



Synapse  
Energy Economics, Inc.

# Clean Power Plan: A Toolkit for State Compliance

---

**2014 NASUCA Annual Meeting**

*San Francisco, CA*

Tuesday, November 18, 2014

Elizabeth A. Stanton, PhD

Bruce Biewald

# Agenda

---

## Today's Presentation:

- What is the Clean Power Plan?
- How does the Clean Power Plan (111(d)) work?
- Compliance costs estimated by EPA
- Challenges and opportunities for states
- Legal compliance options
- Questions & answers

# What is the Clean Power Plan?

# What is the Clean Power Plan?

---

- 2007 Supreme Court determined greenhouse gases may be regulated by EPA
- Section 111 of the Clean Air Act requires EPA to develop regulations for air pollution which may reasonably be expected to endanger public health or welfare. CO<sub>2</sub> was found to threaten public health and welfare.
- Section 111(d) of the Clean Air Act requires EPA to develop regulations for *existing sources* of CO<sub>2</sub> based on the “best system of emission reduction” that has been adequately demonstrated
- New sources are regulated under 111(b)
- EPA released its proposed 111(d) rule, the “Clean Power Plan,” on June 2, 2014
- Clean Power Plan is based on EPA’s analysis of each state’s 2012 CO<sub>2</sub> emissions, and estimates of each state’s ability to reduce emissions through implementing four “building blocks” – methods of reducing electricity CO<sub>2</sub> emissions.

# How Does the Clean Power Plan Work?

# Setting 111(d) Emission Rate Targets

## 111(d) Emission = Rate

### Fossil Fuel Emissions (lbs of CO<sub>2</sub>)

*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*

### Fossil Fuel Generation (MWh)

*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 sunseting;  
In 2012, this value is 0 MWh*

+

# EPA's Building Blocks for Target Setting

---

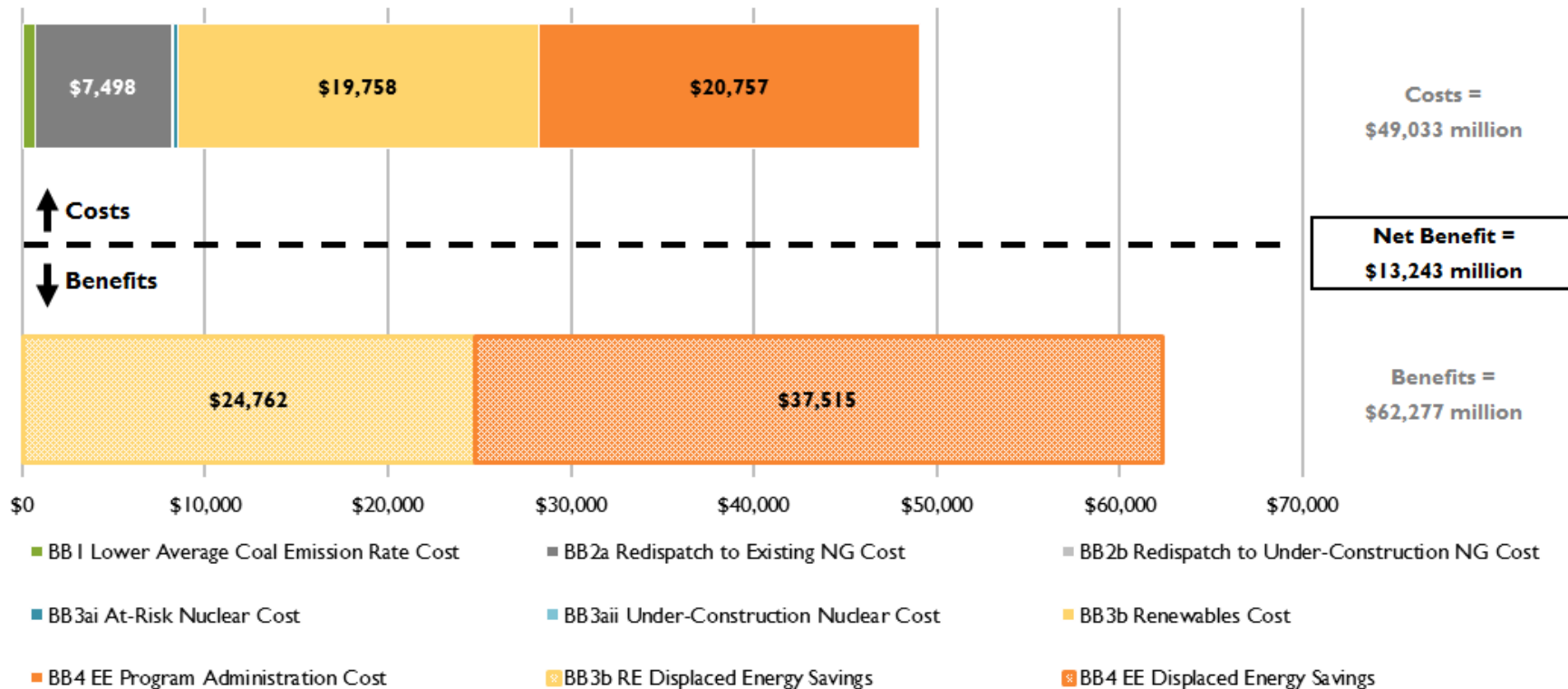
- BB 1:** Reduce Average Coal Emission Rate by 6%
- BB 2a:** Redispatch to Existing NG (up to an average of 70%, coal and oil capacity permitting)
- BB 2b:** Redispatch to Under-Construction NG (from 55% to 70%: only 15% difference counts)
- BB 3a-i:** Credit for Existing “At-Risk” Nuclear (5.8% of 2012 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)

