
PEAK ELECTRICITY AND THE CLEAN POWER PLAN



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Peak Electricity and the Clean Power Plan

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U.S. CO2 EMISSIONS FROM FOSSIL FUELS (MMTCO₂)

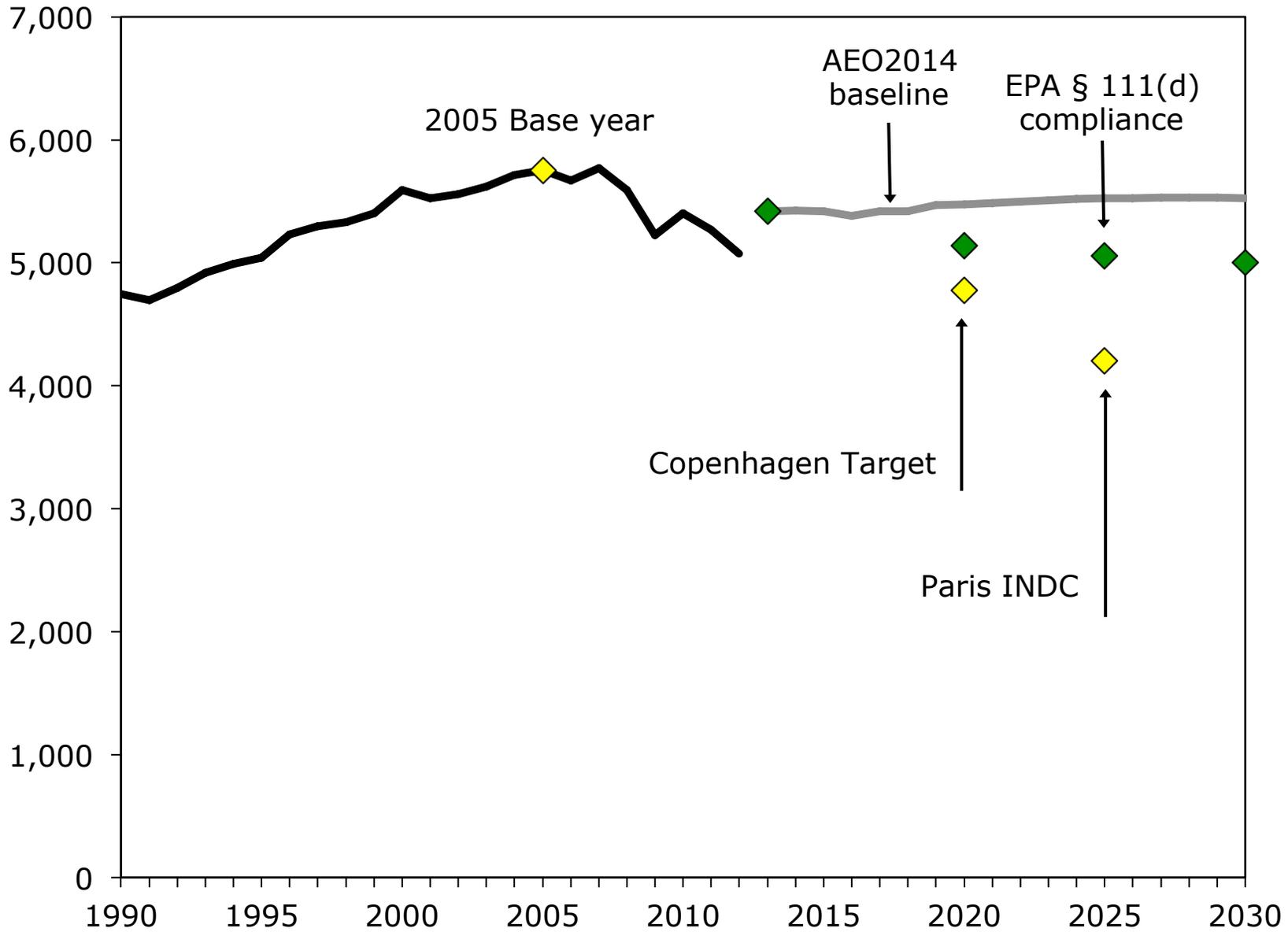
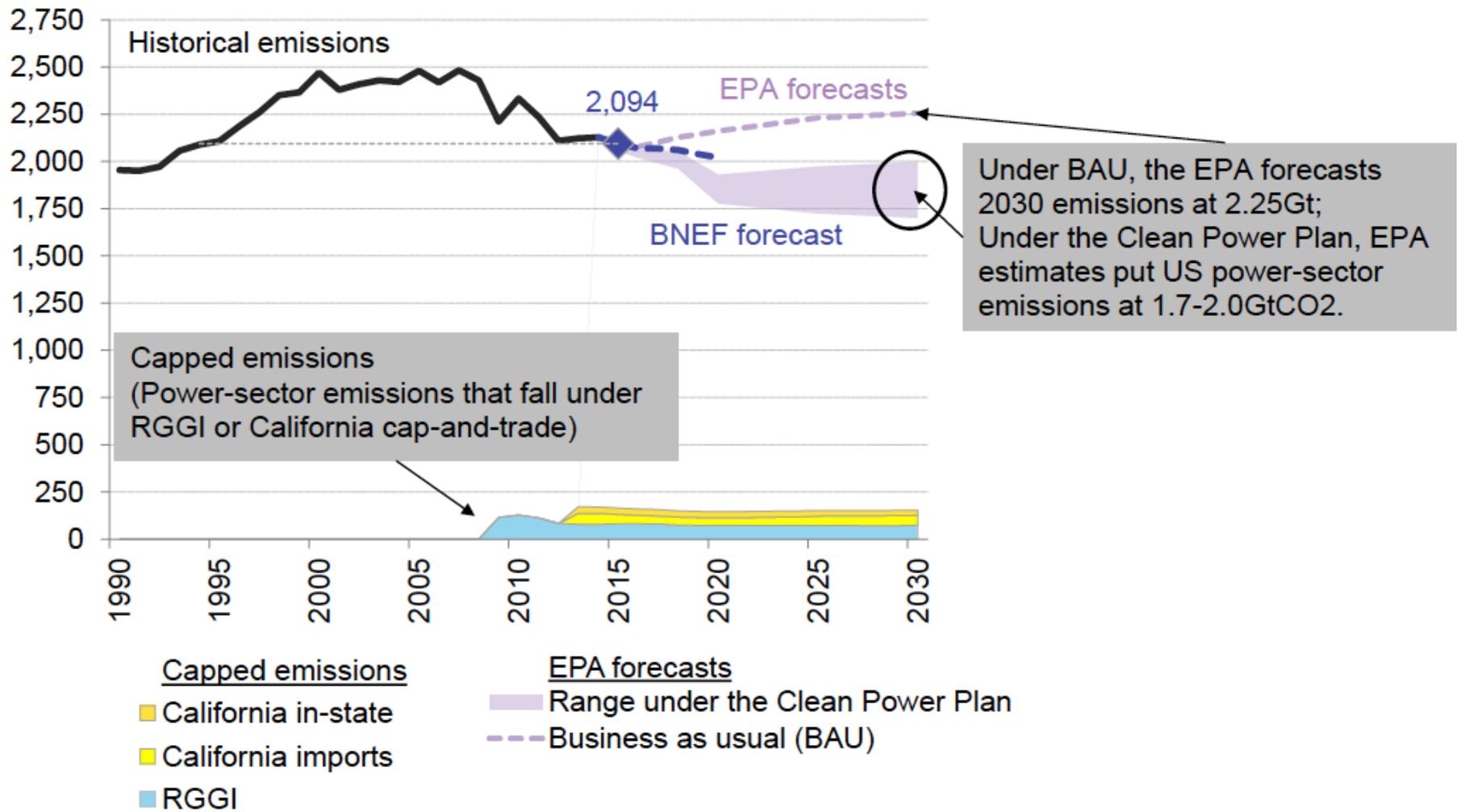


