

# Preliminary Review: U.S. EPA Clean Power Plan Final Rule

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**Electric System Planning Working Group**

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# Agenda

- ◆ **Review changes between the proposed plan and the Final Rule**
- ◆ **Preliminary Review of the Final Rule**
- ◆ **Study Plan**

NYISO Comment	Final Rule
SPs should have a reliability review	Included in the rule
Reliability Safety Valve is required	Included in the rule
Building Block #1 coal heat rate improvement should be eliminated	Assumed improvement decreased from 6.0% to 4.3% in the Eastern Interconnection
Building Block #2 needs to be adjusted to allow for continued operation of critical dual fuel steam units and adjust the increased use of NGCCs such that non-emitting resources are not curtailed	<p>BB#2 reduced from 84% Capacity Factor to 75%</p> <p>BBs applied across the Eastern Interconnect results in significant shifts in emission reduction requirements for NY</p> <p>Dual fuel capability can be maintained</p>

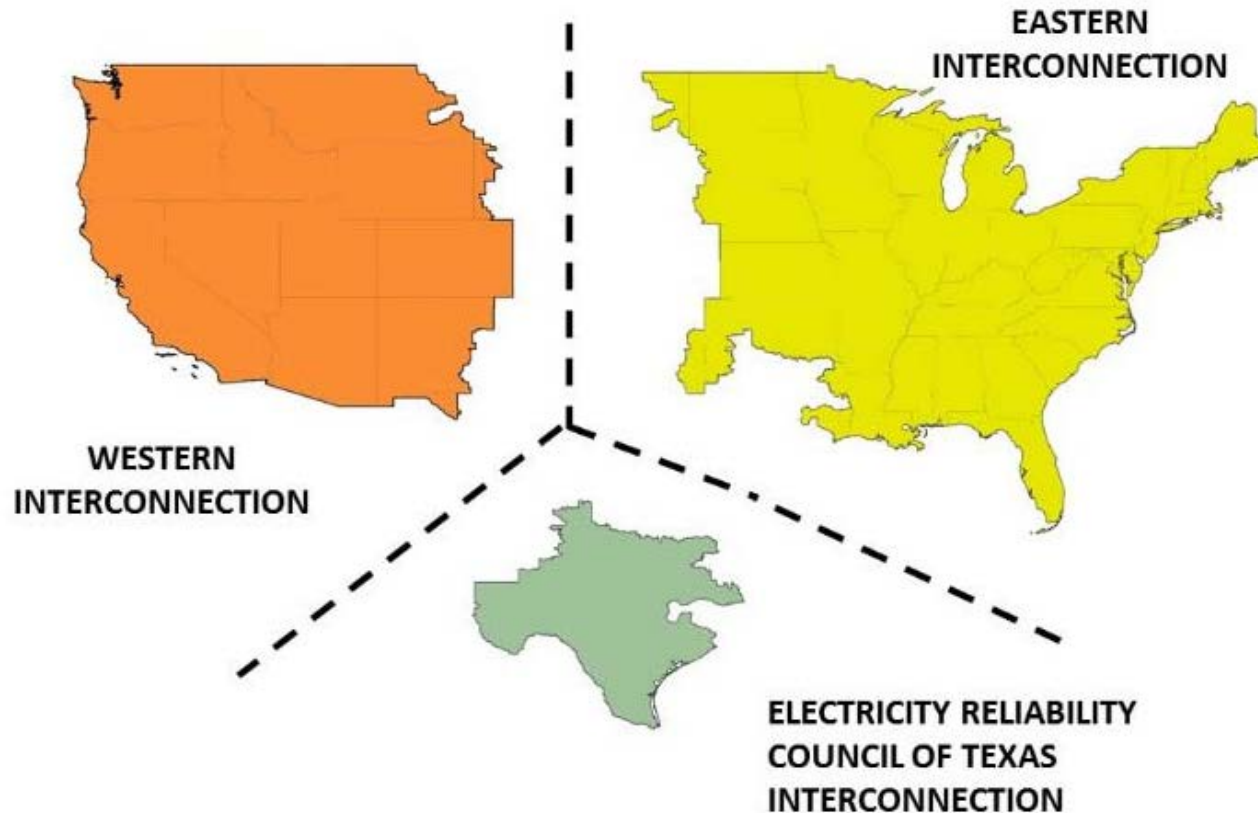
<b>NYISO Comment</b>	<b>Final Rule</b>
Existing hydropower should be included in EPA assumptions about NYS RPS	Existing hydro still not recognized  BBs applied across the EI results in significant shifts in emission reduction requirements for NY
Existing nuclear generation should be removed from BB calculation	Existing nuclear removed from BB calculation
NY should get credit for its Energy Efficiency accomplishments	Not included in the rule
Rate to Mass conversion methodology must be consistent with the rate-setting equation	New methods result in increased mass limits for NY