# **Compliance Costs Estimated by EPA**



# EPA's State Building Block Cost Estimates

2030 U.S. total electric-sector costs and benefits of 111(d) compliance (millions of 2011\$)

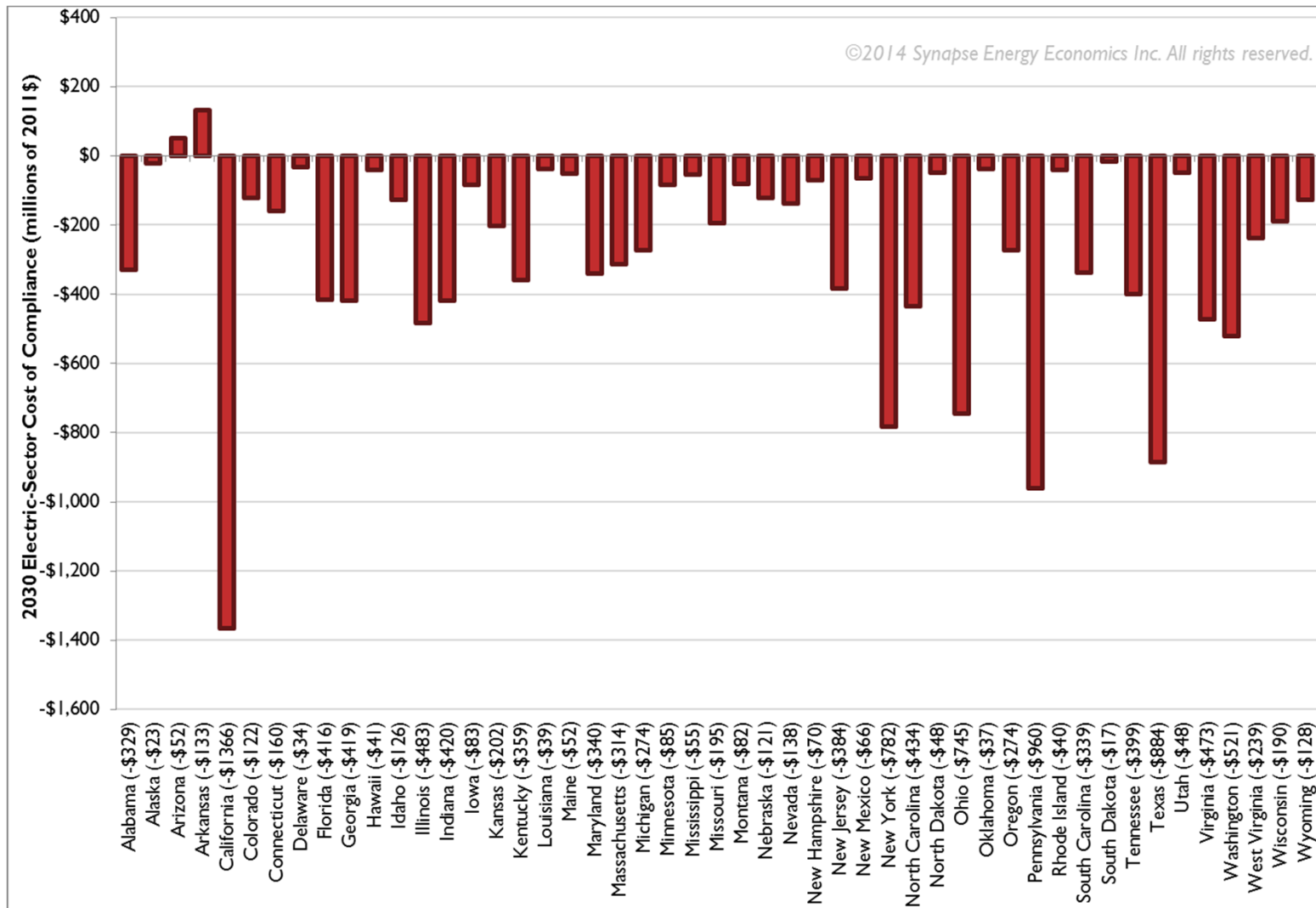


Note: Values estimated by Synapse. Does not include energy efficiency participant costs or climate and health benefits.

