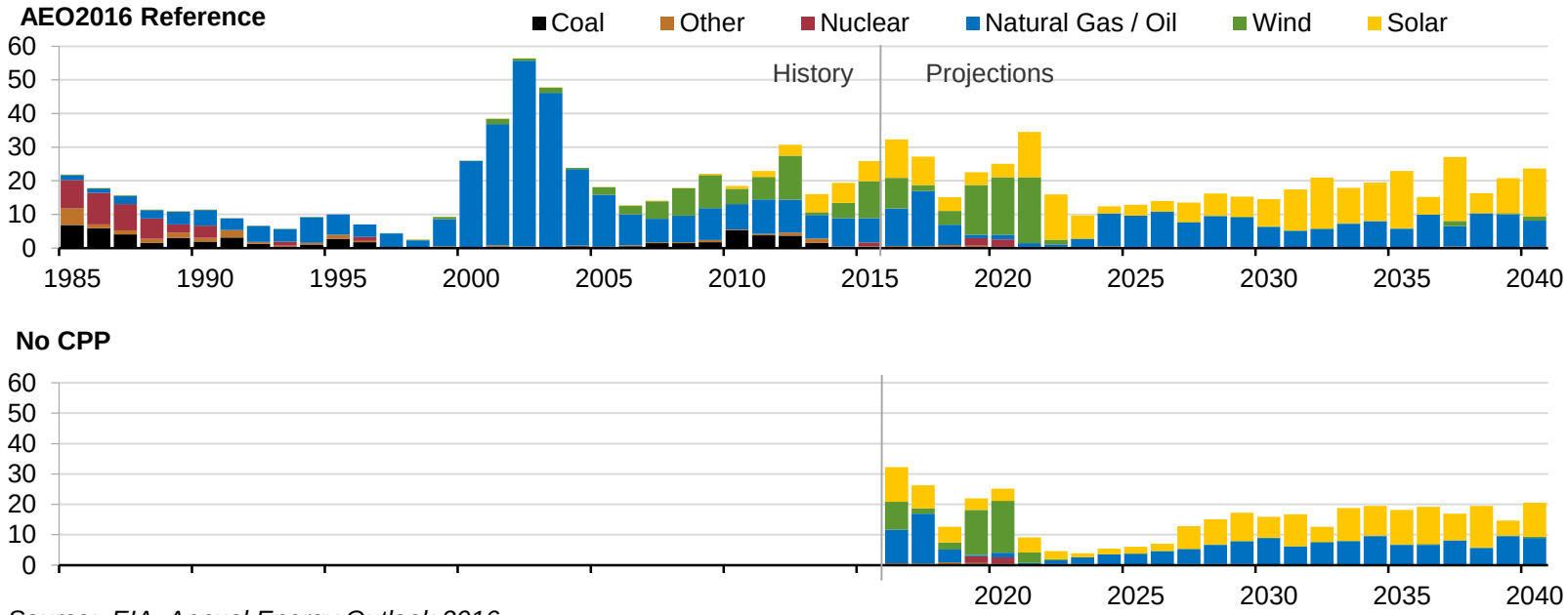


National Average	Minimum	Maximum
$2.35	$1.66	$3.31

Source: EIA, Annual Energy Outlook 2016

Lower costs and extension of renewable tax credits boost projected additions of wind and solar capacity prior to the 2022 effective date of the Clean Power Plan (CPP)