# New Features in Final Rule

- ◆ **Specific rates applied nationally by Technology Category**
- ◆ **The machine to be regulated is defined per synchronously interconnected system**
- ◆ **Delayed start until 2022**
- ◆ **Phased-in increase use of NGCCs**
- ◆ **Limited recognition of early actions**
- ◆ **Simple Cycle Combustion Turbine generally excluded from regulation**

# Best System of Emission Reductions (BSER) Applied to Three Interconnections

## North American Electric Reliability Corporation Interconnections



<http://www2.epa.gov/cleanpowerplan/fact-sheet-overview-clean-power-plan>

# Three Building Blocks

- ◆ **Sequentially applied three Building Blocks to establish uniform BSER Category-specific CO<sub>2</sub> Emission Rate Performance Standards**

1. *BB1: HRI at Coal ST (i.e. 4.3% HRI in EI)*
  2. *BB3: RE (incremental to 2012 baseline) reduces EGU MWH on a one-for-one basis in proportion to baseline*
  3. *BB2: Redispatch ST to CC generation up to 75% Summer Capacity Factor ceiling*
- *EE and Nuclear no longer in BSER determination but may be available for compliance*

<http://www.epa.gov/airquality/cpp/tsd-cpp-emission-performance-rate-goal-computation.pdf>

<http://www.epa.gov/airquality/cpp/tsd-cpp-emission-performance-rate-goal-computation-appendix-1-5.xlsx>

# Adjusted Baseline Emission Rates

- ◆ Aggregated Interconnection level ST and CC fleets to determine Adjusted Baseline Rates

	Fossil Steam (ST)			Natural Gas Combined Cycle (CC)		
	Adj. Baseline	Baseline	Adj. Baseline - Baseline	Adj. Baseline	Baseline	Adj. Baseline - Baseline
<b>Generation (MWh)</b>						
Eastern	1,304,688,597	1,271,709,152	32,979,445	734,535,157	648,956,217	85,578,940
Western	217,303,105	211,859,953	5,443,152	198,374,376	171,557,782	26,816,594
ERCOT	123,381,480	118,580,146	4,801,334	137,182,895	125,159,005	12,023,891
National	1,645,373,182	1,602,149,251	43,223,931	1,070,092,428	945,673,004	124,419,424
<b>Emissions (tons)</b>						
Eastern	1,409,045,625	1,374,348,767	34,696,858	328,219,519	290,451,326	37,768,194
Western	238,857,896	232,300,703	6,557,193	89,135,327	76,937,358	12,197,969
ERCOT	135,239,939	129,839,569	5,400,370	65,236,948	59,519,020	5,717,928
National	1,783,143,460	1,736,489,038	46,654,421	482,591,795	426,907,704	55,684,091
<b>Emission Rate (lb/MWh)</b>						
Eastern	2,160	2,161	2,104	894	895	883
Western	2,198	2,193	2,409	899	897	910
ERCOT	2,192	2,190	2,250	951	951	951
National	2,167	2,168	2,159	902	903	895

