2017 CARIS Emissions Price Forecast Development Updated

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ESPWG

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DRAFT – FOR DISCUSSION PURPOSES ONLY

Agenda

- Past projections
- Current conditions
- Emission price forecasts
  - Carbon Dioxide – CO_2
  - Ozone Season Nitrogen Oxides – $OSNO_X$
  - Annual Nitrogen Oxides – ANO_X
  - Sulfur Dioxide – SO_2
- Feedback

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Past Projections

- Compare actual load metrics with 2016 projections from 2006 Goldbook

	Peak (MW)	Energy (GWh)
2006 Goldbook	36,623	184,630
Actual 2016	33,225	159,169
% Δ	9.3%	13.8%

- Compare actual 2016 NY RGGI emissions and RGGI allowance price projections from 2009 CARIS

	$/ton	NY RGGI Emissions (tons)
2009 CARIS	5.70	56,237,000
Actual 2016	5.23	31,194,515
% Δ	8%	44.5%

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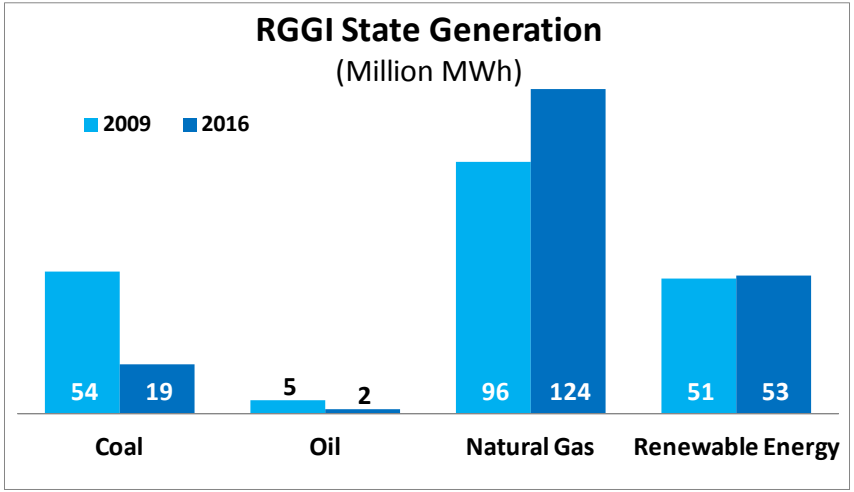
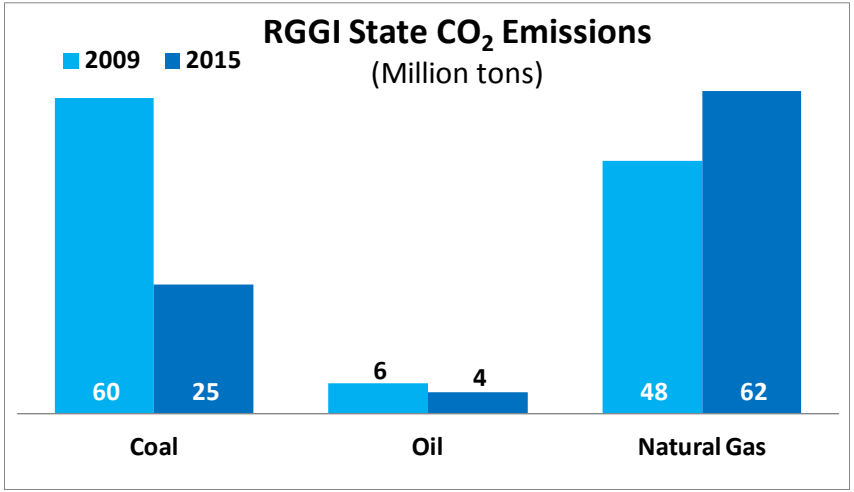
What changed?

- **Marcellus Shale Gas**
  - 2009 CARIS Natural Gas Price 2016: $8-9/mmBTU
  - 2016 Natural Gas Price
    - Henry Hub: $2.46/mmBTU
    - Transco Z6: $2.22/mmBTU
    - TGP6: $3.08/mmBTU
    - Tetco M3: $1.70/mmBTU

What changed?