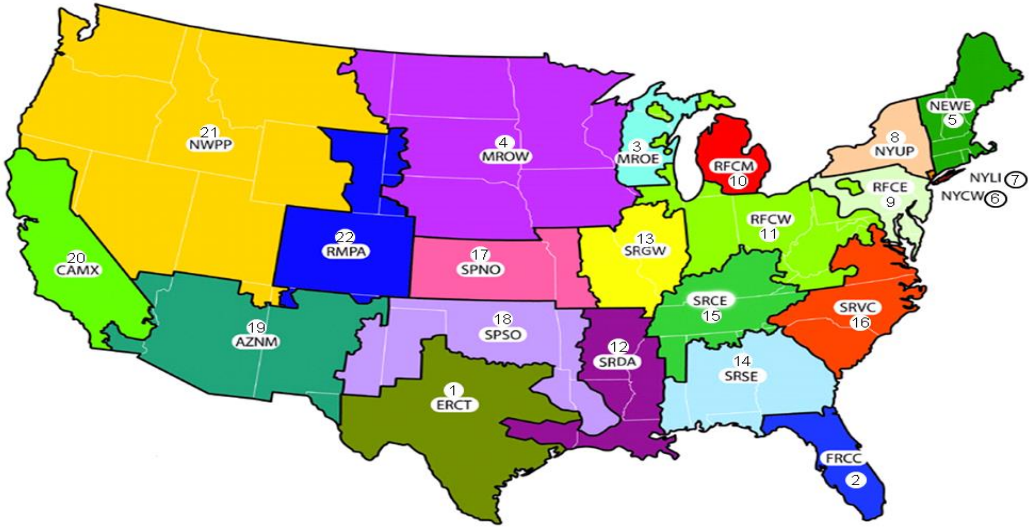
annual capacity additions
gigawatts



Source: EIA, Annual Energy Outlook 2016

New wind costs yield a capacity-weighted average of approximately $1770/kW (in 2015$), when compared to 2014 capacity additions

LBNL reports $1743/kW capacity-weighted average for 2014 (2015$, reported as $1710/KW in 2014$)



	Region																					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Net Cost (2015$/KW)	1,654	2,444	2,256	1,861	2,301	2,301	2,301	2,301	2,301	2,256	2,256	2,444	2,256	2,444	2,444	2,444	1,555	1,555	2,021	2,021	2,021	1,555
2014 New Cap. (MW)	577	0	0	1,259	0	0	0	37	0	317	240	0	0	0	0	0	0	1,781	0	331	20	235

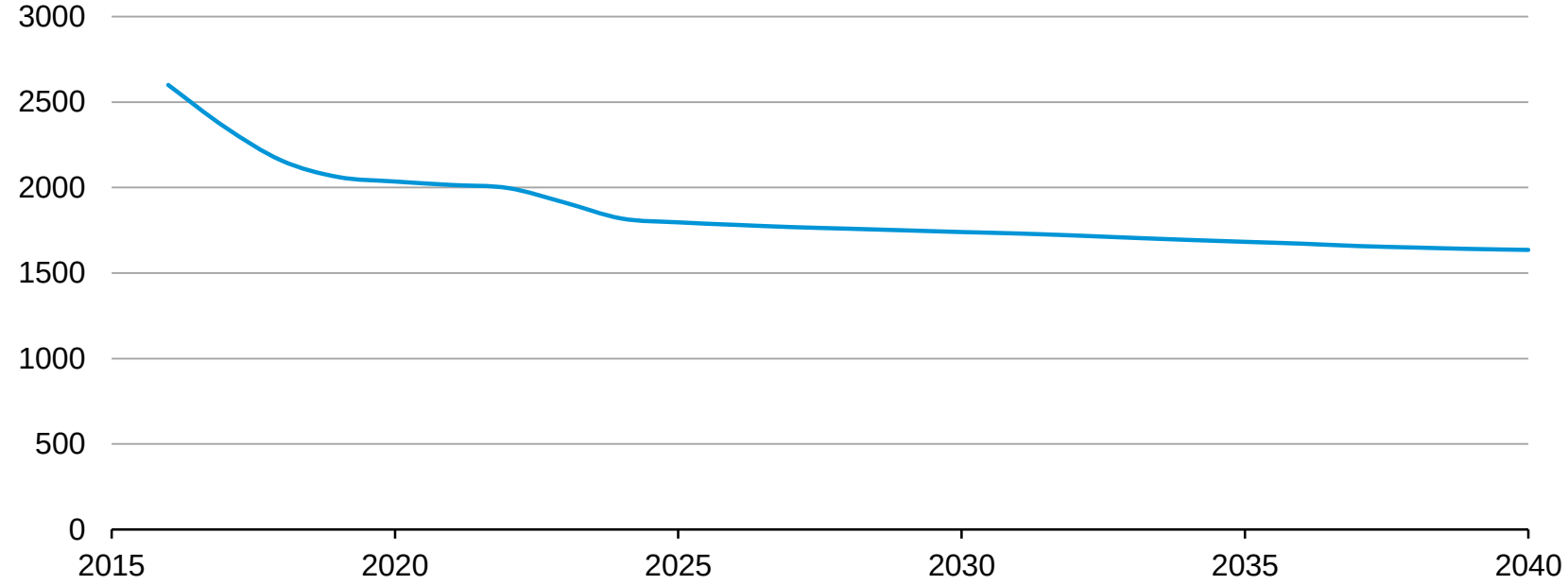
Initial lower solar costs results in increased PV uptake, faster and deeper cost reductions over time