$$EI\ ST\ Rate = \frac{\text{coal emissions} + \text{OG emissions}}{\text{coal gen} + \text{OG gen}} = \frac{\text{ST emissions}}{\text{ST gen}} = \frac{1,409,045,625\ \text{tons}}{1,304,688,597\ \text{MWh}} = 2,160\ \frac{\text{lb}}{\text{MWh}}$$

$$EI\ CC\ Rate = \frac{\text{CC emissions}}{\text{CC gen}} = \frac{328,219,519\ \text{tons}}{734,535,157\ \text{MWh}} = 894\ \frac{\text{lb}}{\text{MWh}}$$



# Step 1: BB1 Heat Rate Improvement for Coal ST fleet

- ◆ **HRI at Coal ST fleet (i.e. 4.3% HRI in EI)**

$$EI\ ST\ Rate\ PostBB1 = \frac{coal\ emissions \times (1 - 0.043) + OG\ emissions}{coal\ gen + OG\ gen} = 2,071 \frac{lb}{MWh}$$

- ◆ **HRI at Coal ST reduces EI emissions while holding Coal ST generation fixed implies an improved ST Emission Rate**
- ◆ **BB1 reduces the 2012 emission rate from coal fired units from 2,160 → 2,071 #CO<sub>2</sub>/MWH**
- ◆ **All example calculations are for 2030 in the EI or NY**

# Step 2: Apply BB3, RE reduces ST and CC Generation

- ◆ RE (incremental to 2012 baseline) reduces ST and CC MWh on a 1:1 basis in the proportion of the 2012 Affected Baseline Generation
  - *USEPA determined the RE potential for BSER in the EI is **438,445 GWh** in 2030*
  - *EI: 64% ST and 36% CC*
  - *USEPA determined RE potentials for each Interconnection based on their application of NREL studies and IPM simulations*

$$\begin{aligned}
 EI \text{ Remaining ST Gen} &= ST \text{ Baseline Gen} - (BB3 \text{ Potential Gen} \times ST \%share) \\
 &= 1,304,689 \text{ GWh} - (438,445 \text{ GWh} \times 0.64) = 1,024,173 \text{ GWh}
 \end{aligned}$$

$$\begin{aligned}
 EI \text{ Remaining CC Gen} &= CC \text{ Baseline Gen} - (BB3 \text{ Potential Gen} \times CC \%share) \\
 &= 734,535 \text{ GWh} - (438,445 \text{ GWh} \times 0.36) = 576,606 \text{ GWh}
 \end{aligned}$$