|                        | BB I    | BB2a      | BB2b   | BB3ai   | BB3aai | BB3b       | BB4        | BB3b     | BB4      | Net      |
|------------------------|---------|-----------|--------|---------|--------|------------|------------|----------|----------|----------|
| (Costs) and Savings    | (\$684) | (\$7,498) | (\$69) | (\$267) | \$0    | (\$19,758) | (\$20,757) | \$24,762 | \$37,515 | \$13,243 |
| Percent of Net Savings | 1%      | 15%       | 0%     | 1%      | 0%     | 40%        | 42%        | -51%     | -77%     |          |

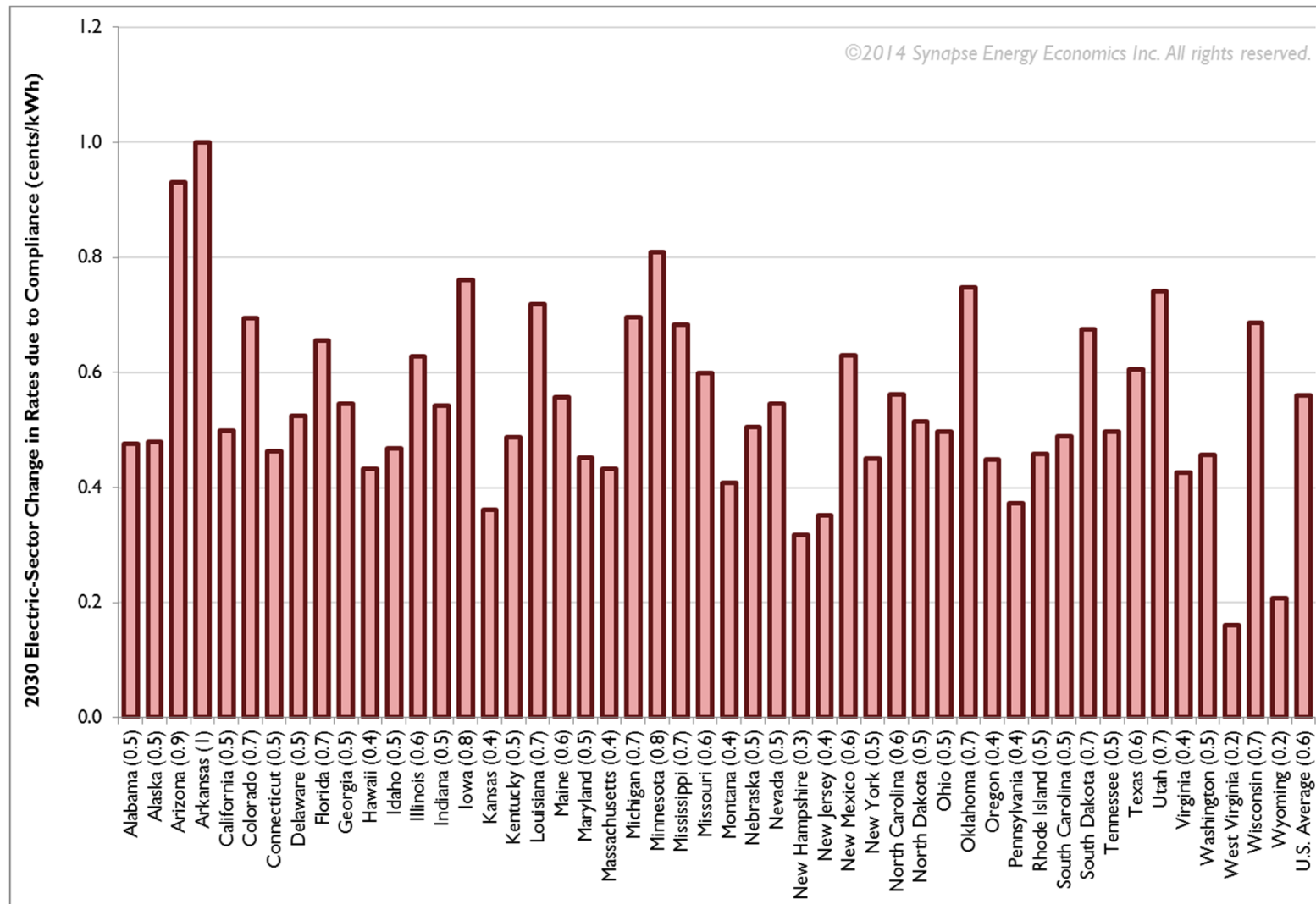
# State Building Block Cost Estimates

EPA's 2030 national electric-sector cost estimates attributed to state building blocks