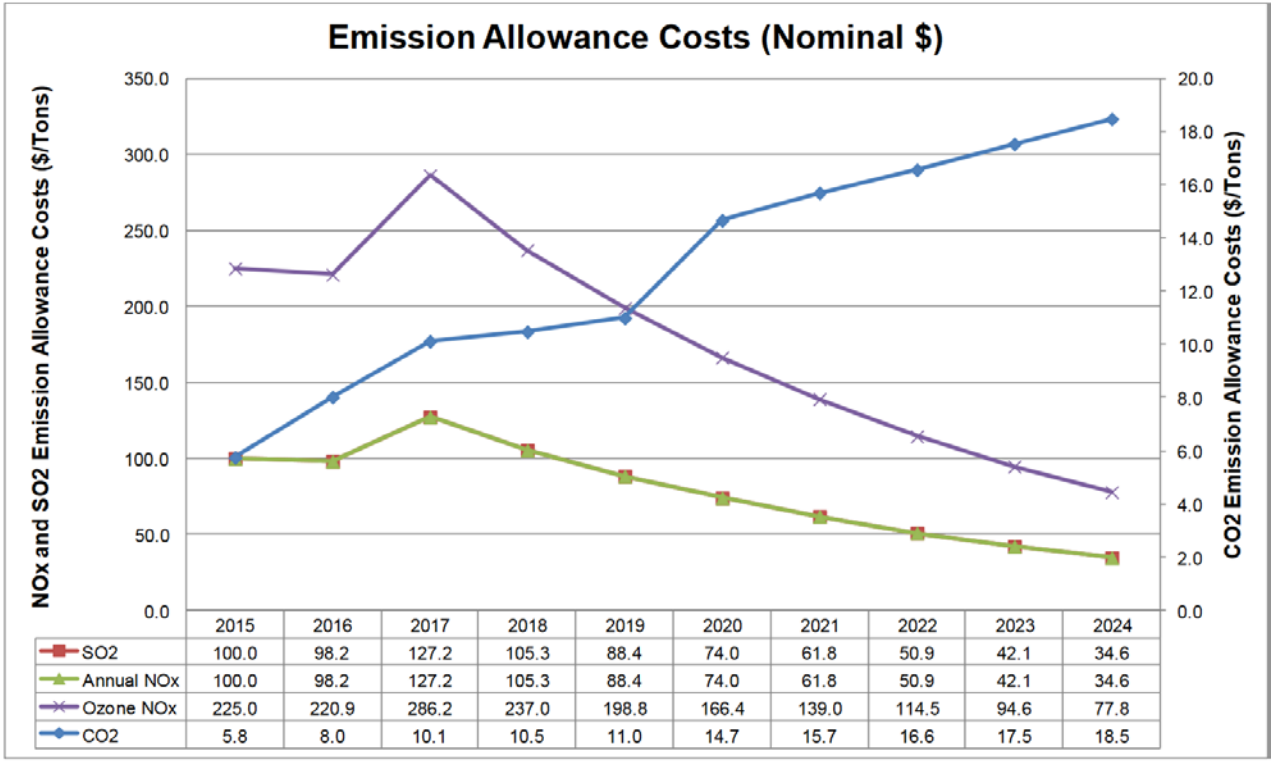




	RGGI State Generation (MWh)	RGGI State Emissions (tons)	RGGI Covered Emissions (tons)
2009	303,432,961	120,229,753	107,521,227
2015/6	288,593,698	96,011,712	80,571,580

Sources: USEIA State Electricity Data, USEPA AMPD

2015 Projections



	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
SO2	100.0	98.2	127.2	105.3	88.4	74.0	61.8	50.9	42.1	34.6
Annual NOx	100.0	98.2	127.2	105.3	88.4	74.0	61.8	50.9	42.1	34.6
Ozone NOx	225.0	220.9	286.2	237.0	198.8	166.4	139.0	114.5	94.6	77.8
CO2	5.8	8.0	10.1	10.5	11.0	14.7	15.7	16.6	17.5	18.5

Figure 4-5: Emission Allowance Forecast

http://www.nyiso.com/public/webdocs/markets_operations/services/planning/Planning_Studies/Economic_Planning_Studies_%28CARIS%29/CARIS_Final_Reports/2015_CARIS_Report_FINAL.pdf

Current Conditions

- **RGGI currently under Program Review to determine post-2020 design features**
  - Level of the regional emission cap
    - New York has proposed a 30% reduction in the cap
  - Structure of the floor and ceiling pricing/supply constraints
    - Cost Containment Reserve (CCR)
    - Emission Containment Reserve (ECR)
    - Offsets
  - Banking adjustment
  - Change in member states
- **State/Regional/Federal Clean Energy and Environmental Policy Uncertainty**

Factors Affecting the Price of a RGGI CO_2 Allowance

- New RGGI Rules
  - Structure of the Cap and Floor
  - Size and treatment of the Bank
  - Membership
- Grid Energy and Peak Requirements
- Federal Actions
  - Potential withdrawal of CPP
  - Support for energy infrastructure development
- Regional Public Policy developments

Factors Affecting the Price of a RGGI CO_2 Allowance (cont.)