Figure 12: US power-sector emissions under various forecasts (MtCO₂)



Source: BNEF White Paper (April 2015)

AGENDA

- **Legal context**
- EPA's approach to 111(d)
- The art and science of energy modeling

REGULATING GHGs UNDER THE CLEAN AIR ACT

2007 *Massachusetts v. EPA*

Supreme Court: CO₂ is an “air pollutant” under CAA

2009 **EPA’s Endangerment Finding**

Regulation of mobile sources begins ... CAFE stds w/ US DOT

2010 **EPA’s Tailoring Rule**

Regulation of stationary sources under PSD Program

2012 *Coalition for Responsible Regulation v. EPA*

D.C. Circuit: PSD program okay; decision appealed

2013 **EPA proposes 111(b) regulations**

2014 **EPA proposes 111(d) regulations**

2014 *Utility Air Regulatory Group v. EPA*

Supreme Court: EPA cannot require PSD for GHGs only

ALPHABET SOUP FOR STATIONARY SOURCES: EPA's REGULATIONS PRIOR TO 111(d)

Prevention of Significant Deterioration (PSD) program:

- Requires Best Available Control Technology (BACT) for new or modified “major” sources.
- State environmental agencies determine BACT for six “criteria air pollutants” (SO₂, PM, NO_x, CO, O₃, Pb) for which EPA developed a National Ambient Air Quality Standard (NAAQS) (units: ppm).
- EPA moved to include GHGs in PSD program, but did not set a NAAQS for GHGs.

ALPHABET SOUP FOR STATIONARY SOURCES: EPA's REGULATIONS PRIOR TO 111(d)

Utility Air Regulatory Group v. EPA (2014):

- Clean Air Act requires regulation of sources with more than 100/250 tpy, which would trigger permitting for a huge number of sources—including medium commercial buildings.
- EPA issued a “tailoring rule” that pushed threshold to 75,000/100,000 mtCO₂/yr for PSD program (excludes 14% of stationary CO₂)
- Supreme Court: EPA cannot apply PSD for GHGs unless PSD would be required for any other criteria air pollutant (“anyway” sources, 83% of stationary CO₂).

PSD PROGRAM: PRACTICAL EFFECTS

- Only 3% of emissions excluded from EPA's preferred authority. (14% excluded via Tailoring Rule, 83% covered under PSD)
- PSD permits are required for most new and modified “major” sources of GHGs, but BACT determination is made by states.
- EPA has limited discretion to review state BACT determination (*see ADEC v. EPA*); early experience with PSD suggests minimal changes due to permitting requirements.
- However, BACT must be at least as strong as any New Source Performance Standard EPA issues under Section 111(b) of the Clean Air Act ... (42 U.S.C. § 7479(3))

CLEAR AIR ACT § 111(d)

(d) Standards of performance for existing sources; remaining useful life of source

(1) ... each State shall submit to the Administrator a plan which

(A) establishes **standards of performance** for any existing source for any air pollutant

(i) for which air quality criteria have not been issued [NAAQS] ...

(ii) to which a standard of performance under this section would apply if such existing source were a new source [§ 111(b)], and

(B) provides for the implementation and enforcement of such standards of performance. Regulations ... shall permit the State ... to take into consideration, among other factors, the **remaining useful life of the existing source** to which such standard applies.

—42 U.S.C. § 7411(d)

CLEAR AIR ACT § 111(a)

(a) Definitions

For purposes of this section:

- (1) The term “**standard of performance**” means a standard for emissions of air pollutants which reflects the degree of emission limitation achievable through the application of the **best system of emission reduction** which (taking into account the cost of achieving such reduction and any nonair quality health and environmental impact and energy requirements) the Administrator determines has been adequately demonstrated.

—42 U.S.C. § 7411(a)

IN ENGLISH

BSER = best system of emission reduction

- Must be “adequately demonstrated”;
- EPA must determine the BSER with respect to the costs and benefits (*c.f.* NAAQS);
- As a result, the proposed rule explains (1) what is in the BSER, (2) how those features are adequately demonstrated, and (3) some justification of the costs and benefits.

AGENDA

- Legal context
- **EPA's approach to 111(d)**
- The art and science of energy modeling

CLEAR AIR ACT § 111 — AS PROPOSED FOR ELECTRIC GENERATING UNITS (EGUs)

Section 111(b) (a.k.a “New Source Performance Standards”)

- Applies to all new facilities
- No more than 1,100 lbs CO₂/MWh
- No new conventional coal; natural gas CC, CCS okay

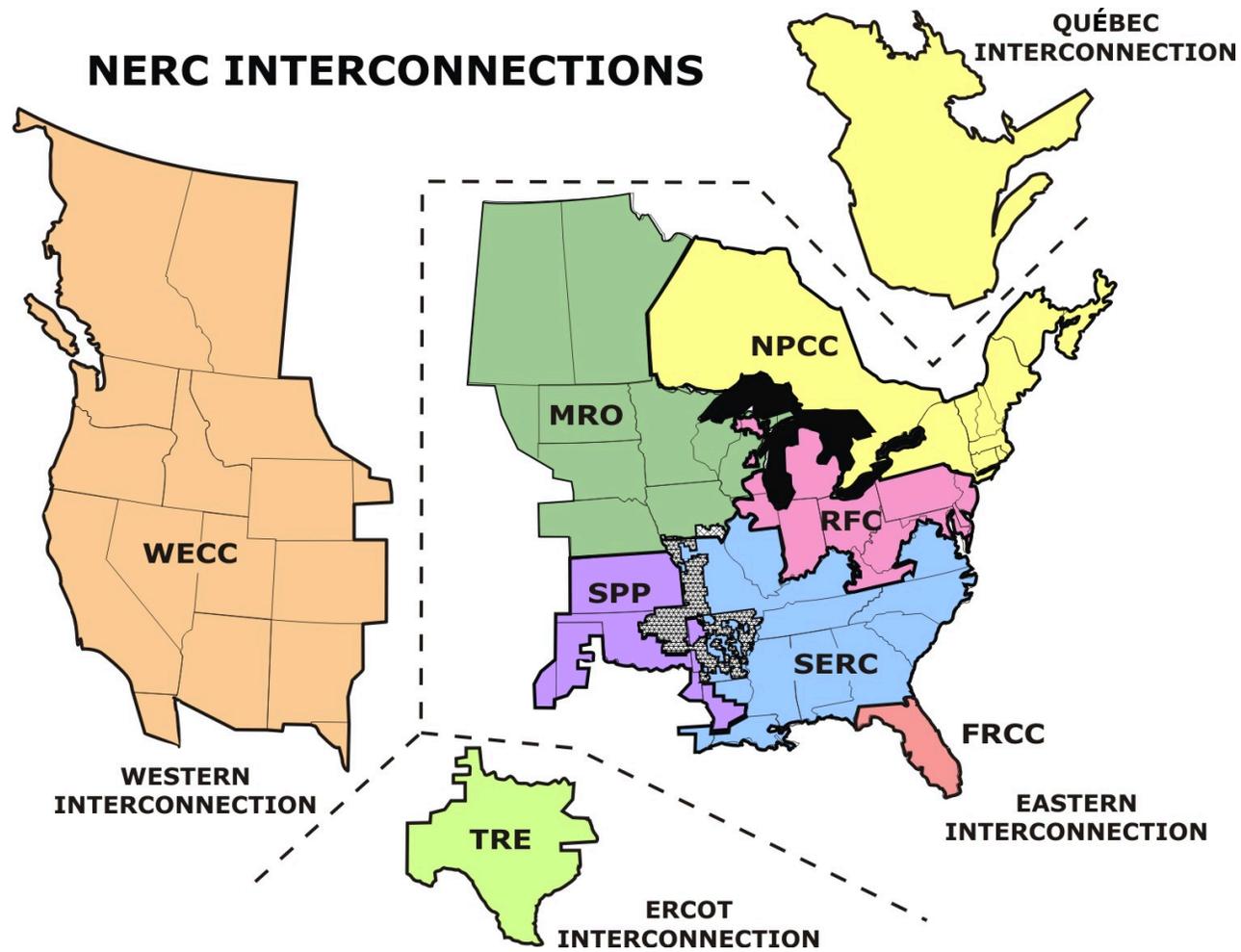
Section 111(d) (a.k.a. “Clean Power Plan”)