# State Building Block Cost Estimates

EPA's 2030 change in electric rate estimates attributed to state building blocks



# There May be Lower-Cost Ways to Comply

- EPA's Building Blocks are not mandatory, nor are they "least cost"
- States are not required to use any specific building block or apply building blocks to the extent EPA did in setting targets
- No effort has been made as yet to find least-cost options by state
- Each state needs to do its own least-cost analysis to determine the least expensive way to achieve its target emission rate
  - The specific assumptions and costs for each state should be adjusted based on state-specific data and analysis
- States may choose to employ measures other than those identified by EPA, as long as the 111(d) emissions rate goal is met

# Challenges and Opportunities for States

# Building Blocks Challenges and Opportunities

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

- Each state differs; may not be possible or cost effective

## **BB 2: Redispatch to Natural Gas Generators**

- Dependent on adequate supply of natural gas
- Multi-state compliance open additional dispatch opportunities and allow states to take advantage of NG price differentials
- FERC and wholesale market dispatch protocols may complicate re-dispatch decisions

## **BB 3a: At-Risk and Under-Construction Nuclear**

- Not every state has “at risk” nuclear to leverage for this building block
- TN, SC, GA: if under-construction nuclear is not completed, compliance will be challenging

## **BB 3b: Credit for Renewable Generation**

- Based on regional estimates; may over- or under-state technical & economic potential for individual states

## **BB 4: Credit for Energy Efficiency Improvements**

- States with less EE experience may find targets hard to meet and sustain
- Other states may find targets can be exceeded at low cost, providing an opportunity

# Least-Cost Compliance Strategies

**Thinking outside the blocks:  
Consider full range of  
resources**

1. Imports, REC trading
2. Retirement
3. Heat rate improvements at non-coal fossil plants
4. Carbon capture & storage
5. Fuel switching, co-firing
6. Integrated renewable technology
7. New natural gas capacity
8. Credits for new plant over-compliance
9. Transmission & distribution efficiency
10. Increased use of NGCTs
11. Innovative demand-side options
  - Storage
  - Distributed generation
  - Other forms of energy efficiency
  - Smart grid and demand response

# Least-Cost Compliance Strategies

## Least-cost analysis

- Use appropriate modeling tools that capture energy, capacity, T&D, ancillary services impacts
- Include state-specific assumption regarding costs, fuel-price projections, transmission constraints, and resource constraints
- Evaluate both rate impacts and bill impacts
- Conduct distributional analysis to evaluate equity impacts

## Multi-state compliance

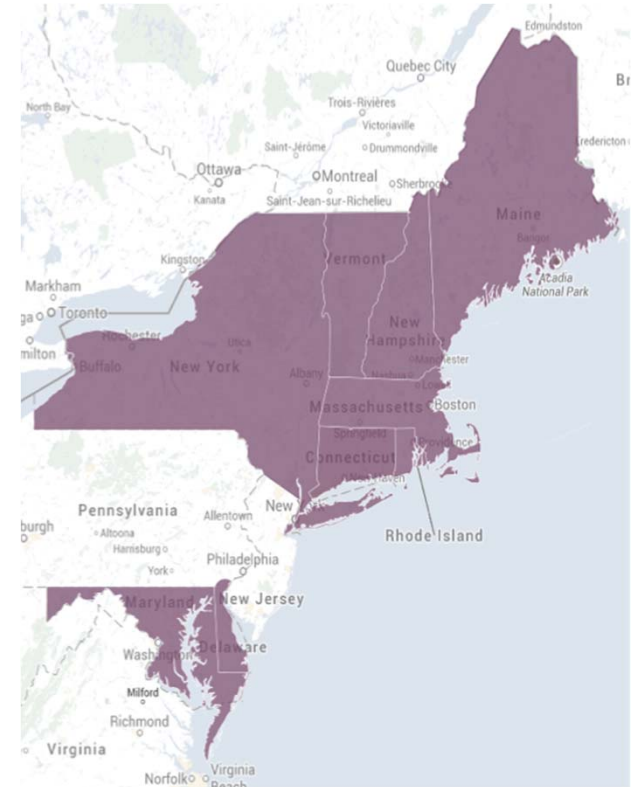
- Expands number of opportunities for emissions reductions
  - including expanded credit for energy efficiency for electricity importers
- Allows least-cost opportunities in the region to be exploited (similar to efficiencies of wholesale market regions)
- May reduce administrative costs



# Multi-State Compliance and Tradable Instruments

- Multi-state compliance may entail a mass-based approach using tradable instruments, such as:
  - Allowances per ton CO<sub>2</sub>
  - Allowances per ton above a certain threshold (e.g., 1,000 lbs/MWh)
  - Carbon reduction credits relative to a baseline (e.g., WRA proposal for West)
  - Renewable energy or energy efficiency certificates
- **BUT:** Windfall profits for generators if CO<sub>2</sub> allowances are given away for free.
  - Generators will raise their prices to reflect the cost of purchasing emissions permits, and pass these costs on to consumers
  - Generators should purchase emissions permits through and auction or other mechanism, with the revenues returned to ratepayers in some manner