- **Composition and location of generating resources**
  - Operation of nuclear plants in the region
  - Potential retirements of GTs and STs
    - By 2026 3,500 MW of GTs and 4,000 MW of STs will be older than the age at which 95% of similar units have retired nationally
  - NY's Clean Energy Standard plan identified 5,000 MW of new renewables by 2026
  - Other RGGI states also have aggressive RE goals
  - New efficient fossil fuel-fired resources
  - Imports
- **Natural Gas Price**
  - Gas transmission system expansion
  - Continued reductions in the cost of developing and delivering natural gas

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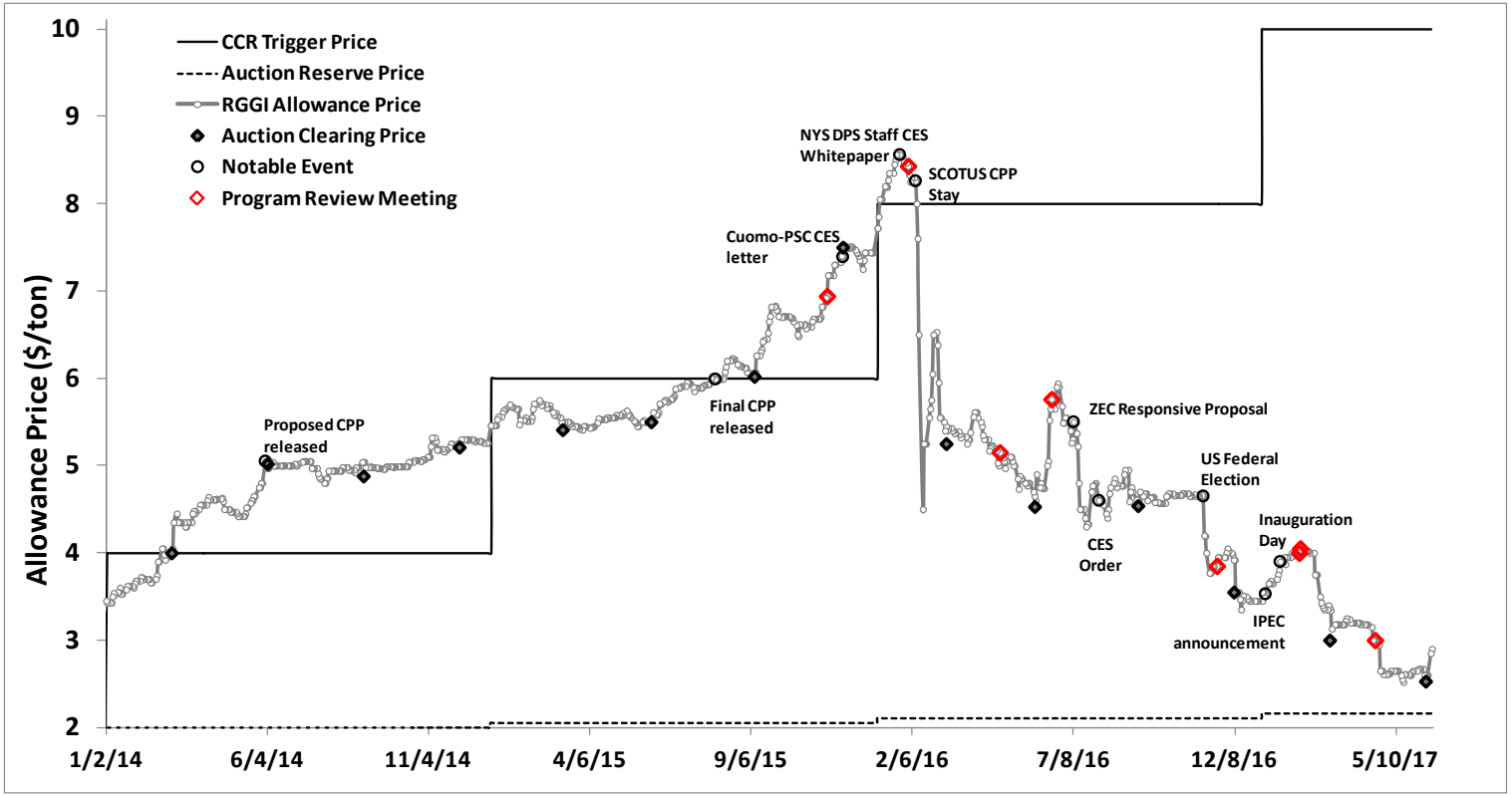
RGGI prices reflect the expectations of market participants for the rules, membership, generating fleet composition, fuel prices and policies



Sources: Argus Air Daily, RGGI Inc.