- Applies to existing facilities (production, not consumption)
- Rate- (lbs CO₂/MWh) or mass- (lbs CO₂) based options
- States can choose mass-based standards that apply either to existing sources only, or to both new and existing sources.

111(d) IN A NUTSHELL

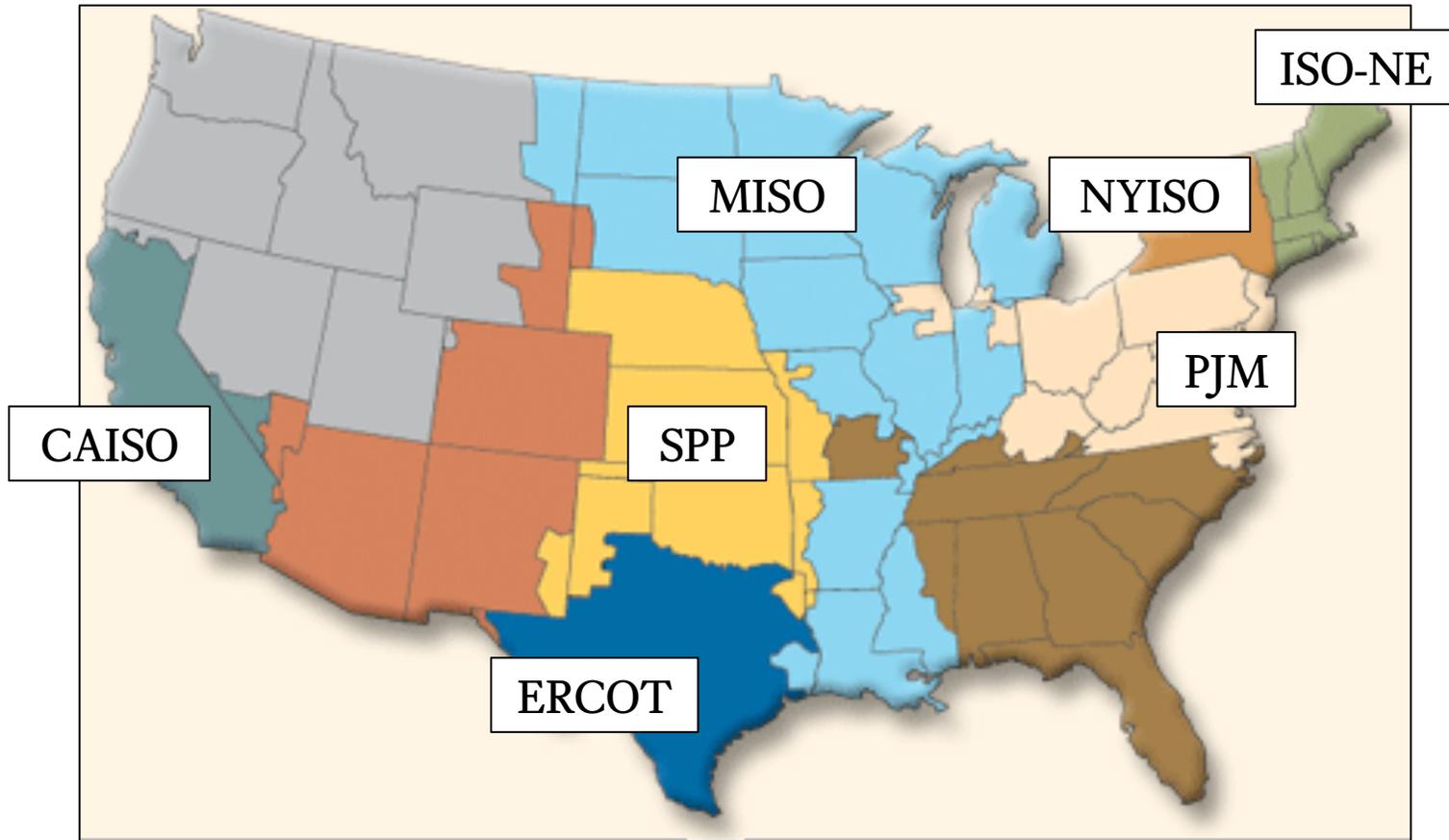
- EPA calculates targets by applying a consistent BSER methodology to each state.
- States choose:
 - State vs. regional compliance;
 - Rate- vs. mass-based standards;
 - Their preferred mixture of policies and measures, so long as states can show EPA their approach will achieve the selected state or regional target. (States do not have to match EPA's building blocks.)

GRID INTERCONNECTIONS



Source: NERC

WHOELSALE ELECTRIC POWER MARKETS (RTOs/ISOs)



Source: FERC

THE 111(d) PROCESS

- June 2014: Draft rule released
74 Fed. Reg. 34830
- August 2015: Goal for final § 111 rule(s)
- June 2016: State plans due
1-2 year extensions permissible
- June 2018: Regional plans due
- **2020-29: Interim targets**
- **2030: Final year targets**

FOUR BUILDING BLOCKS IN THE BSER

“Inside the Fence”

Block 1:

- Boiler tune-ups: improve the thermodynamic efficiency at existing coal plants

Block 2:

- Switch from coal-fired power plants to existing natural gas combined cycle plants (NGCC)

“Outside the Fence”

Block 3:

- Increase renewable energy
- Don't retire nuclear

Block 4:

- Increase energy efficiency (*i.e.*, consume less)

FOUR BUILDING BLOCKS IN THE BSER: EFFORTS AND ESTIMATED COSTS (IPM)

“Inside the Fence”

Block 1:

- Boiler tune-ups: 6% improvement in heat rates (\$8/tCO₂).

Block 2:

- Re-dispatch: increase NGCC generation until NGCC fleet capacity factor hits 70%; decrease coal- and oil-fired boilers accordingly (\$30-33/tCO₂).