## Example: RGGI



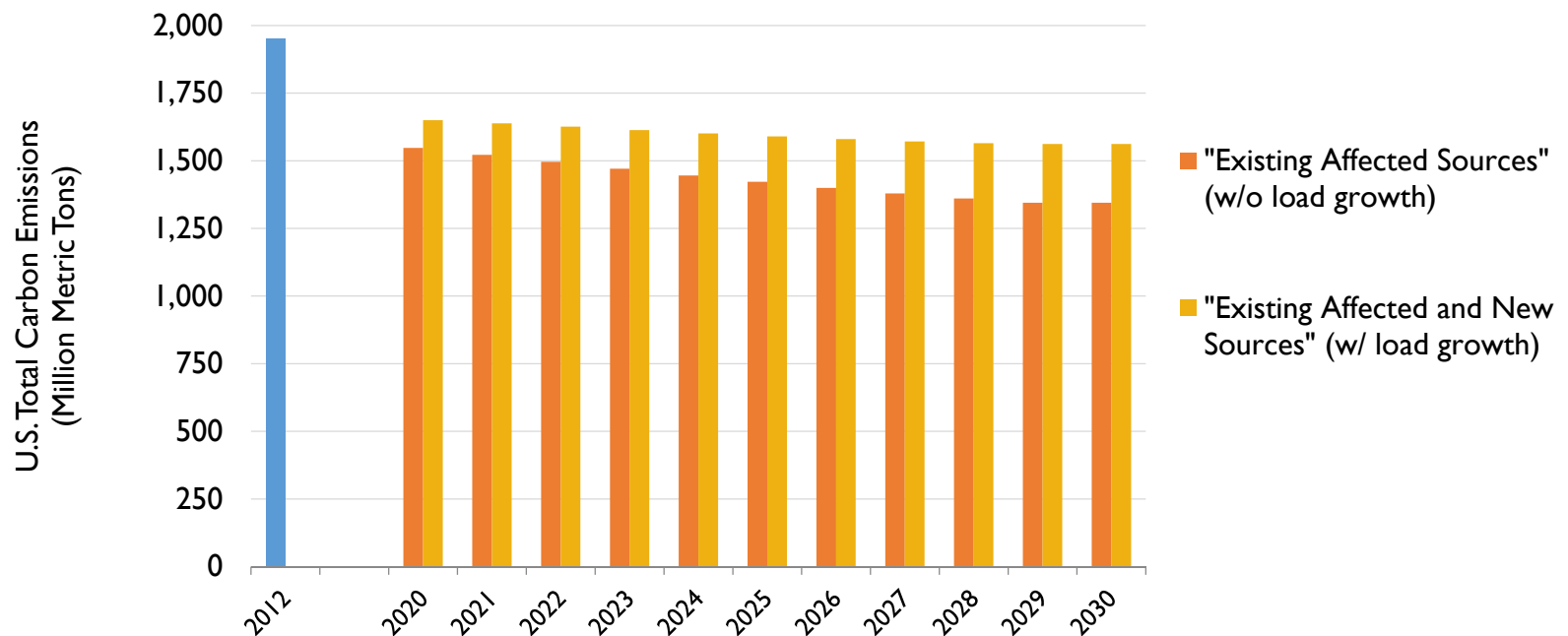
Source: Carbon Offset Research & Education (CORE).  
"Regional Greenhouse Gas Initiative." Available at:  
<http://www.co2offsetresearch.org/policy/RGGI.html>

# Compliance Options

# Mass-Based Compliance

EPA has proposed two methods for “translating” state 111(d) emission rate-based targets (lbs CO<sub>2</sub> /MWh) into mass-based targets (tons of CO<sub>2</sub>)

- (1) “Existing Affected Sources” = 2012 generation level \* rate-based target
- (2) “Existing Affected and New Sources” = (load growth from AEO \* transmission loss factor) + (2012 generation level \* rate-based target)



# State Plans and 111(d) Compliance

- EPA outlines several ways states could design compliance plans. Options include:
  - Hold affected sources (power plants) solely responsible for achieving the performance standard
  - “Portfolio” approach
  - A “state commitment” approach (not in EPA’s proposal, but under consideration)
  - Individual state *or* multi-state plan
- All compliance plans must meet 4 general criteria and contain 12 specific components

## Clean Power Plan Planning Tool (CP3T)

---

- Synapse developed an Excel-based spreadsheet tool for performing first-pass planning of statewide compliance with the Clean Power Plan
- Users can adjust:
  - unit retirements
  - fossil unit capacity factors
  - renewable energy and energy efficiency projections
  - 111(b) unit additions for each state
- Outputs for each scenario include:
  - generation
  - capacity
  - emissions
  - 111(d) emission rates
  - costs

## Clean Power Plan Planning Tool (CP3T)

---

- The tool is available now on the Synapse website
- Synapse will host a webinar walkthrough of CP3T on November 21, 1:00-1:45 EST
- To access the tool and register for the free webinar, go to:

[www.synapse-energy.com/cp3t](http://www.synapse-energy.com/cp3t)

# Questions & Answers

**Elizabeth A. Stanton, Ph.D., Senior Economist**

**Bruce Biewald, Founder and CEO**

**Synapse Energy Economics**

617-661-3248

[eastanton@synapse-energy.com](mailto:eastanton@synapse-energy.com)

[bbiewald@synapse-energy.com](mailto:bbiewald@synapse-energy.com)

[www.synapse-energy.com](http://www.synapse-energy.com)

## *About Synapse Energy Economics*

- Synapse Energy Economics is a research and consulting firm specializing in energy, economic, and environmental topics. Since its inception in 1996, Synapse has grown to become a leader in providing rigorous analysis of the electric power sector for public interest and governmental clients.
- Staff of 30+ experts
- Located in Cambridge, Massachusetts

# Appendix



## Market Price Effects

---

- One critical area for analysis in electric-sector modeling for 111(d) compliance will be the effect of EPA's building blocks—and the Building Block 2 re-dispatch to NGCCs, in particular—on the wholesale market price of electricity.
- EPA expects that re-dispatch to NGCCs will be implemented via a price instrument (for example, a CO<sub>2</sub> allowance price).
- In our judgment, a price instrument is essential to this re-dispatch: electric markets follow economic dispatch based on price signals.

# Market Price Effects

---

- Emission allowance price instruments can have either a strongly inflating effect or a neutral effect on the wholesale price of energy, depending on their design.
- The effect of an inflated wholesale market price would be windfall profits to existing low-emission resources, along with higher costs to consumers.
- This is an important area for additional research and modeling, along with careful policy design, for all states.

# Nuclear

Illinois' 2030 111(d) Emission Rate Target (including 91 million MWh of nuclear):

|                            |   |                            |   |         |        |           |       |         |            |              |                    |
|----------------------------|---|----------------------------|---|---------|--------|-----------|-------|---------|------------|--------------|--------------------|
| 111(d)<br>Emission<br>Rate | = | million lbs<br>million MWh | = | 145,156 | 18,063 | 0         | 503   | 0       | 0          | 0            | = 1,271<br>lbs/MWh |
|                            |   |                            |   | Coal    | NGCC   | O/G Steam | Other | Nuclear | Renewables | E.Efficiency |                    |
|                            |   |                            |   | 66      | 21     | 0         | 1     | 5       | 18         | 18           |                    |

Illinois' 2030 111(d) Emission Rate with all nuclear retired:

|                            |   |                            |   |         |        |           |       |         |            |              |                    |
|----------------------------|---|----------------------------|---|---------|--------|-----------|-------|---------|------------|--------------|--------------------|
| 111(d)<br>Emission<br>Rate | = | million lbs<br>million MWh | = | 145,156 | 18,063 | 0         | 503   | 0       | 0          | 0            | = 1,325<br>lbs/MWh |
|                            |   |                            |   | Coal    | NGCC   | O/G Steam | Other | Nuclear | Renewables | E.Efficiency |                    |
|                            |   |                            |   | 66      | 21     | 0         | 1     | 0       | 18         | 18           |                    |

# Nuclear

Georgia's 2030 111(d) Emission Rate Target (including 31 million MWh of existing nuclear and 17 million MWh of new nuclear):