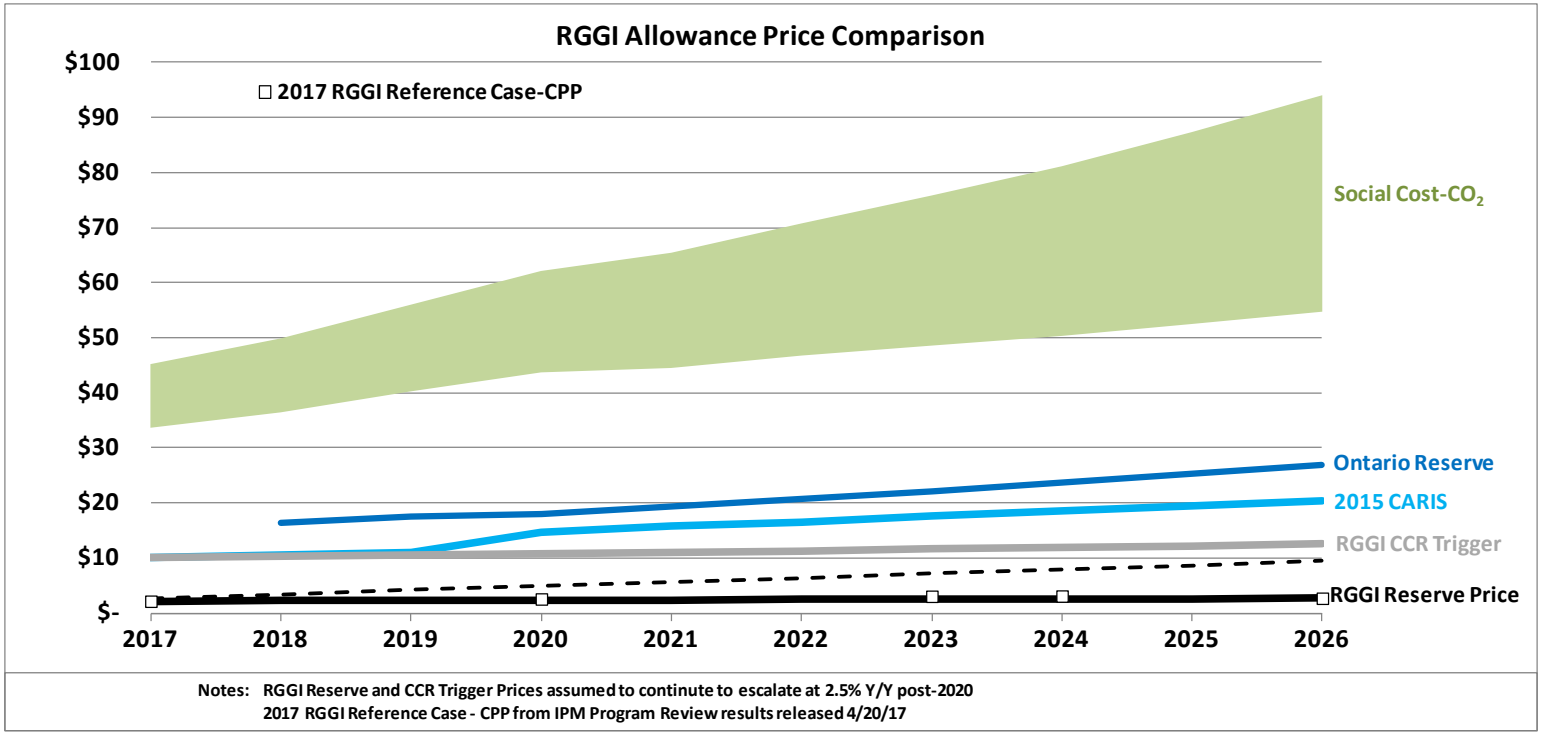
NYISO approach to estimating RGGI Allowance Prices for CARIS 2017

- RGGI will have a Minimum Reserve Price (floor) and CCR similar to the current design
- The base case will include a 30% cap reduction by 2030 compared to the 2020 cap
- The estimated RGGI cap will be 64,103,676 tons in 2026
- The allowance bank and renewable energy expansion will dampen the emissions impacts of nuclear retirements
- The production simulation will be run iteratively with adjusted allowance prices until the reported CO_2 emissions are approximately equal to the 2026 cap
- Allowance prices will be estimated to grow linearly between 2017 and 2026