“Outside the Fence”

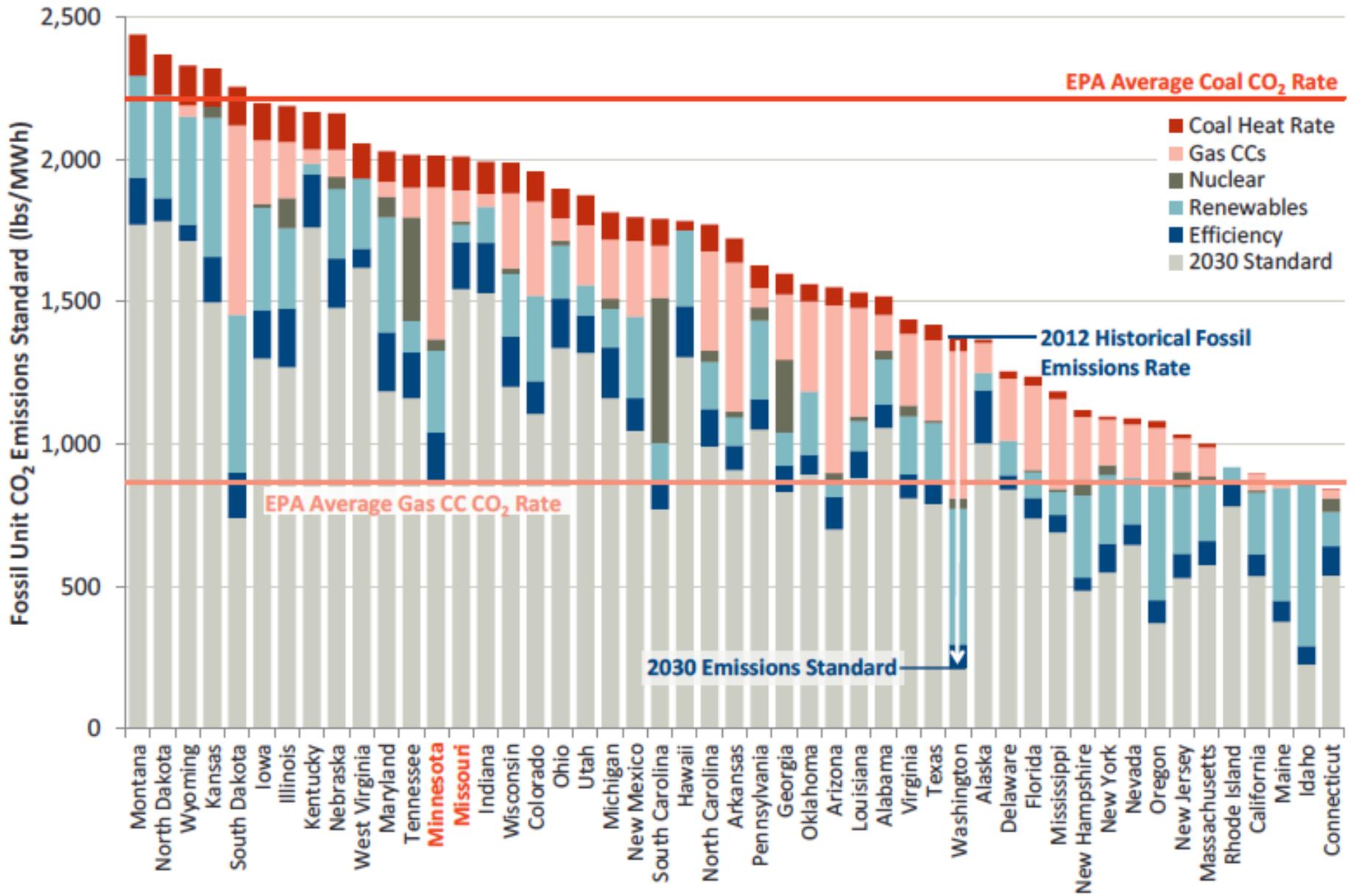
Block 3:

- Increase renewable energy (~13% total generation in 2030, \$10-40/tCO₂)
- Avoid 6 GW of at-risk nuclear retirement (\$12-17/tCO₂)

Block 4:

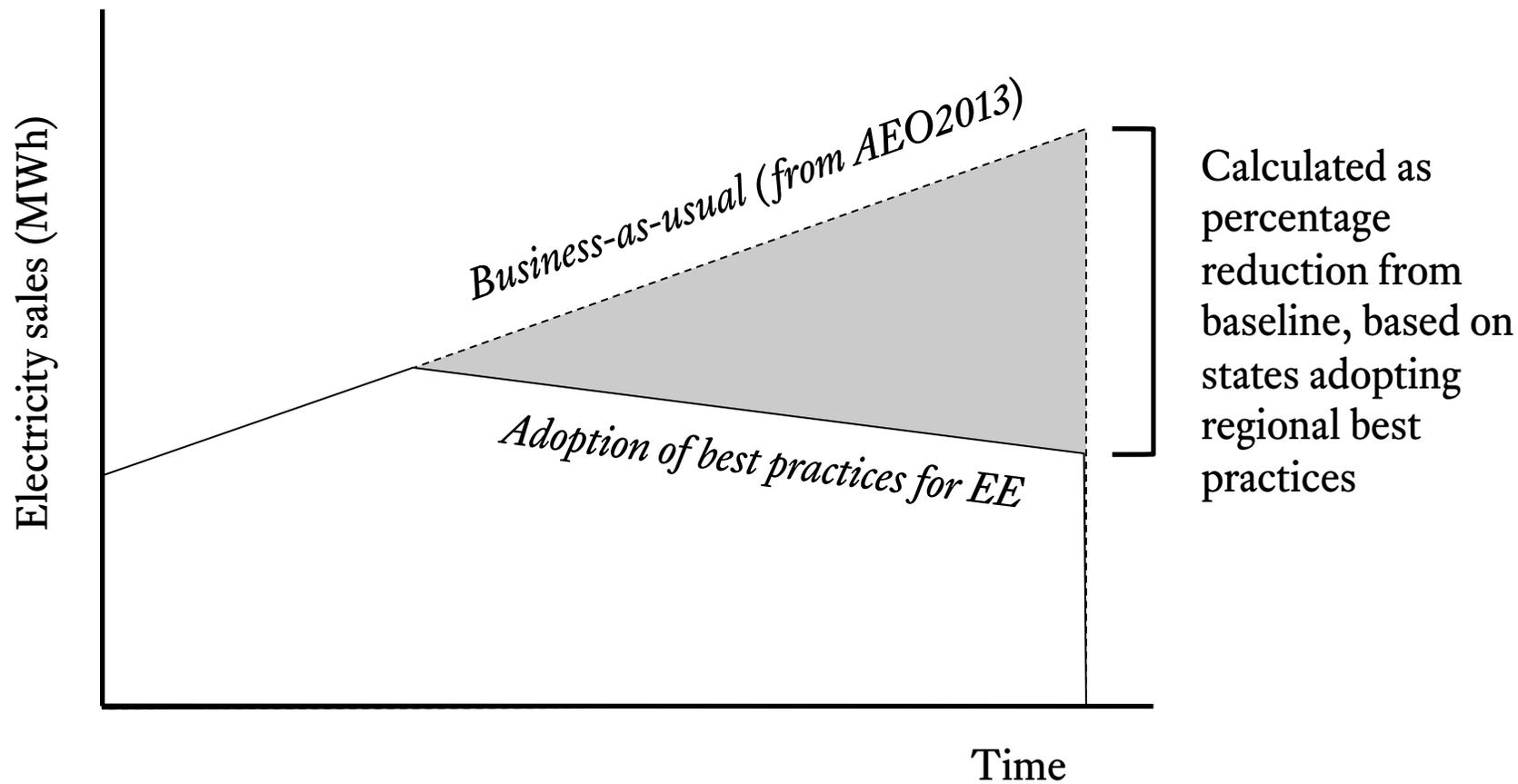
- Energy efficiency (10.7% cumulative savings by 2030, \$18-24/tCO₂)

Source: Michael Wara, *RFF Common Resources* (June 10, 2014)



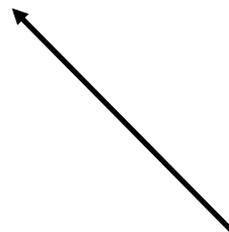
Source: Brattle Group

ENERGY EFFICIENCY IN THE BSER



NEW AND/OR EXISTING SOURCES?