By 2020, costs drop by over 20% with new assumptions

For 2014, LBNL reports $3,800/kW capacity-weighted average (all tech), with $2,800/kW median for fixed-tilt c-Si

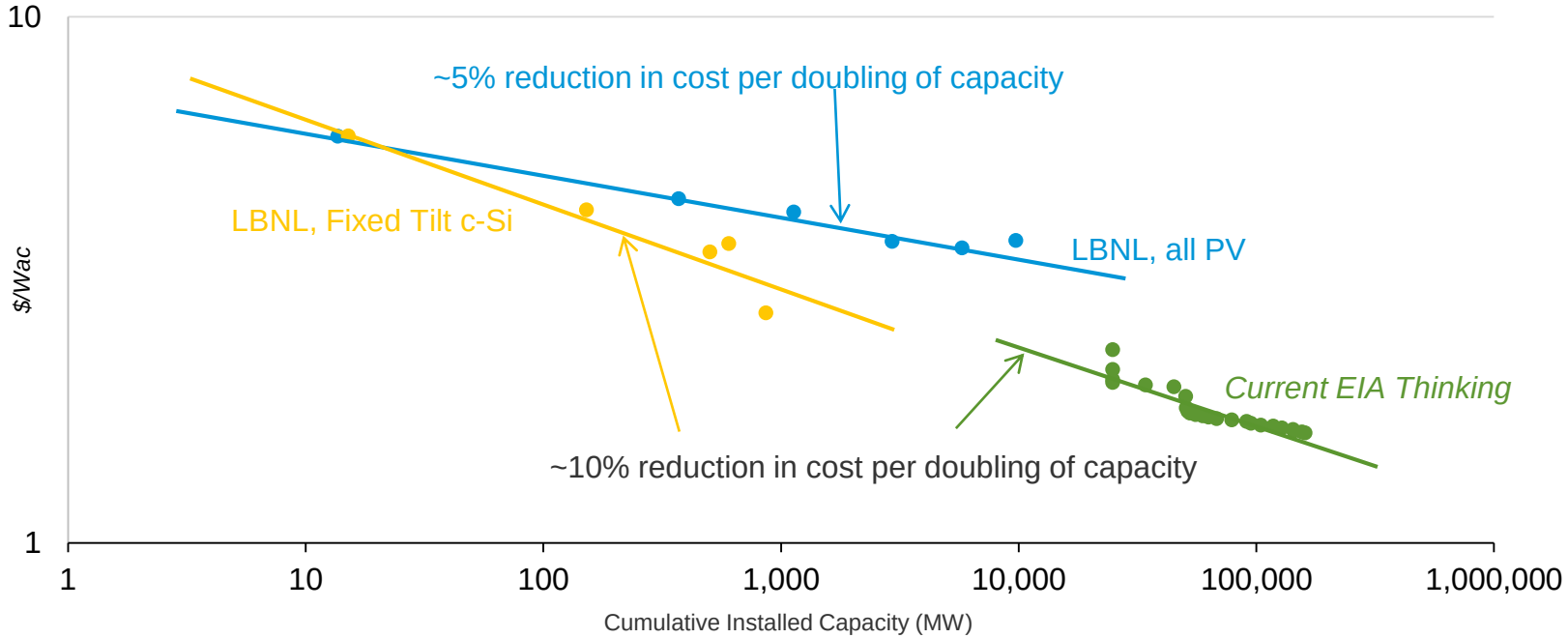
PV cost trajectory

2015$/kWAC



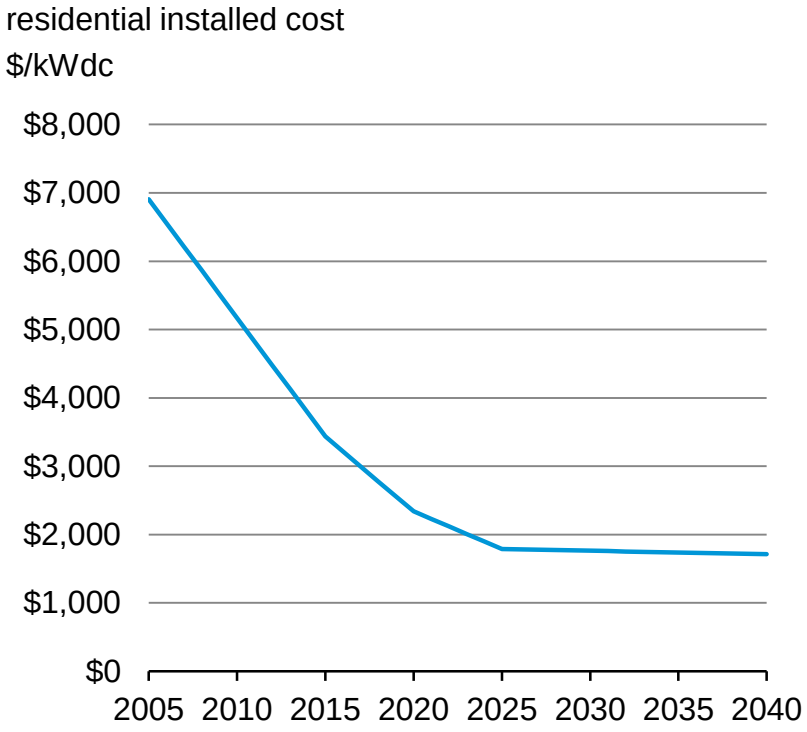
Source: EIA, Annual Energy Outlook 2016

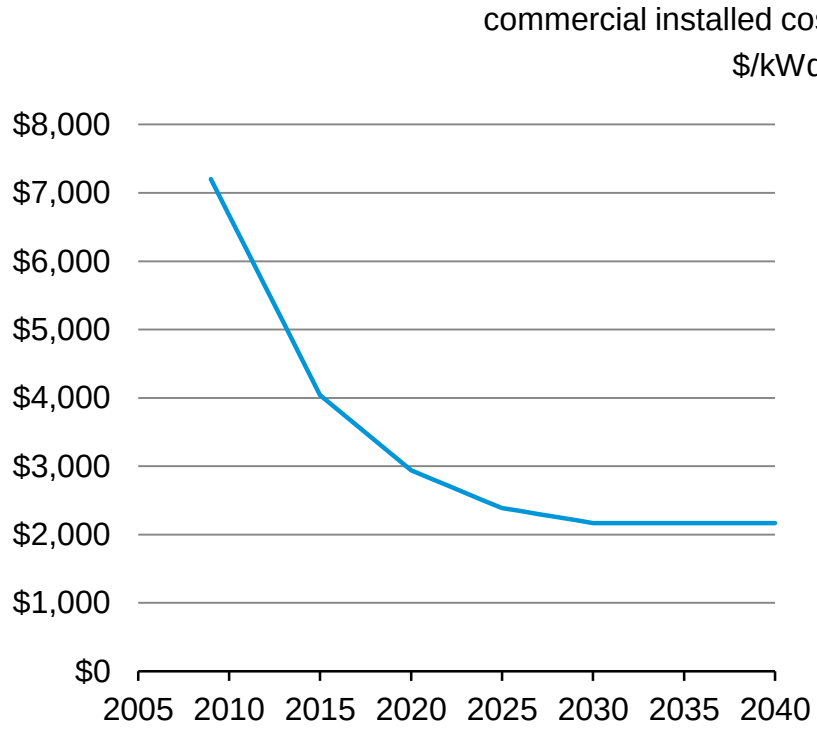
EIA PV learning using updated initial costs is more optimistic than fleet average, but similar to the more limited data from fixed tilt systems



Note: Current EIA thinking shows gross cost reduction from learning and macro cost adjustments, which are implicitly embedded in reported costs from LBNL and other public sources

Updated residential and commercial installed solar PV cost projections





Source: EIA, Annual Energy Outlook 2016

For more information

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

Electric Power Monthly | www.eia.gov/electricity/monthly

Annual Energy Outlook | www.eia.gov/aeo

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

Today in Energy | www.eia.gov/todayinenergy

Monthly Energy Review | www.eia.gov/mer

State Energy Profiles | www.eia.gov/state