Emission Price Forecasts

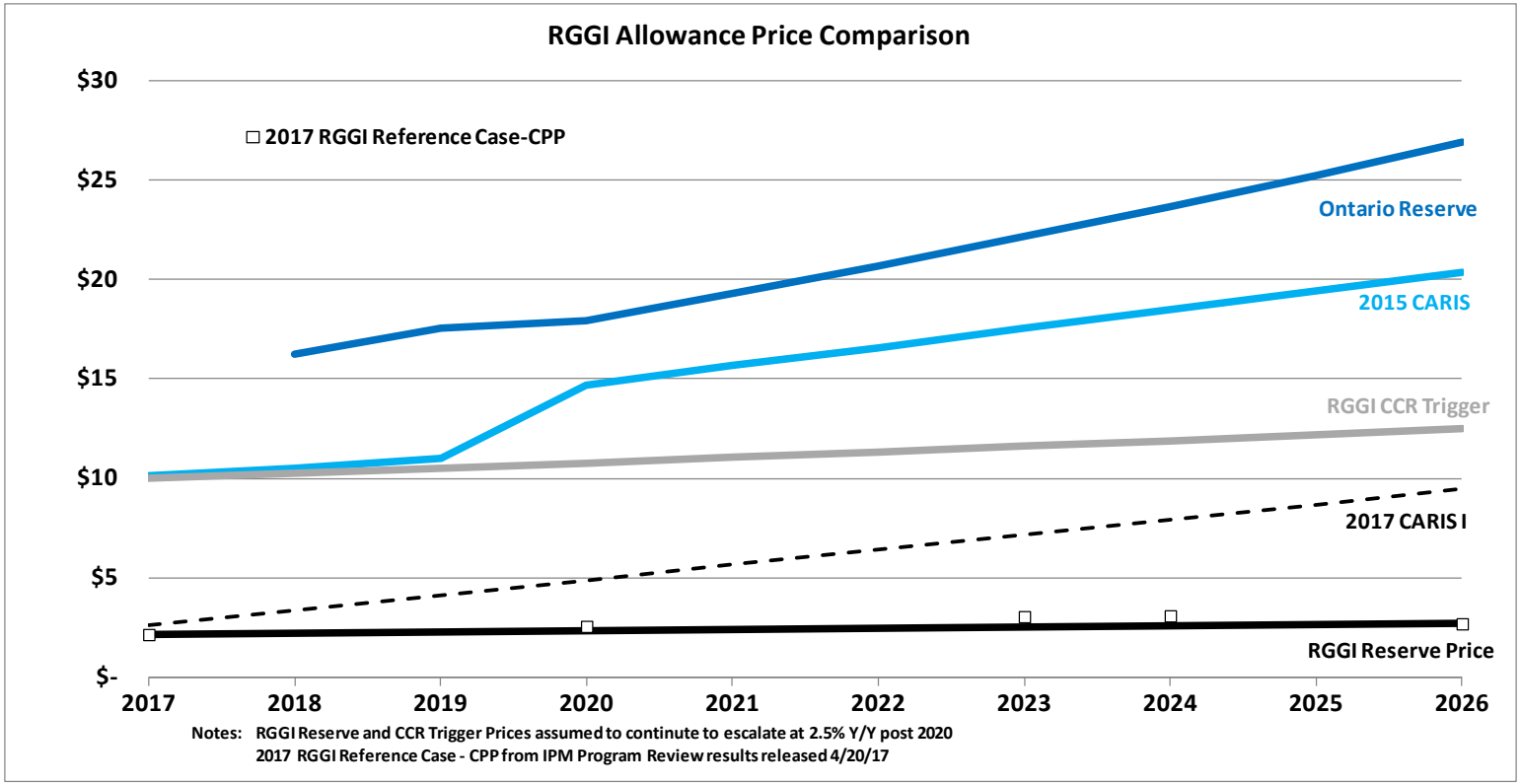
CO_2, $OSNO_X$, ANO_X, and SO_2

CO_2 Allowance Price Forecast



Notes: RGGI Reserve and CCR Trigger Prices assumed to continute to escalate at 2.5% Y/Y post-2020
2017 RGGI Reference Case - CPP from IPM Program Review results released 4/20/17

