# $CO_2$ Price Forecasting

## Planning for Future Environmental Regulations

**EUEC 2015, San Diego CA**

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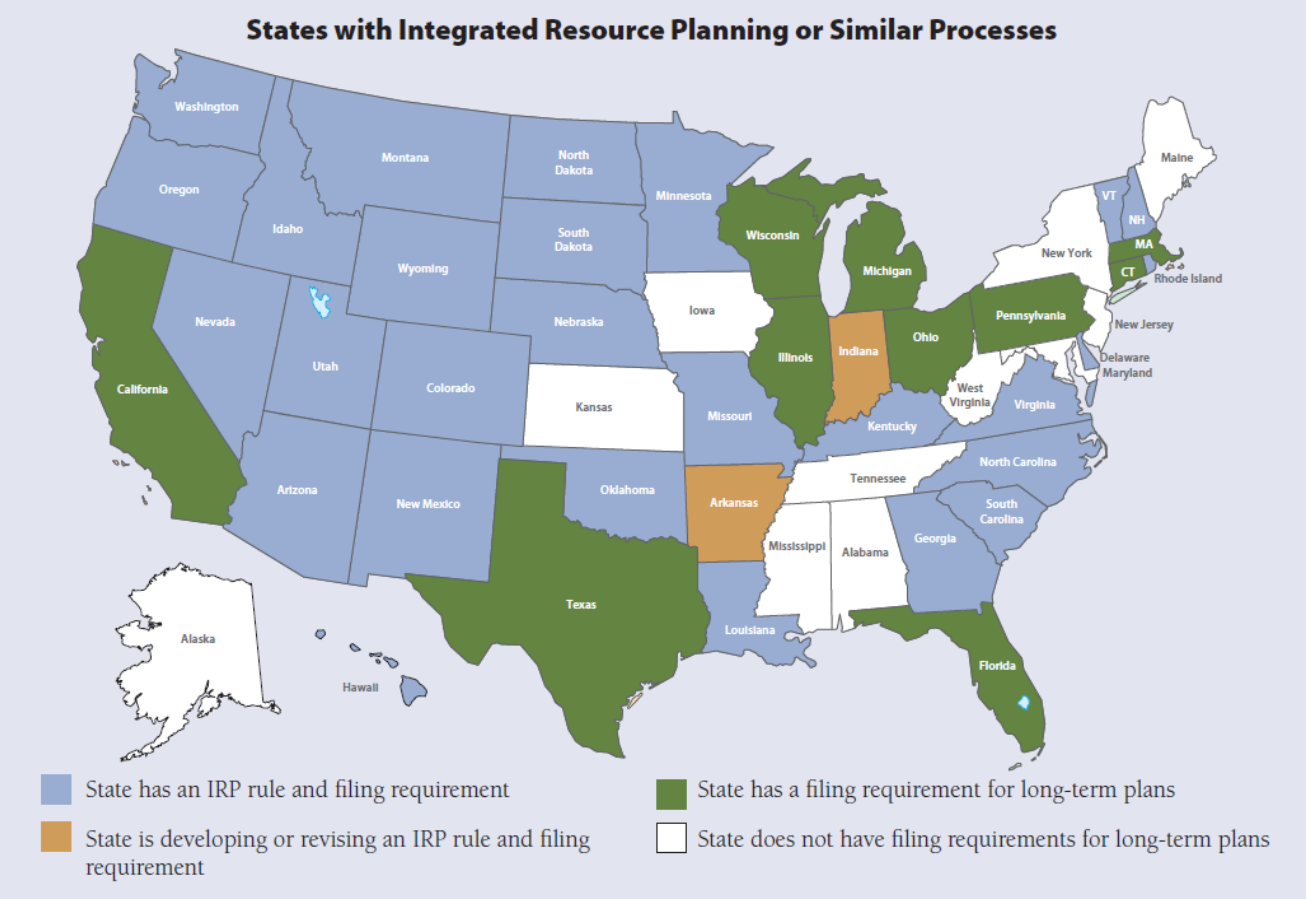
# Integrated planning key to cost-effective utility service

- What is the most cost effective way to reliably meet loads in the next 10-20 years?