**Generation post BB3 application is termed “Remaining” by USEPA**

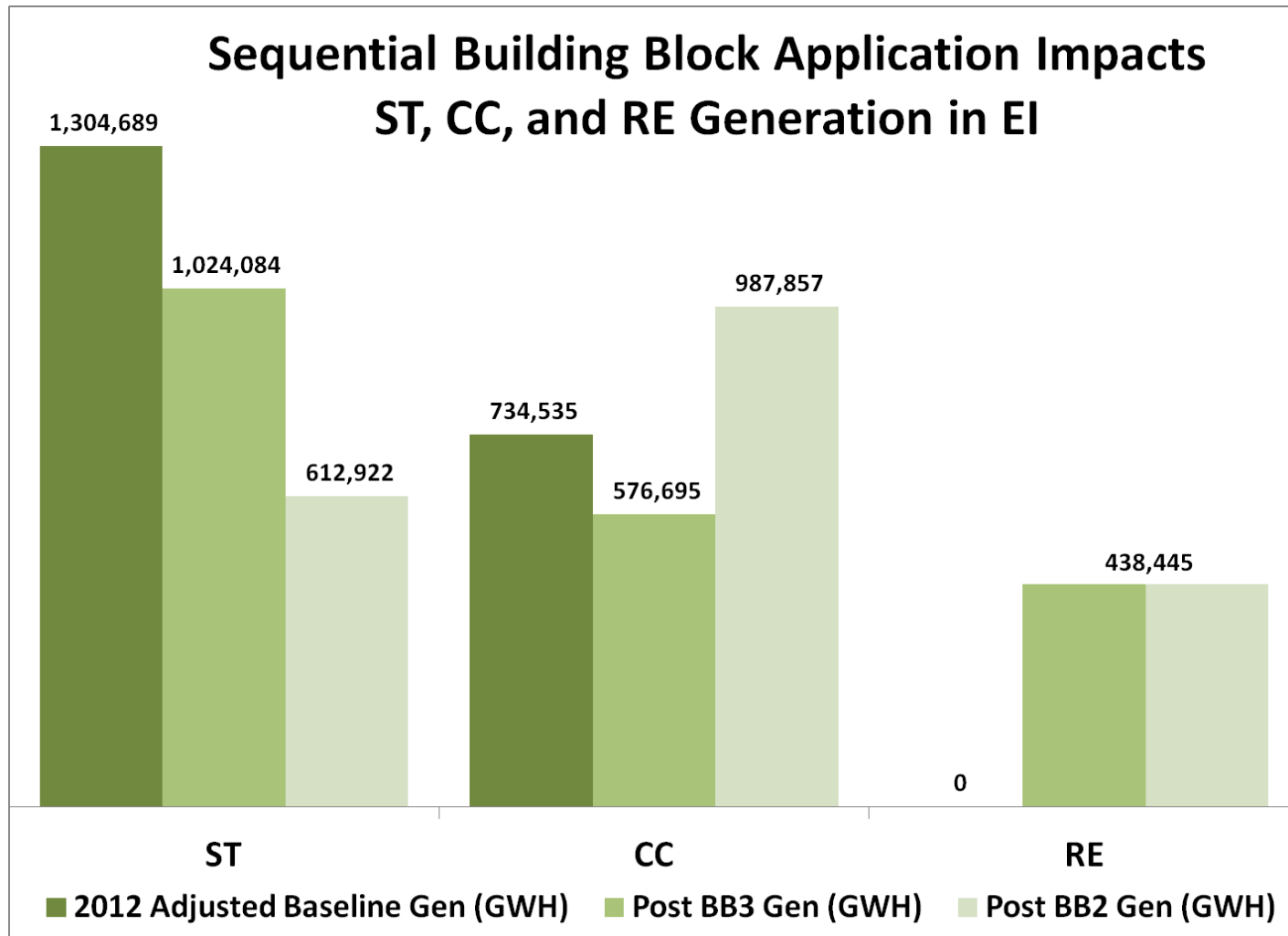
## Step 3: Apply BB2, Redispatch ST to CC

- ◆ **Increase CC generation up to 75% Summer Capacity Factor ceiling which reduces ST production on a 1:1 basis.**

$$\begin{aligned}EI \text{ PostBB } ST \text{ Gen} &= \text{Remaining } ST \text{ Gen} - (\text{CC Potential at 75\%} - \text{Remaining CC Gen}) \\ &= 1,024,173 \text{ GWh} - (987,857 \text{ GWh} - 576,606 \text{ GWh}) = 612,922 \text{ GWh}\end{aligned}$$

$$\begin{aligned}EI \text{ PostBB } CC \text{ Gen} &= \text{Remaining CC Gen} + (\text{Change in BB2 } ST \text{ Gen}) = \text{BB2 Max CC Gen} \\ &= 576,606 \text{ GWh} + (1,024,173 - 612,922) \text{ GWh} = 987,857 \text{ GWh}\end{aligned}$$