CO_2 Allowance Price Forecast

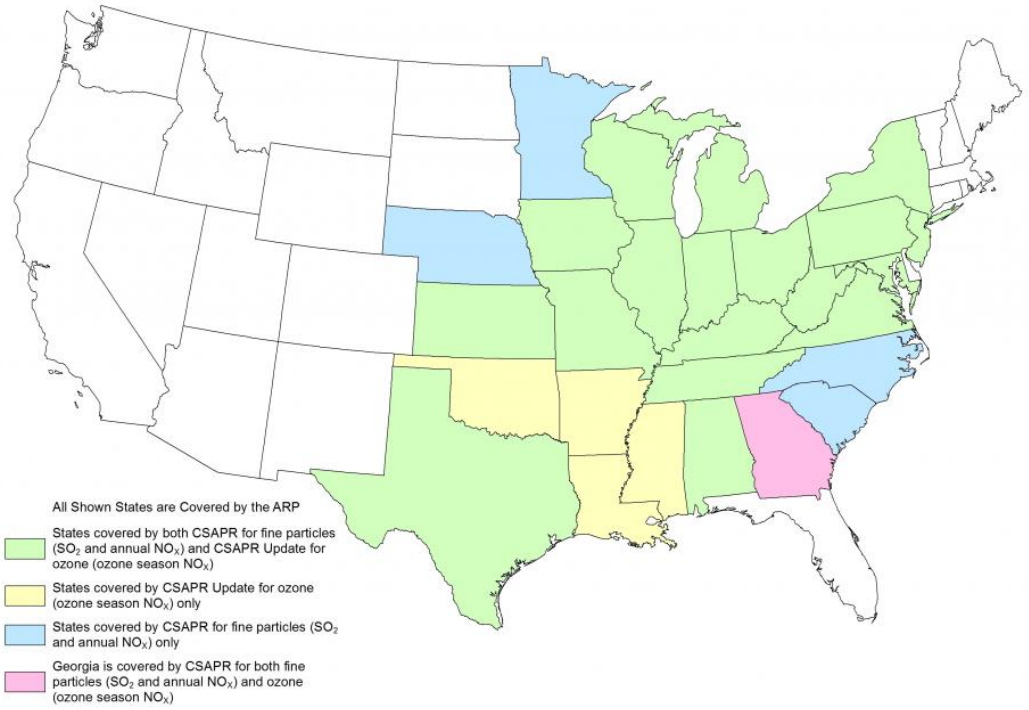


Long-Term Carbon Price Forecast: ICF-Ontario Energy Board Report – May 31, 2017 – https://www.oeb.ca/sites/default/files/uploads/OEB-LTCPF-Report-20170531.pdf

CSAPR Update Rule - Map and State Budgets

Budgets and Emissions for States in the Final CSAPR Update

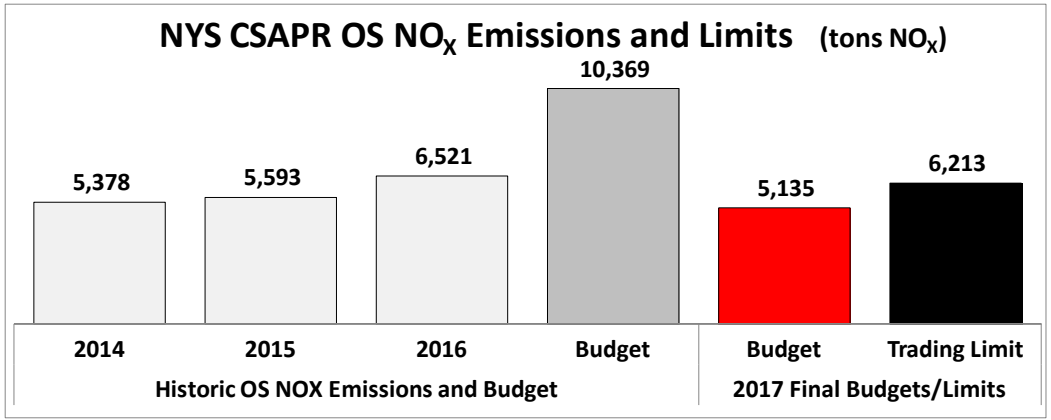
State	2015 Emissions[1]	Final 2017 CSAPR Update Budget[2]	Proposed 2017 CSAPR Update Budget[3]
Alabama	20,369	13,211	9,979
Arkansas	12,560	12,048	6,949
Illinois	15,976	14,601	12,078
Indiana	36,353	23,303	28,284
Iowa	12,178	11,272	8,351
Kansas	8,136	8,027	9,272
Kentucky	27,731	21,115	21,519
Louisiana	19,257	18,639	15,807
Maryland	3,900	3,828	4,026
Michigan	21,530	16,545	19,115
Mississippi	6,438	6,315	5,910
Missouri	18,855	15,780	15,323
New Jersey	2,114	2,062	2,015
New York	5,593	5,135	4,450
Ohio	27,382	19,522	16,660
Oklahoma	13,922	11,641	16,215
Pennsylvania	36,033	17,952	14,387
Tennessee	9,201	7,736	5,481
Texas	55,409	52,301	58,002
Virginia	9,651	9,223	6,818
West Virginia	26,937	17,815	13,390
Wisconsin	9,072	7,915	5,561
Total	**398,596**	**315,986**	**299,592**