Wilson & Biewald "Best Practices in Electric Utility Integrated Resource Planning" 2013

# Expected Regulations

# Regulations putting pressure on $CO_2$-intensive resources

| | Timeline |
|---|---|
| **NAAQS** | SO2, PM2.5, Ozone designations expected soon<br>• *Require action pre-2020* |
| **CSAPR** | Limits nitrogen oxides and sulfur dioxides<br>• *Stay lifted Oct 2014, Phase I begins Jan 1 2015, Phase II Jan 1, 2017* |
| **MATS** | Utilities have been planning for MATS action in recent years<br>• *Compliance deadline April 16 2015* |
| **CCR** | Final coal combustion residual rule issued Dec 2014 |
| **ELGs** | Steam electric effluent guidelines<br>• *Final rule must be issued by Sept 30, 2015* |

# Clean Power Plan Timeline

## Target

- EPA establishes state targets, accepts comments
- Targets finalized in final rule, binding – "mid-summer 2015"

## SIP

- Individual SIPs due summer 2016 (plus extension), regional in 2018
- EPA approves plans – all plans finalized by summer 2019

## Enforcement

- States and EPA assess if emissions are meeting targets, remediation measures

# Why act before rule is final?

- Proposed rule gives some indication of assumed level of stringency of the rule
- Final rule expected soon
- Long-lived assets
- Compliance begins in 2020

**Enforcement of CPP creates opportunity cost for GHG abatement**

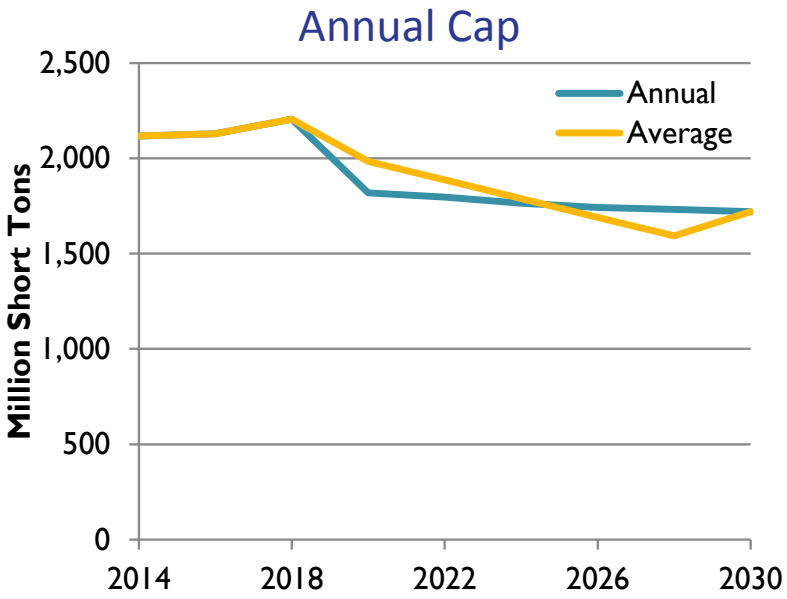
# What will CPP cost?

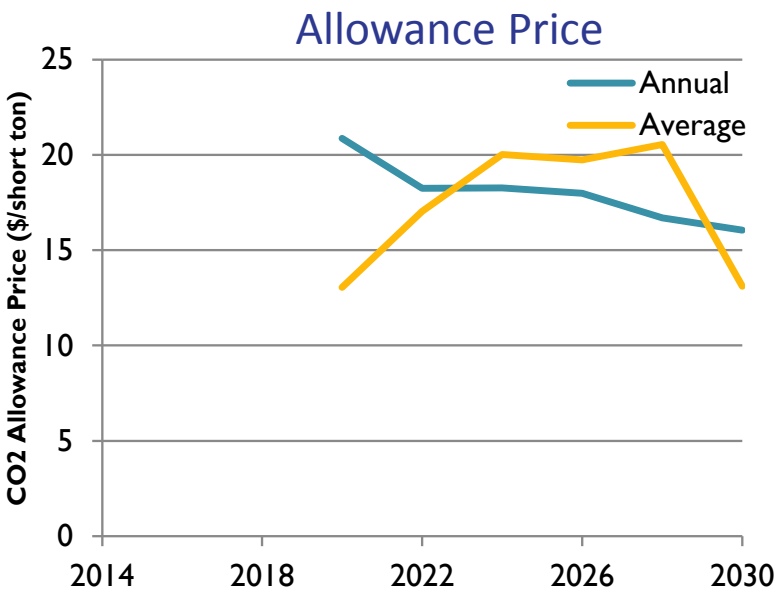
# Rate based or mass based?