	New sources	Existing sources
Rate-based target	B	D
Mass-based target (existing sources only)	B	D
Mass-based target (new and existing sources)	B and D	D



Matches structure of existing carbon markets (RGGI, California)

CALCULATING EMISSIONS RATE-BASED TARGETS (DEFAULT OPTION)

$$\frac{\text{Emissions from electricity generation (lbs CO}_2\text{)}}{(\text{Fossil gen.} + \text{Nuclear gen.} + \text{RE gen.} + \text{EE}) \text{ (MWh)}}$$

*Acceptable methods for
calculating EE TBD;
EM&V presumed ...*



CALCULATING EMISSIONS MASS-BASED, EXISTING SOURCES ONLY (*)

Mass equivalent generation level (MWh) =
Historical fossil generation (MWh) + new
renewables (MWh) (*) + avoided nuclear closure
(MWh) + avoided generation from EE (MWh) (*)

Equivalent mass-based target (CO₂) =
Mass equivalent generation level (MWh) *
Rate-based target (lbs CO₂/MWh)

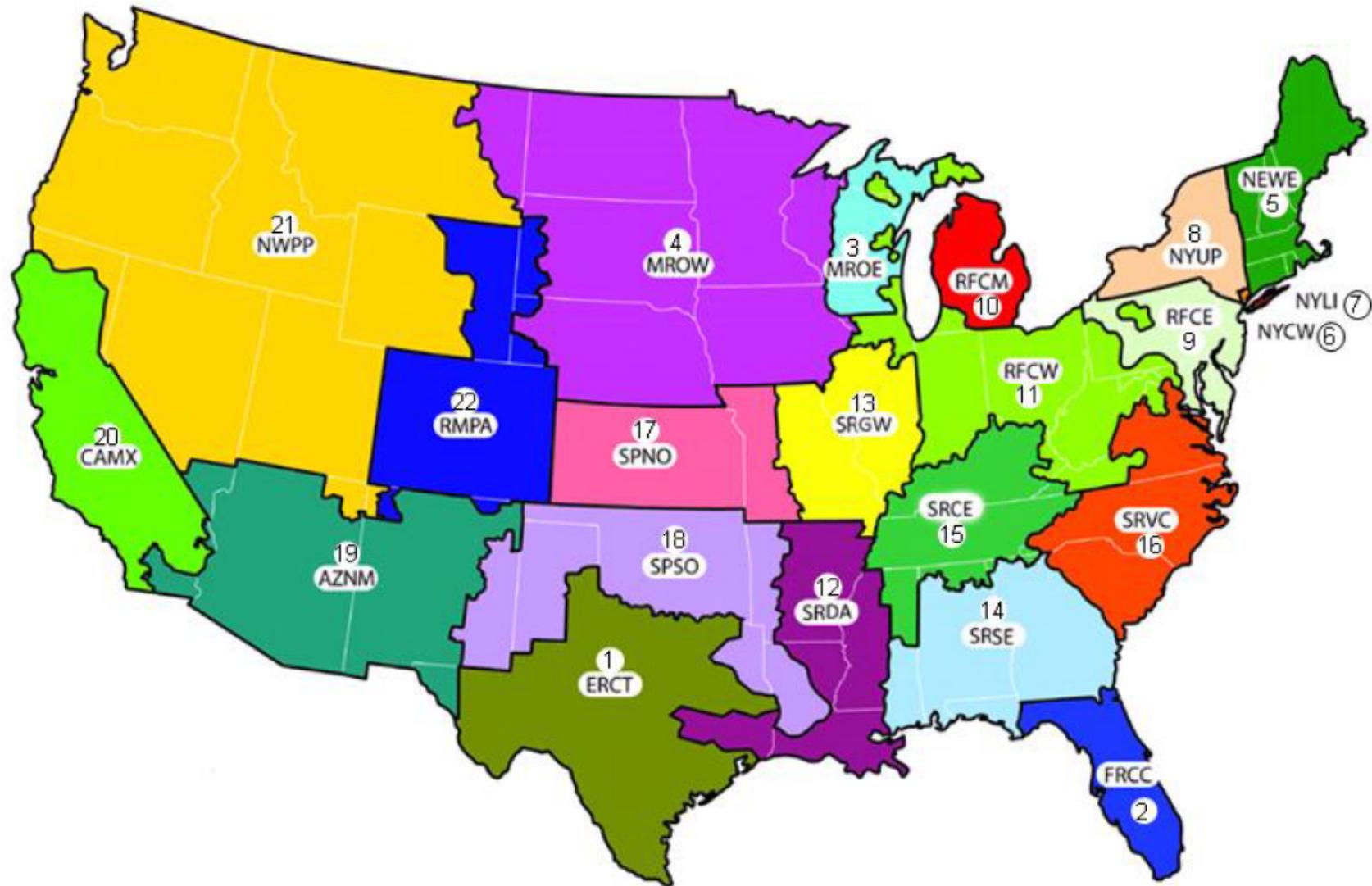
CALCULATING EMISSIONS MASS-BASED, NEW AND EXISTING SOURCES

Mass equivalent generation level (MWh) =
(Same sources as before) (MWh) + Incremental
Demand for New Generation (MWh)