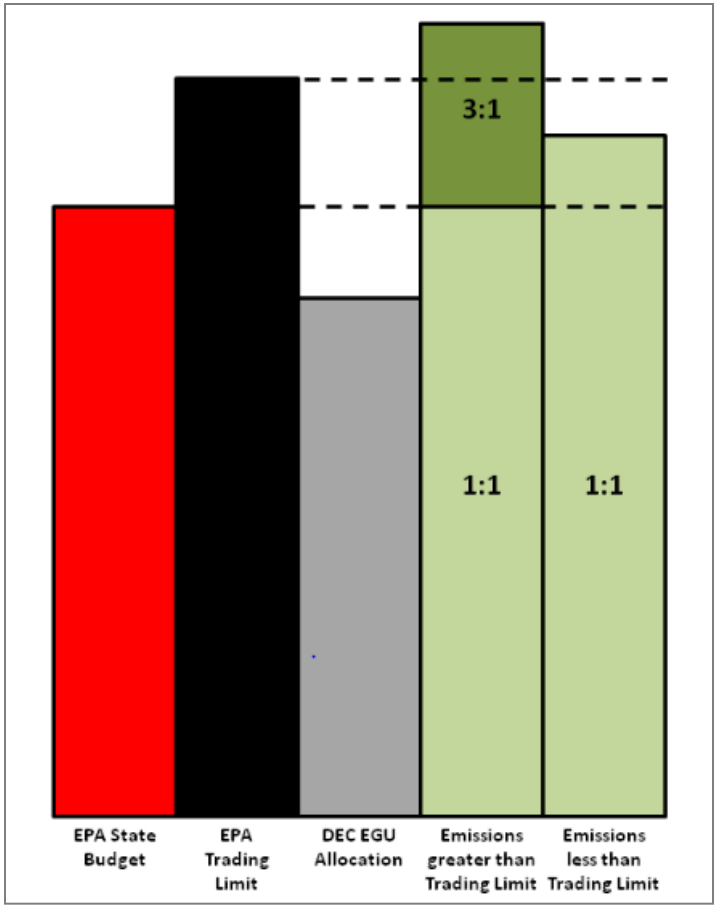


https://www.epa.gov/sites/production/files/2017-06/documents/final_finalcsaprur_keychangesfactsheet.pdf
https://www.epa.gov/airmarkets/map-states-covered-csapr

CSAPR Penalty Provisions

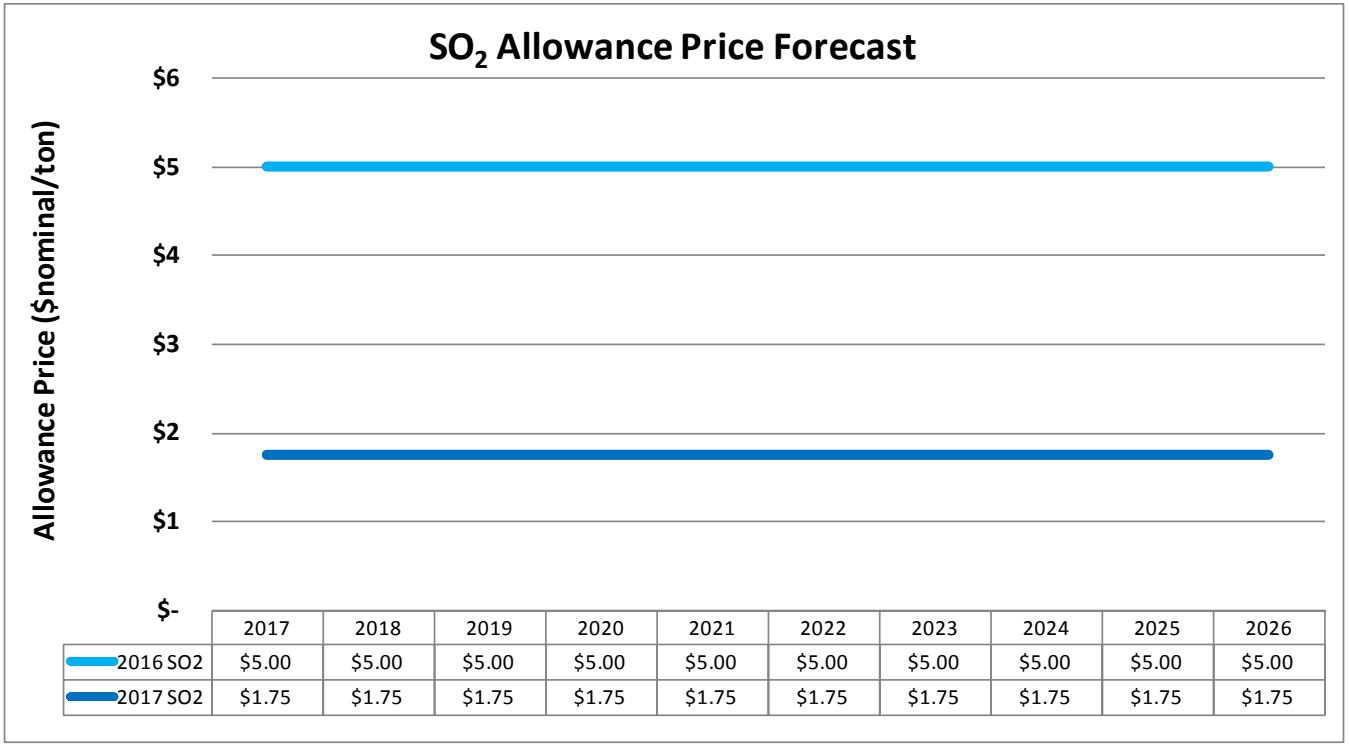
- Recent past ozone season emissions exceed new limits applicable beginning May 1, 2017
  - Ozone season occurs annually May 1 – September 30
- When the trading limit is exceeded, emissions in excess of the budget require three allowances for each ton (3:1)