- EPA allowance prices: $27 per short ton in 2030 (ranging from $0 - $101)
  - Regional compliance reduced range to $25 - $33 per short ton
- SNL Energy found similar prices using a more detailed model
  - Mass-based targets
  - $21 - $33 per ton, assuming regional compliance
- MISO mass-based approach resulted in $38 per ton
- PJM nodal production cost analysis, many scenarios ranging from $5 - $30
  - High gas price scenario increased it to $35 - $55 per ton

# National compliance?

- We used the latest edition of NREL's ReEDS model to model a national cap under two scenarios
  - Annual caps as specified by EPA
  - 2020-2029 average, allowing more gradual glide path
  - Prices $13 to $22 per short ton



# How to plan for GHG regulations?

# Rate based or mass based?

- Mass-based similar to other cap and trade schemes employed for $SO_2$, $NO_x$, and $CO_2$ in California and RGGI
  - Dispatch and capacity implications are well understood
  - Model as opportunity cost rather than cap (if overcomplying, could sell associated credits)
- Rate-based compliance is more difficult
  - Models may struggle with co-optimizing retirements, EE, and RE
    - Retirements could reduce absolute emissions, but not the rate
  - Utilities that have tried this have required significant manual trial-and-error

# How many specifics to model?

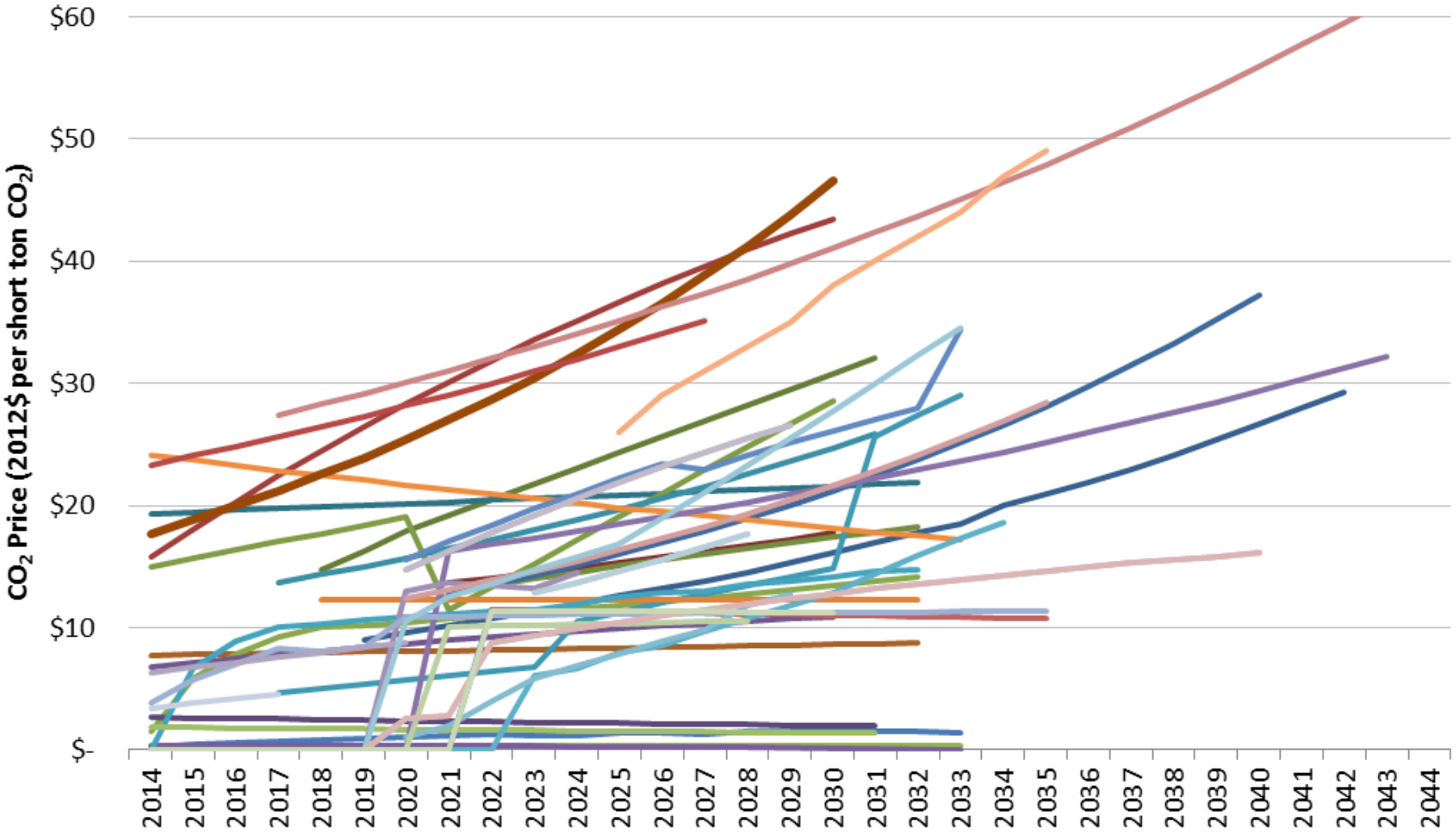
- Numerous ambiguities in current proposal
- Final rule very likely to change substantially from proposed rule
- Proposed rule *does* imply an assumed level of stringency that EPA is willing to accept

**Simplified approach using a $CO_2$ price as a proxy provides meaningful data**

- Other uncertainties
  - New or only existing units?
  - Behavior of neighboring utilities in the same state