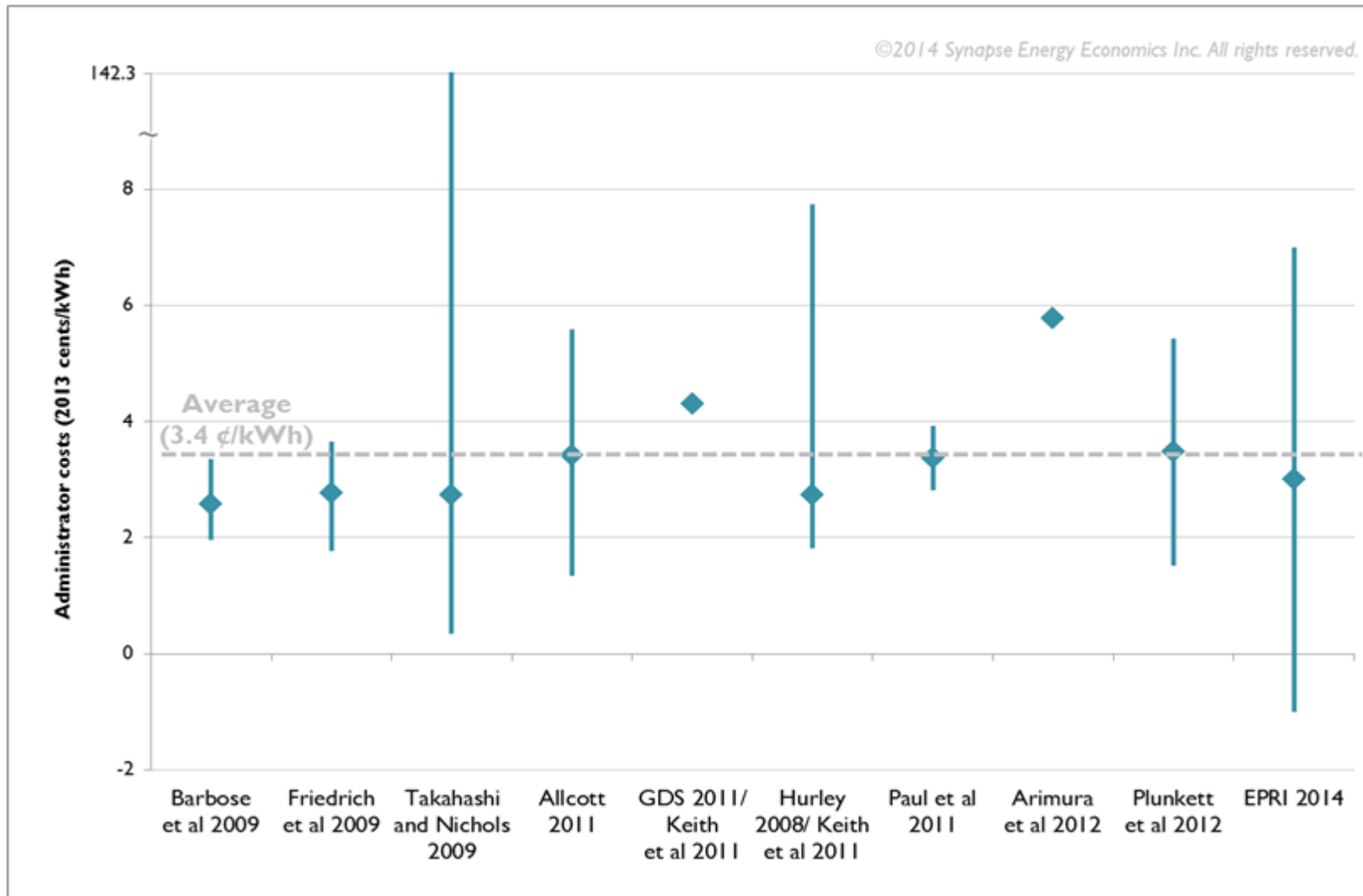
|                            |   |             |   |        |        |           |       |         |            |              |                  |
|----------------------------|---|-------------|---|--------|--------|-----------|-------|---------|------------|--------------|------------------|
| 111(d)<br>Emission<br>Rate | = | million lbs | = | 58,647 | 43,213 | 0         | 68    | 0       | 0          | 0            | = 834<br>lbs/MWh |
|                            |   |             |   | Coal   | NGCC   | O/G Steam | Other | Nuclear | Renewables | E.Efficiency |                  |
|                            |   |             |   | 27     | 51     | 0         | 0     | 19      | 12         | 12           |                  |

Georgia's 2030 111(d) Emission Rate with new nuclear not completed:

|                            |   |             |   |        |        |           |       |         |            |              |                  |
|----------------------------|---|-------------|---|--------|--------|-----------|-------|---------|------------|--------------|------------------|
| 111(d)<br>Emission<br>Rate | = | million lbs | = | 58,647 | 43,213 | 0         | 68    | 0       | 0          | 0            | = 972<br>lbs/MWh |
|                            |   |             |   | Coal   | NGCC   | O/G Steam | Other | Nuclear | Renewables | E.Efficiency |                  |
|                            |   |             |   | 27     | 51     | 0         | 0     | 2       | 12         | 12           |                  |

# Energy Efficiency

## Review of recent estimates of the cost of saved energy (excluding participant costs)



# On What Issues is the EPA Requesting Comments?

# List of Specific Issues

---

- BSER
- Each building block
- State goals
- State plans and compliance
- A wide variety of other topics

# Short- Versus Long-Term Compliance

## EPA 111(d) proposed and alternative rule comparison

|   | Proposed Rule<br>(Option 1)  | Alternative Rule<br>(Option 2)   |
|---|--|--|
| End of rule roll-out  | 2030   | 2025   |
| (BB1) Lower Average Coal Emission Rate  | 6% reduction by 2020;<br>steady to 2030  | 4% reduction by 2020;<br>steady to 2025  |
| (BB2a) Redispatch to Existing NG;<br>(BB2b) Redispatch to Under-Construction NG | redispatch from coal and<br>steam to 70% NGCC capacity<br>factors by 2020;<br>steady to 2030 | redispatch from coal and<br>steam to 65% NGCC capacity<br>factors by 2020;<br>steady to 2025 |
| (BB3a-i) At-Risk Nuclear  | credit for 5.8% of nuclear in<br>use in 2020;<br>steady % to 2030                            | credit for 5.8% of nuclear in<br>use in 2020;<br>steady % to 2025                            |
| (BB3a-ii) Under-Construction Nuclear  | credit for all post-2012<br>nuclear in 2020;<br>steady to 2030                               | credit for all post-2012<br>nuclear in 2020;<br>steady to 2025                               |
| (BB3b) Incremental Renewables   | annual state targets starting<br>in 2020;<br>growing each year through<br>2030               | same annual state targets<br>starting in 2020;<br>growing each year through<br>2025          |
| (BB4) Incremental Energy Efficiency   | annual state targets starting<br>in 2020;<br>growing each year through<br>2030               | lower annual state targets<br>starting in 2020;<br>growing each year through<br>2025         |
| <b>Annual electric-sector net costs (billions of 2011\$):</b>                   |  |  |
| <i>in 2020</i>  | \$2.3  | \$1.4  |
| <i>in 2025</i>  | (\$9.0)  | (\$4.8)  |
| <i>in 2030</i>  | (\$12.6)   | N/A  |