Incremental Demand, year X =
2012 electricity sales (MWh) * $(1+Rate)^{X-2012}$

Rate = average growth rate from AEO2013 over
2012-2029, matched to EMM regions

Figure 3. Market model supply regions

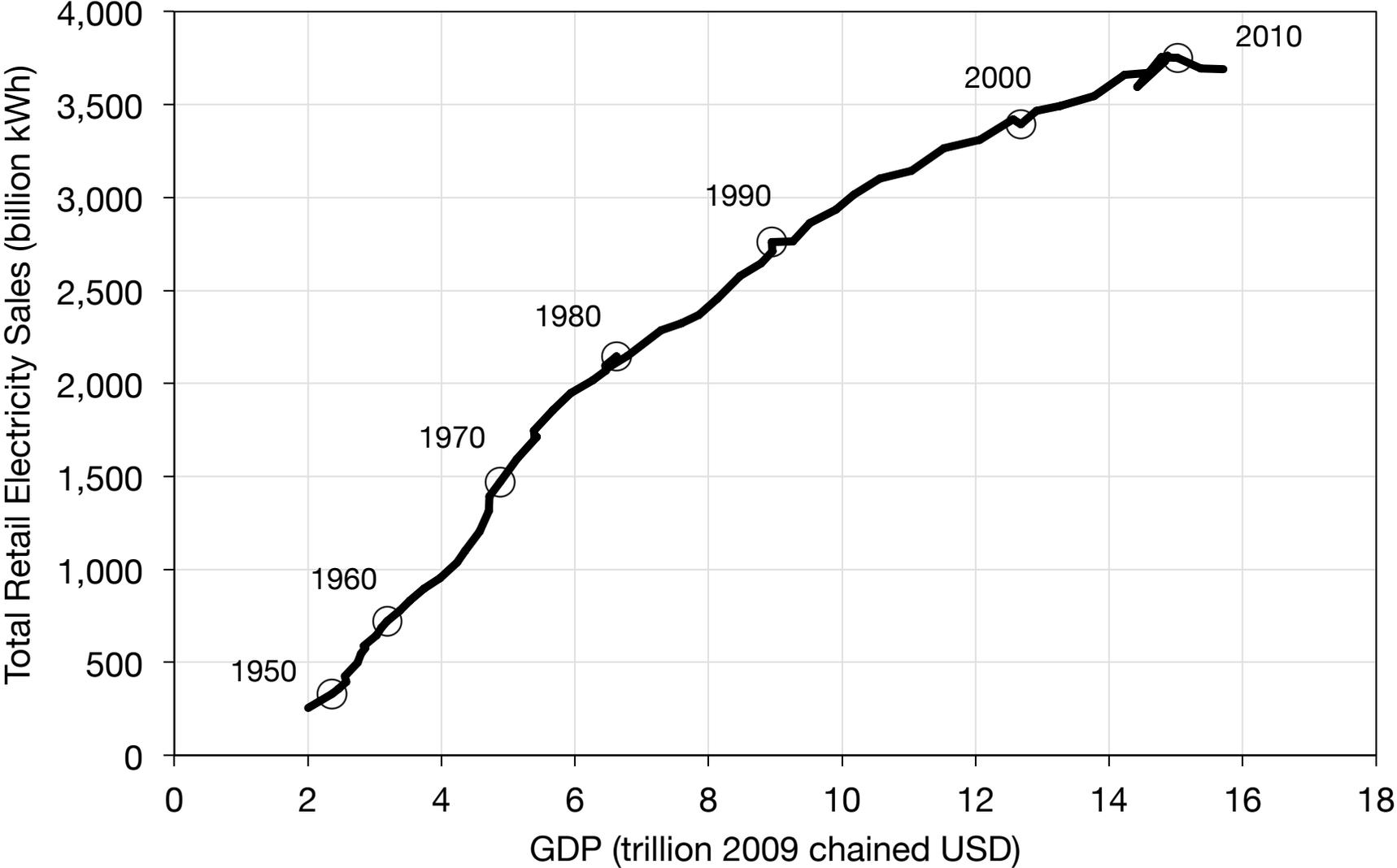


Source: NEMS Electricity Market Module (2013)

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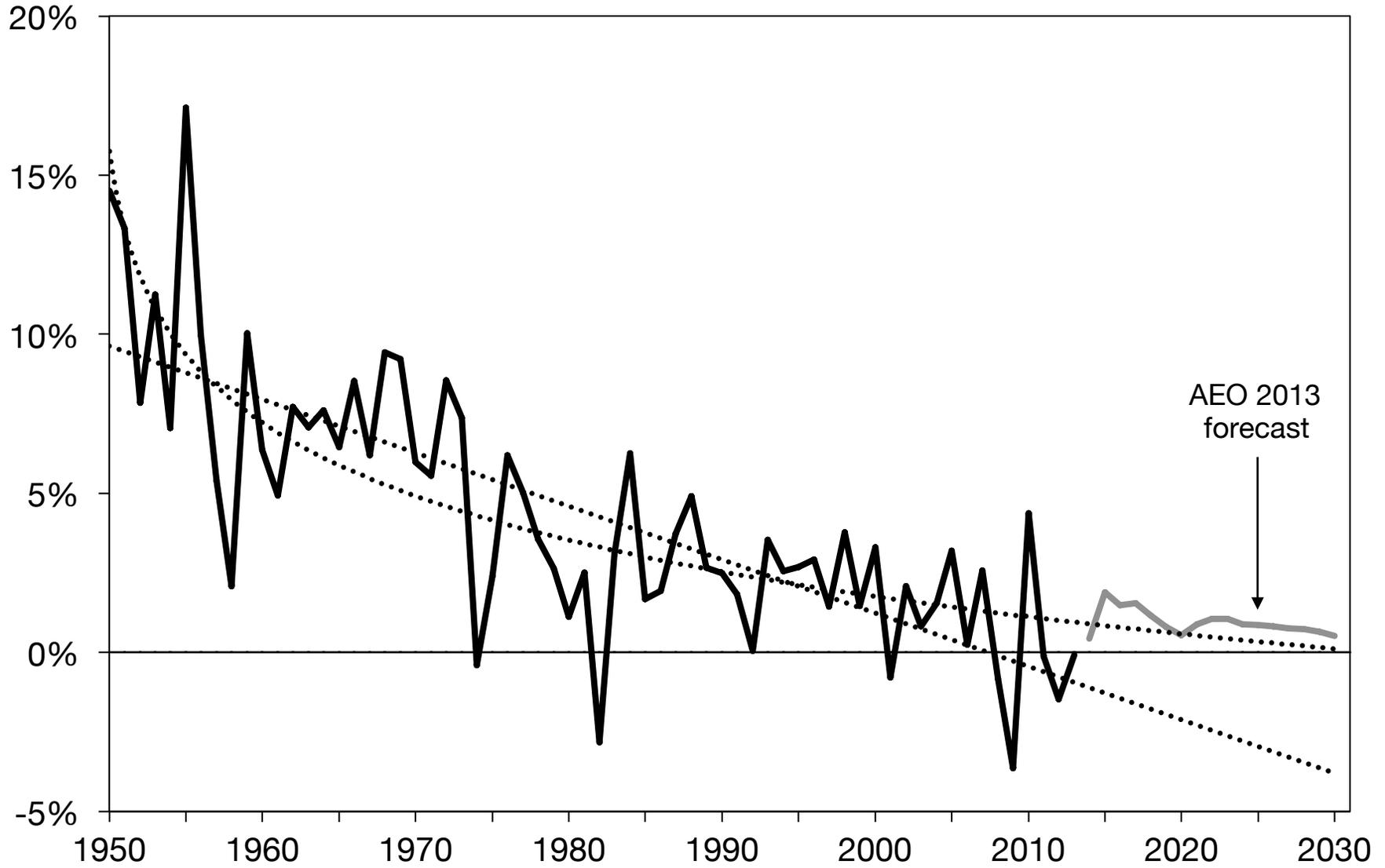
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The Evolving Electricity Intensity of the U.S. Economy