# Generation Levels due to BBs



# BSER Technology Category-specific Emission Rate Calculation

- ◆ **BB assumptions applied to each**

$$\begin{aligned}
 EI \text{ BSER ST Rate} &= \frac{(PostBB \text{ ST Gen} \times ST \text{ Rate PostBB1}) + (Incremental \text{ BB2 CC Gen} \times CC \text{ Rate})}{PostBB \text{ ST Gen} + ST \text{ BB3 Gen} + Incremental \text{ BB2 CC Gen}} \\
 &= \frac{(612,922,289 \text{ MWh} \times 2,071 \text{ lb/MWh}) + ((987,857,765 \text{ MWh} - 734,535,157 \text{ MWh}) \times 894 \text{ lb/MWh})}{612,922,289 + 280,515,465 + (987,857,765 - 734,535,157) \text{ MWh}} \\
 &= 1,305 \text{ lb/MWh}
 \end{aligned}$$

$$\begin{aligned}
 EI \text{ BSER CC Rate} &= \frac{(PostBB \text{ CC Gen} \times CC \text{ Rate})}{(PostBB \text{ CC Gen} + CC \text{ BB3 Gen})} = \frac{987,857,765 \text{ MWh} \times 894 \text{ lb/MWh}}{(987,857,765 + 157,929,234) \text{ MWh}} \\
 &= 771 \text{ lb/MWh}
 \end{aligned}$$

- ◆ **The least stringent of the three annual interconnection rates for each category are the uniform national BSER Rates**

# State-Specific Emission Rate Calculation

- ◆ **Calculated as blended Category-specific rates times the baseline proportion of each category by year**
  - *in NY: 27% ST and 73% CC*

$$\begin{aligned}
 \text{NY State Rate Goal} &= \frac{(\text{ST Baseline Gen} \times \text{BSEER ST Rate}) + (\text{CC Baseline Gen} \times \text{BSEER CC Rate})}{(\text{ST Baseline Gen} + \text{CC Baseline Gen})} \\
 &= \frac{(16,661,795 \text{ MWh} \times 1,305 \text{ lb/MWh}) + (44,035,434 \text{ MWh} \times 771 \text{ lb/MWh})}{(16,661,795 + 44,035,434) \text{ MWh}} = \\
 &= (\text{ST \%share} \times \text{BSEER ST Rate}) + (\text{CC \%share} \times \text{BSEER CC Rate}) \\
 &= (27\% \times 1,305 \text{ lb/MWh}) + (73\% \times 771 \text{ lb/MWh}) = 918 \text{ lb/MWh}
 \end{aligned}$$

- ◆ **All state rates bounded by BSEER rates in each year**

# State-Specific Emission Mass Calculation: Mass Adjustment

## ◆ Derived by inclusion of a Mass Adjustment

$$\begin{aligned} \text{NY Mass Adjustment} &= 2 \times \text{State Rate Goal} \times \text{BB3 Gen not captured in Category Specific Rates} \\ &= 2 \times 918 \text{ lb/MWh} \times (0.02235 \times 166,255,493 \text{ MWh}) = 6,822,966,508 \text{ lb} \\ &= 3,411,483 \text{ tons} \end{aligned}$$

## ◆ NY/National gen share x not captured RE

- *Not all RE potential was apportioned in BB3 because least stringent amount of RE was defined as BSER*
  - Not captured RE = 166,255,493 MWH

## ◆ USEPA **doubles** the RE adjustment as a provision for growth

# State-Specific Emission Mass Calculation

- ◆ **Mass goal has two components:**
  - **1) State Rate times the Baseline Generation**
  - **2) Mass Adjustment**

*NY Affected EGU Mass Goal*

$$\begin{aligned} &= \text{State Rate Goal} \times \text{2012 Adjusted Affected EGU Gen} + \text{Mass Adjustment} \\ &= \frac{918\text{lb/MWh} \times 60,697,229 \text{ MWh}}{2,000\text{lb/ton}} + 3,411,483 \text{ tons} = 31,257,429 \text{ tons} \end{aligned}$$