## REC Purchases Versus In-State Renewable Generation

Ohio's 2013 111(d) Emission Rate Target (includes 15% annual growth in RE):

|                            |   |             |   |         |        |           |       |         |            |              |                    |
|----------------------------|---|-------------|---|---------|--------|-----------|-------|---------|------------|--------------|--------------------|
| 111(d)<br>Emission<br>Rate | = | million lbs | = | 159,898 | 26,387 | 396       | 2,791 | 0       | 0          | 0            | = 1,338<br>lbs/MWh |
|                            |   |             |   | Coal    | NGCC   | O/G Steam | Other | Nuclear | Renewables | E.Efficiency |                    |
|                            |   | million MWh |   | 80      | 27     | 0         | 3     | 1       | 14         | 16           |                    |

Ohio's 2013 111(d) Emission Rate with 30% annual growth in RE:

|                            |   |             |   |         |        |           |       |         |            |              |                    |
|----------------------------|---|-------------|---|---------|--------|-----------|-------|---------|------------|--------------|--------------------|
| 111(d)<br>Emission<br>Rate | = | million lbs | = | 159,898 | 26,387 | 396       | 2,791 | 0       | 0          | 0            | = 1,165<br>lbs/MWh |
|                            |   |             |   | Coal    | NGCC   | O/G Steam | Other | Nuclear | Renewables | E.Efficiency |                    |
|                            |   | million MWh |   | 80      | 27     | 0         | 3     | 1       | 35         | 16           |                    |

What if Ohio sells its excess renewables to Texas?

## Exchange Rates

---

- Under the proposed 111(d) Clean Power Plan, states can comment on whether compliance should be attained through only in-state actions, or whether trading mechanisms can be set up so actions pursued in other states can be used to meet another state's compliance target
- If trading is allowed, then states will be able to meet their compliance target emission rates by conducting trades of emission certificates
- Unlike trades for RPS compliance, the commodity being traded is tons, not MWh
- How do you compare the emission impacts of 100 MWh of energy efficiency in one state versus 100 MWh of energy efficiency in another?

## Exchange Rates – Example

AVERT calculates that one MWh of renewable energy yields:

1,541 lbs of CO<sub>2</sub> reductions in Ohio

1,288 lbs of CO<sub>2</sub> reductions in Texas

So, one MWh of renewable energy in Ohio is 1.2 times (1,541 / 1,288) as valuable to someone in Texas than one MWh of renewable energy in Texas

## REC Purchases Versus In-State Renewable Generation

Ohio's 2013 111(d) Emission Rate Target (includes 15% annual growth in RE):

|                            |   |                            |   |         |        |           |       |         |            |              |                    |
|----------------------------|---|----------------------------|---|---------|--------|-----------|-------|---------|------------|--------------|--------------------|
| 111(d)<br>Emission<br>Rate | = | million lbs<br>million MWh | = | 159,898 | 26,387 | 396       | 2,791 | 0       | 0          | 0            | = 1,338<br>lbs/MWh |
|                            |   |                            |   | Coal    | NGCC   | O/G Steam | Other | Nuclear | Renewables | E.Efficiency |                    |
|                            |   |                            |   | 80      | 27     | 0         | 3     | 1       | 14         | 16           |                    |

Ohio's 2013 111(d) Emission Rate with 30% annual growth in RE:

|                            |   |                            |   |         |        |           |       |         |            |              |                    |
|----------------------------|---|----------------------------|---|---------|--------|-----------|-------|---------|------------|--------------|--------------------|
| 111(d)<br>Emission<br>Rate | = | million lbs<br>million MWh | = | 159,898 | 26,387 | 396       | 2,791 | 0       | 0          | 0            | = 1,165<br>lbs/MWh |
|                            |   |                            |   | Coal    | NGCC   | O/G Steam | Other | Nuclear | Renewables | E.Efficiency |                    |
|                            |   |                            |   | 80      | 27     | 0         | 3     | 1       | 35         | 16           |                    |

What if Ohio sells its excess renewables to Texas?

21 million MWh of RE in Ohio is worth 25 million MWh in Texas