# Utilities are using $CO_2$ prices already

# Utility *Reference case* $CO_2$ Forecasts made in 2012-2015



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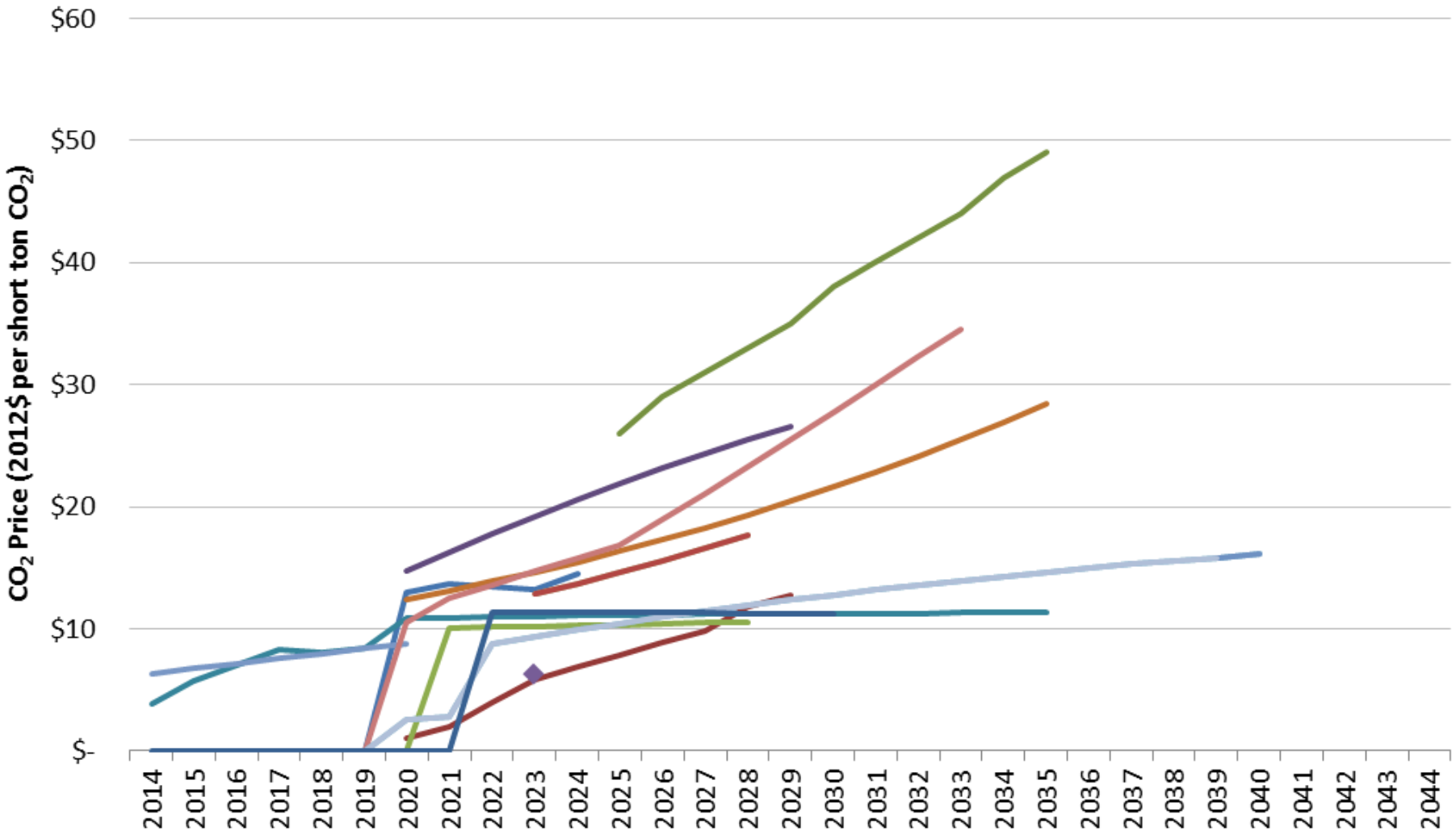

# This IRP database:

- Number of 2012-2015 IRP: 115
- Number of 2012-2015 IRP with $CO_2$ price: 66
- Percent of sales: 22%
- Number of IRP from top 5% of utilities: 33
- Number of IRP from top 5% with $CO_2$: 29