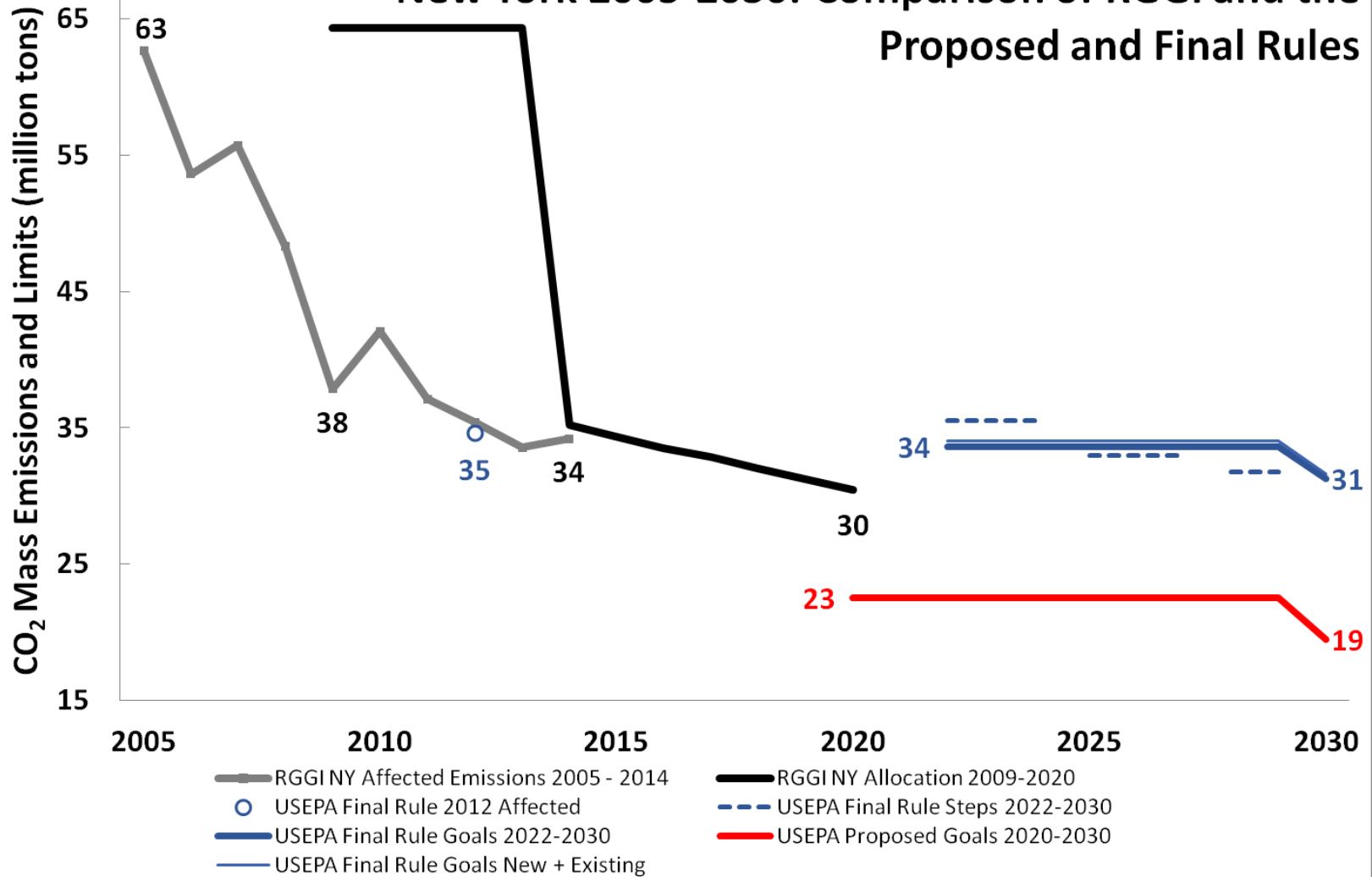
# Clean Power Plan Performance Standards for NY