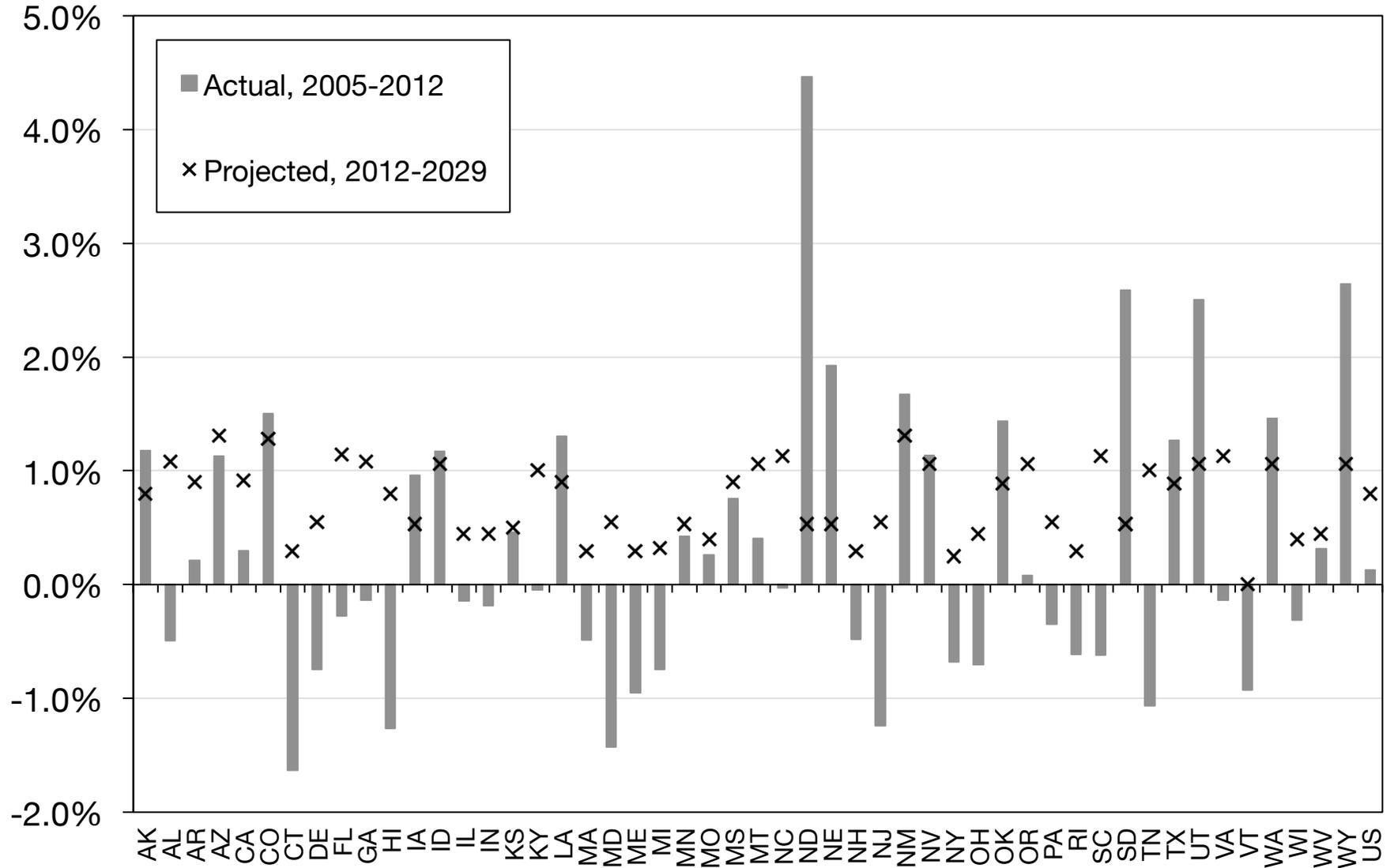
Source: Wara et al., *The Electricity Journal* (2015)

Annual Growth in Total Retail Electricity Sales



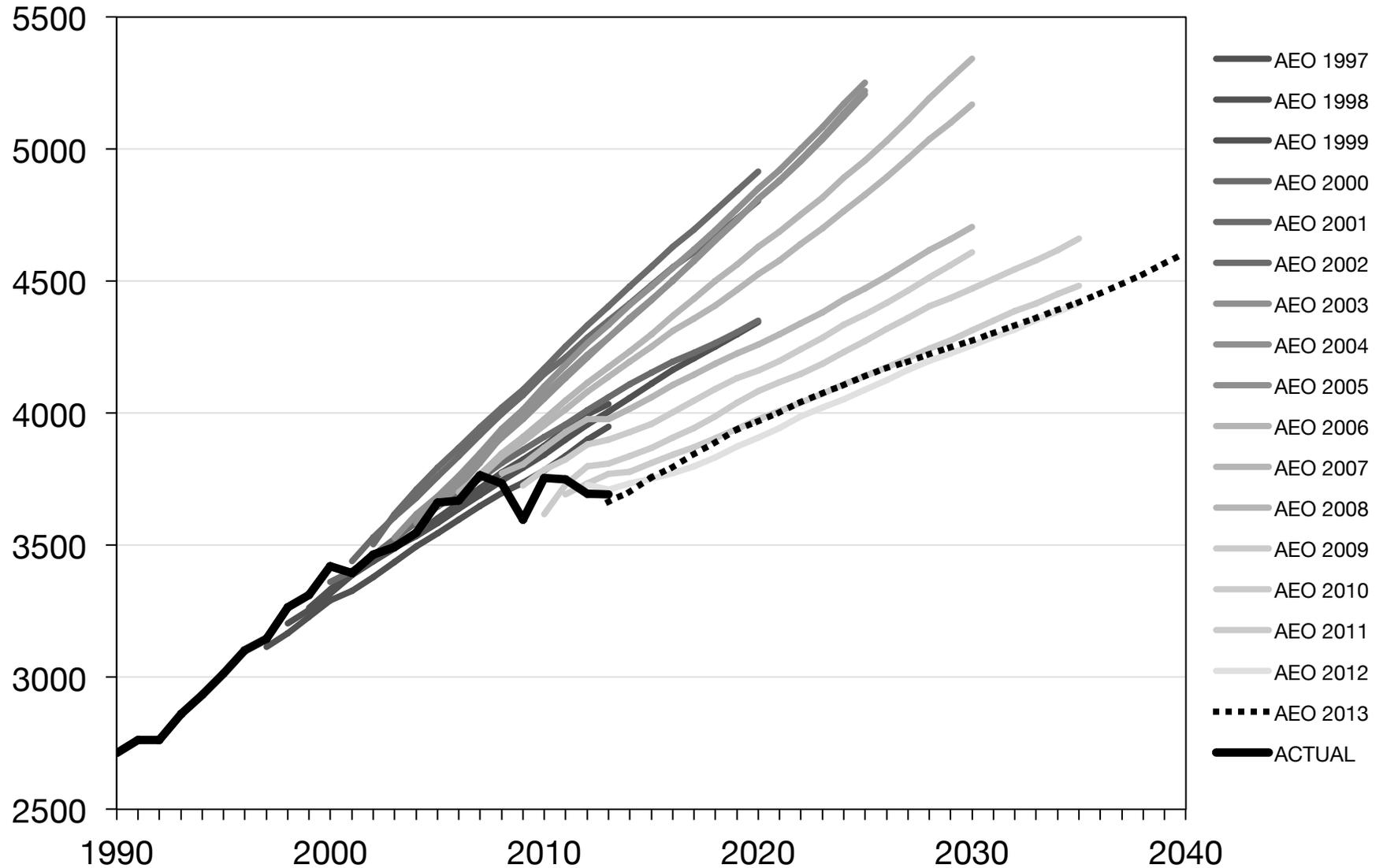
Source: Wara et al., *The Electricity Journal* (2015)