# Synapse $CO_2$ Forecast

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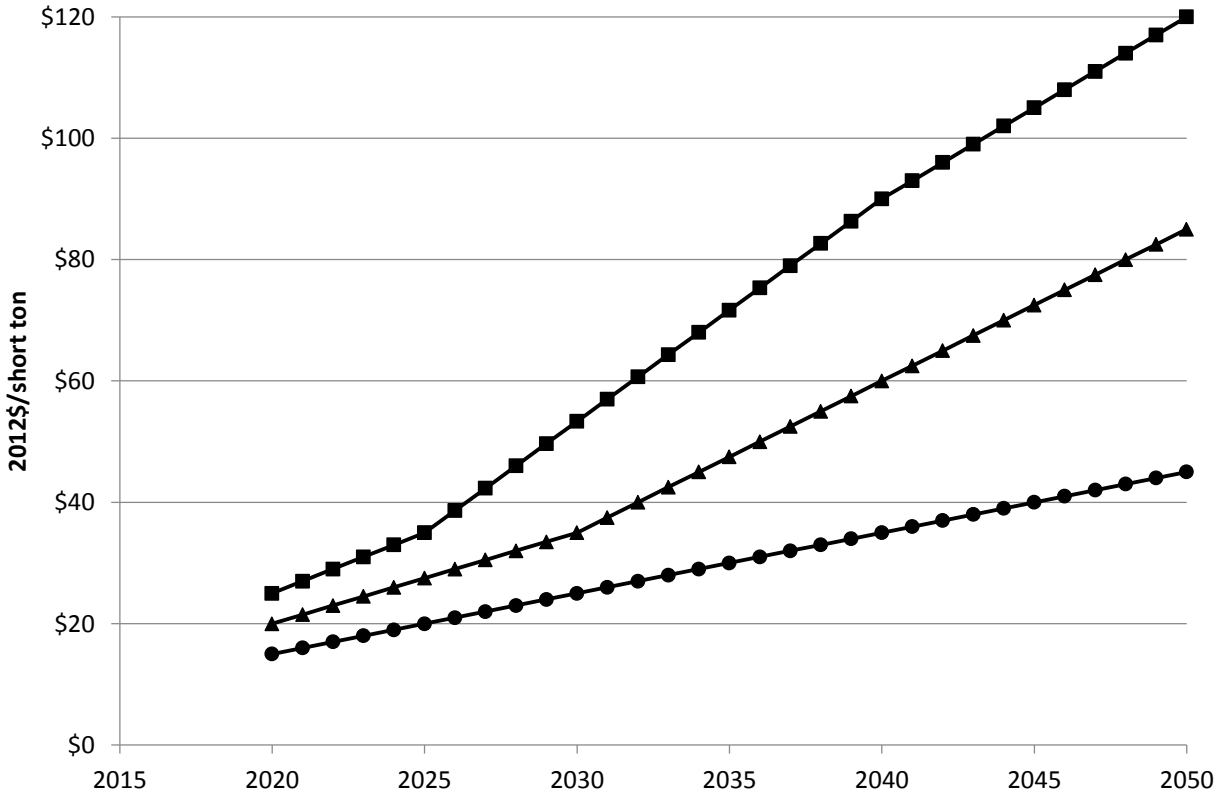

# Questions?

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Thanks to Spencer Fields, Sarah Jackson, Liz Stanton, Jeremy Fisher, and Bruce Biewald

# References

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# The 111(d) Emission Rate

- Measured in lbs of $CO_2$ per MWh
- The "currency" for both targets and compliance
- The same formula for initial year (2012), targets (2020-2030), and compliance measurement (2020-2030)

**111(d) Emission Rate =**

$$\frac{\text{Fossil Fuel Emissions (lbs of } CO_2\text{)}}{\text{Fossil Fuel Generation (MWh)} + \text{Nuclear Generation (MWh)} + \text{Renewable Generation (MWh)} + \text{Energy Efficiency (MWh)}}$$

**Fossil Fuel Emissions (lbs of $CO_2$)**
*Coal, natural gas CC and CT, oil, and IGCC, and useful thermal from co-generation from generators that existed in 2012 and use of NGCC's under construction in 2012+ above a 55% CF*

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*Coal, natural gas CC and CT, oil, and IGCC, and useful thermal from co-generation from generators that existed in 2012 and use of NGCC's under construction in 2012 above a 55% CF*

+

**Nuclear Generation (MWh)**
*From 2020, 5.8% of use of 2012 existing nuclear; Use of under construction in 2012+ nuclear*

**Renewable Generation (MWh)**
*Excludes hydro existing in 2012*

**Energy Efficiency (MWh)**
*Cumulative from 2017 with sunsetting; In 2012, this value is 0 MWh*

# The 111(d) "Building Blocks"

**BB 1:** Reduce Average Coal Emission Rate by 6%

**BB 2a:** Redispatch to Existing NG (up to an average of 70%, coal and oil capacity permitting)

**BB 2b:** Redispatch to Under-Construction NG (from 55% to 70%: only 15% difference counts)

**BB 3a-i:** Credit for Existing "At-Risk" Nuclear (5.8% of 2012 nuclear fleet)

**BB 3a-ii:** Credit for Nuclear Under Construction in 2012

**BB 3b:** Credit for Renewable Generation (excludes existing hydro)

**BB 4:** Credit for Energy Efficiency Improvements (cumulative from 2017; in 2012, this value is 0 MWh)