	2022	2023	2024	2025	2026	2027	2028	2029	2030	Interim*	Final*
<b>Annual Category-Specific Rates (#CO<sub>2</sub>/MWH)</b>											
ST	1,741	1,681	1,592	1,546	1,500	1,453	1,404	1,355	1,304	1,534	1,305
CC	898	877	855	836	817	798	789	779	770	832	771
<b>New York State Annual, Interim, Final, and Step Rate Goals (#CO<sub>2</sub>/MWH)</b>											
NY Annual Rate Goal	1,129	1,098	1,057	1,031	1,005	978	958	937	918	1,025	918
NY Step Rate Goal	1,095			1,005			948		918	1,025	918
<b>New York State Annual, Interim, Final, and Step Mass Goals (million tons CO<sub>2</sub>)</b>											
NY Annual Mass Goal	36.66	35.54	34.28	33.66	32.99	32.15	31.89	31.60	31.26	33.60	31.26
NY Step Mass Goal	35.49			32.93			31.74		31.26	33.60	31.26

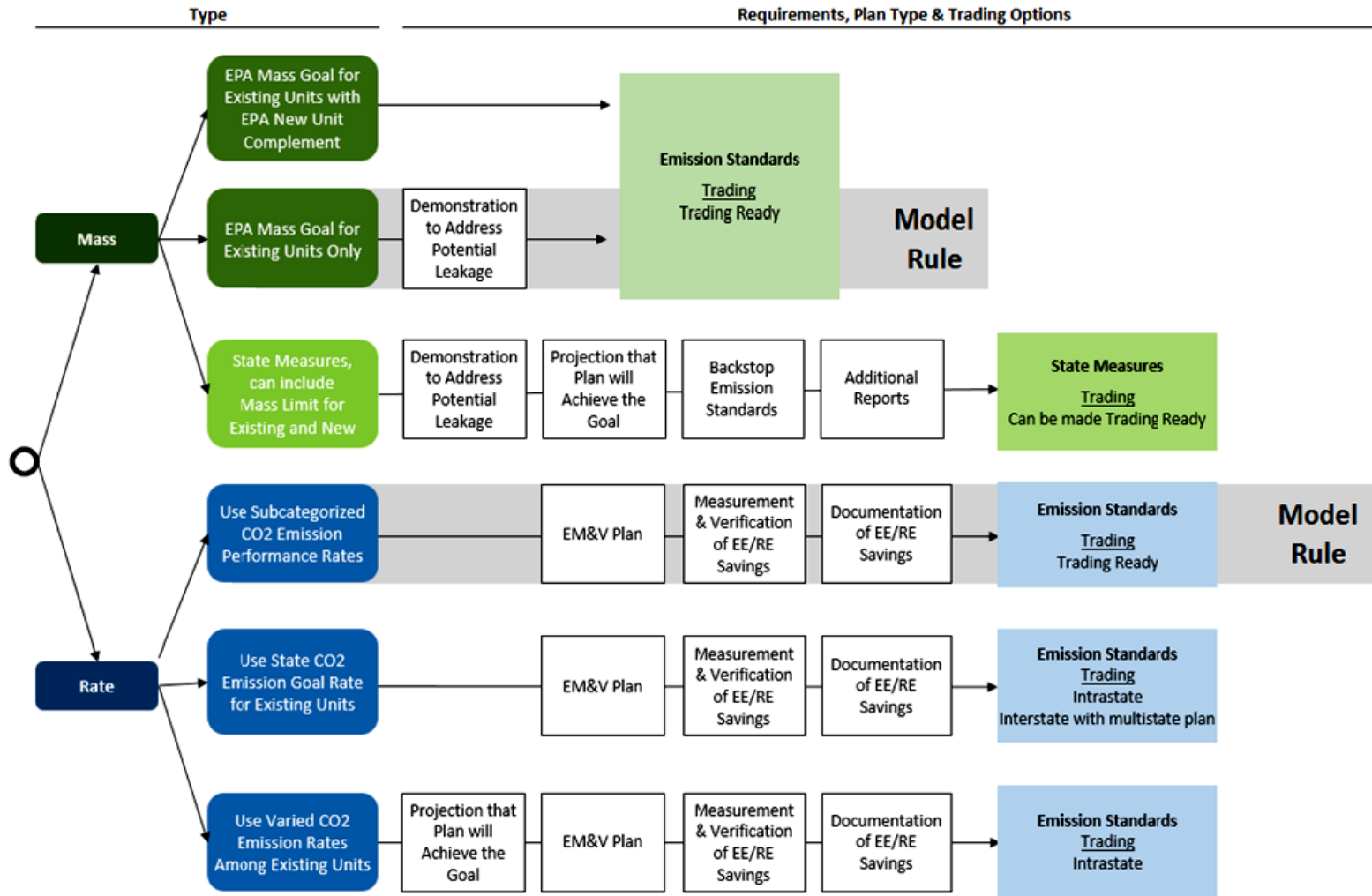
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<http://www.epa.gov/airquality/cpp/tsd-cpp-emission-performance-rate-goal-computation-appendix-1-5.xlsx>