Average Annual Growth Rate, Total Retail Electricity Sales



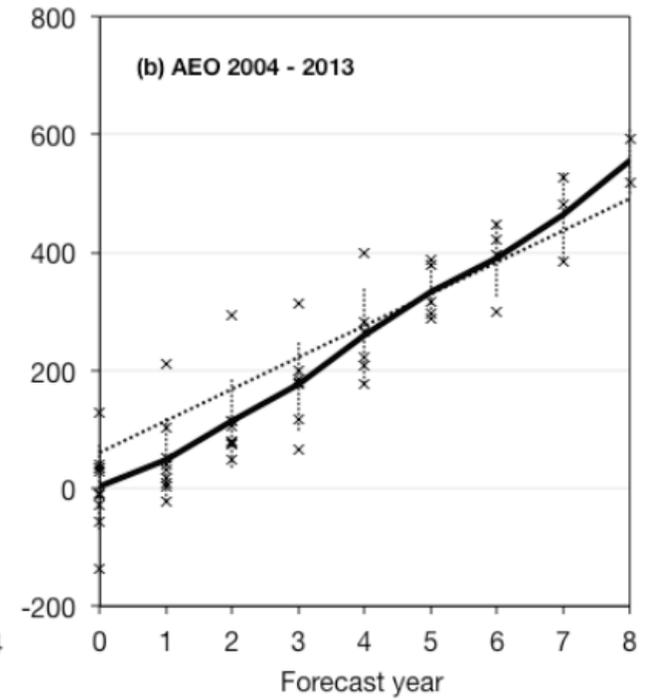
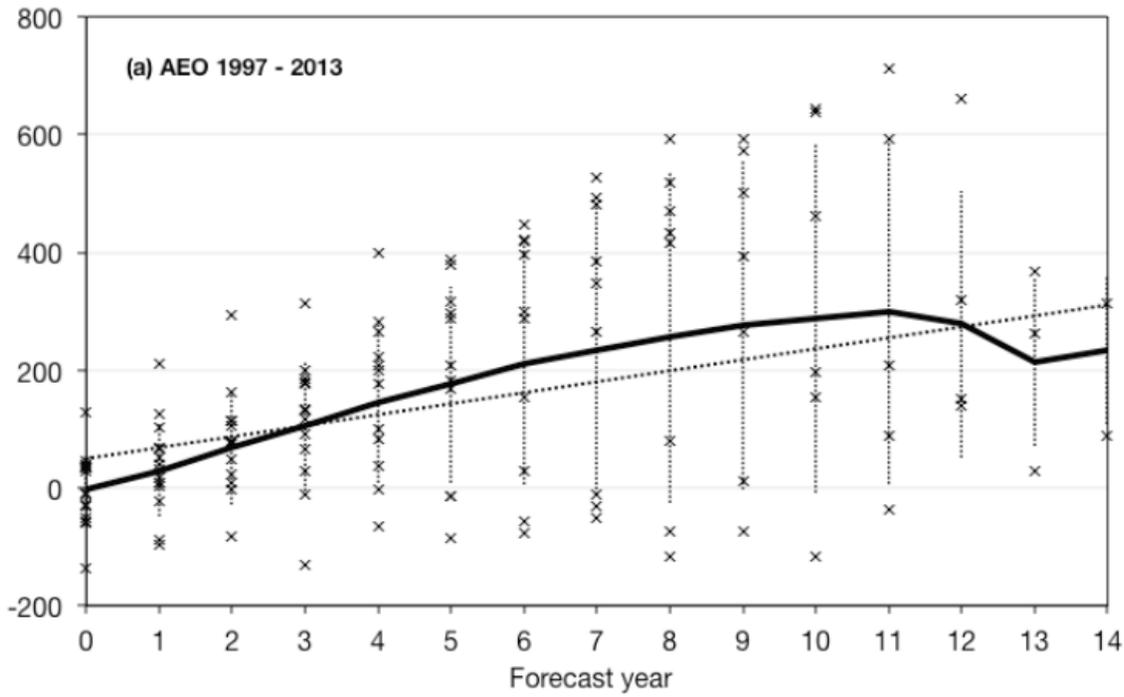
Source: Wara et al., *The Electricity Journal* (2015)

Total Retail Electricity Sales, NEMS Forecasts vs. Actual (billion kWh)



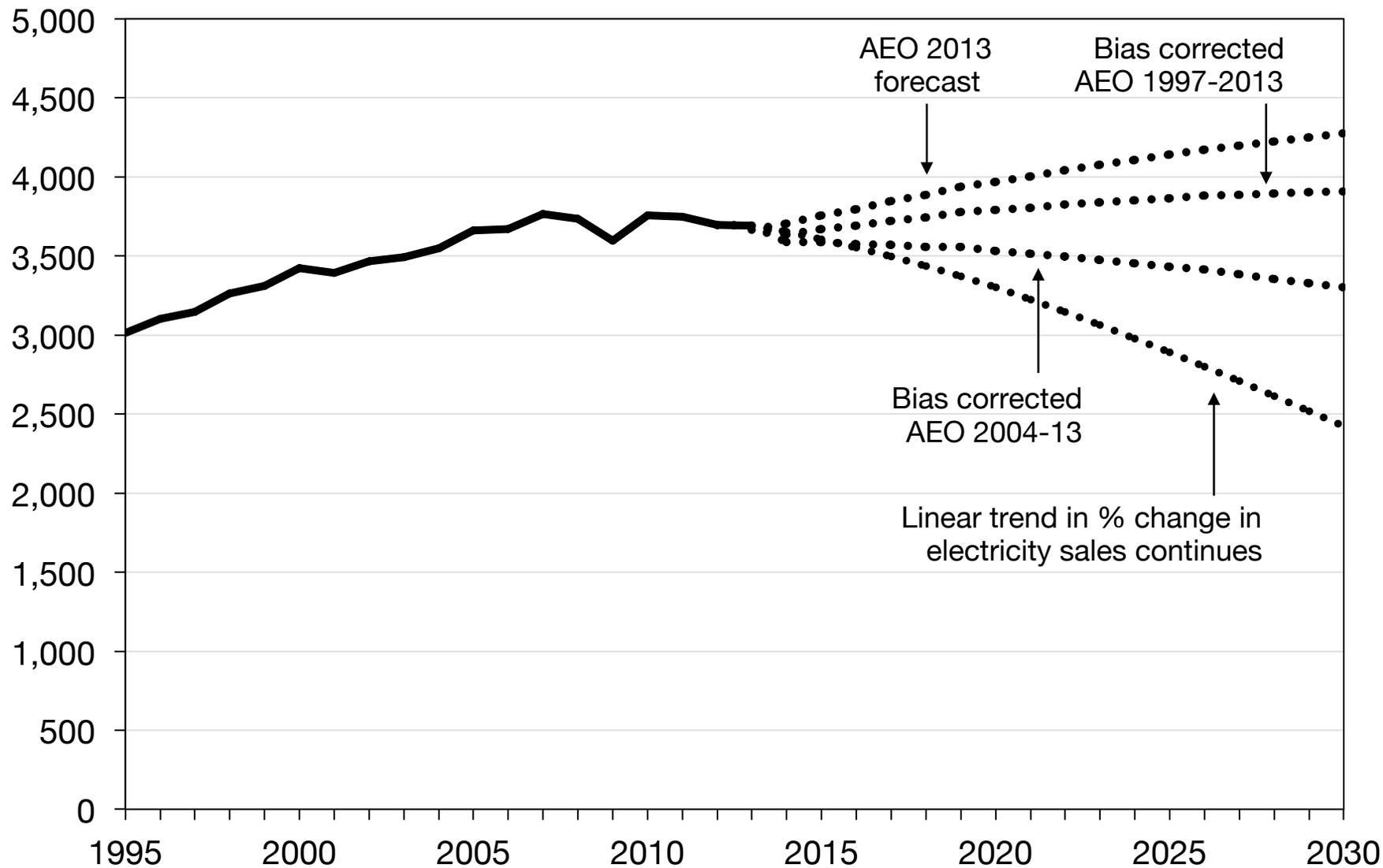
Source: Wara et al., *The Electricity Journal* (2015)

NEMS Forecast Error, Total Retail Electricity Sales (billion kWh)



Source: Wara et al., *The Electricity Journal* (2015)

Projecting Total Retail Electricity Sales (billion kWh)



Source: Wara et al., *The Electricity Journal* (2015)

POLICY QUESTIONS

- **Goal-setting:**
Did EPA calculate the contribution of building block 4 in a defensible manner?
- **Counting hot air:**
Can states copy EPA's method for estimating EE?
- **Risk of strategic default:**
If the mass-based standard for new and existing sources is too lenient, will some states elect this option and count non-additional efficiency trends in lieu of making actual emission reductions?

SOME POTENTIAL SOLUTIONS

- EPA could conduct a sensitivity/scenario analysis in the final rule and adjust accordingly.
- EPA could distinguish estimating feasible EE for BSEER from setting EM&V standards for compliance.
- EPA could delay rate-to-mass conversions, using subsequent forecasts and/or data available closer to compliance period.
- EPA (and other agencies) should avoid using long-term point source forecasts to drive regulations.

THANKS!

QUESTIONS?



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