## The USEPA Clean Power Plan CO<sub>2</sub> Emissions and Limits in New York 2005-2030: Comparison of RGGI and the Proposed and Final Rules



# SP Compliance Pathways



[http://www2.epa.gov/sites/production/files/2015-08/documents/flow\\_chart\\_v6\\_aug5.pdf](http://www2.epa.gov/sites/production/files/2015-08/documents/flow_chart_v6_aug5.pdf)

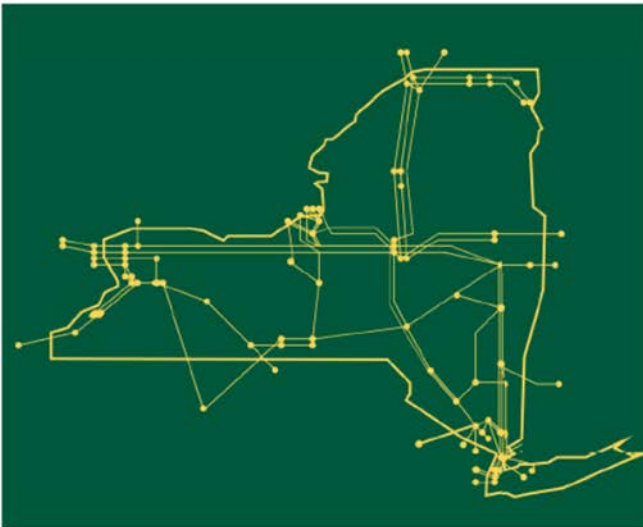
# Study Plan

- ◆ **Continue assimilation and analysis**
- ◆ **Collaboration with State Agencies, ISOs, MPs, and USEPA**
- ◆ **Develop analyses of multiple approaches to SPs**
- ◆ **Develop analyses of possible RGGI/CPP SPs**
- ◆ **Periodic reports to ESPWG**

# Abbreviations Used

- ◆ **BB** – Building Block
- ◆ **BSER** – Best System of Emission Reductions
- ◆ **CPP** – Clean Power Plan
- ◆ **EE** – Energy Efficiency
- ◆ **EGU** – Electric Generating Unit
- ◆ **EI** – Eastern Interconnection
- ◆ **FIP** – Federal Implementation Plan
- ◆ **HRI** – Heat Rate Improvement
- ◆ **IPM** – Integrated Planning Model
- ◆ **SP** – State Plan
- ◆ **ST** – Fossil Steam (coal/oil/gas boilers)
- ◆ **NGCC/CC** – Natural Gas Combined Cycle
- ◆ **RE** – Renewable Energy

The New York Independent System Operator (NYISO) is a not-for-profit corporation responsible for operating the state's bulk electricity grid, administering New York's competitive wholesale electricity markets, conducting comprehensive long-term planning for the state's electric power system, and advancing the technological infrastructure of the electric system serving the Empire State.



[www.nyiso.com](http://www.nyiso.com)