SO_2 Allowance Price Forecasts

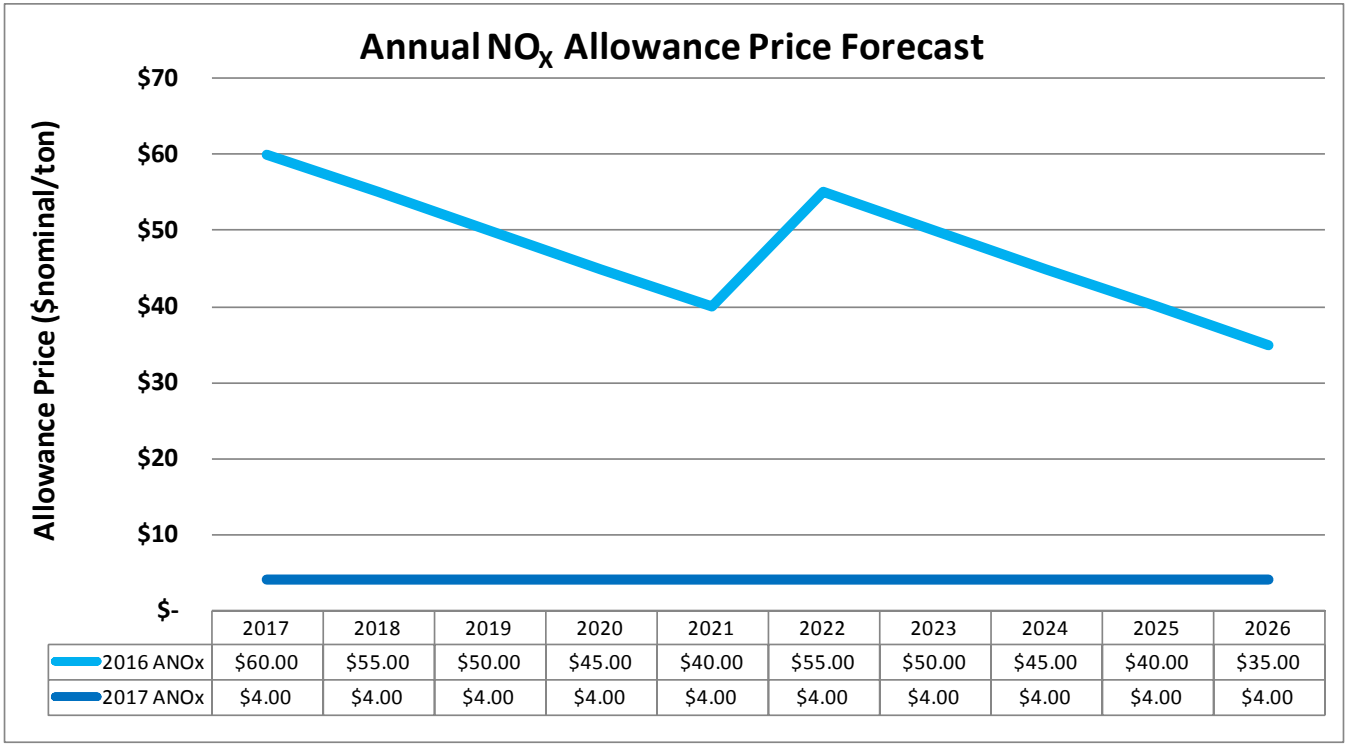
Comparison to 2016 CARIS 2



	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
2016 SO2	$5.00	$5.00	$5.00	$5.00	$5.00	$5.00	$5.00	$5.00	$5.00	$5.00
2017 SO2	$1.75	$1.75	$1.75	$1.75	$1.75	$1.75	$1.75	$1.75	$1.75	$1.75

Annual NO_X Allowance Price Forecasts

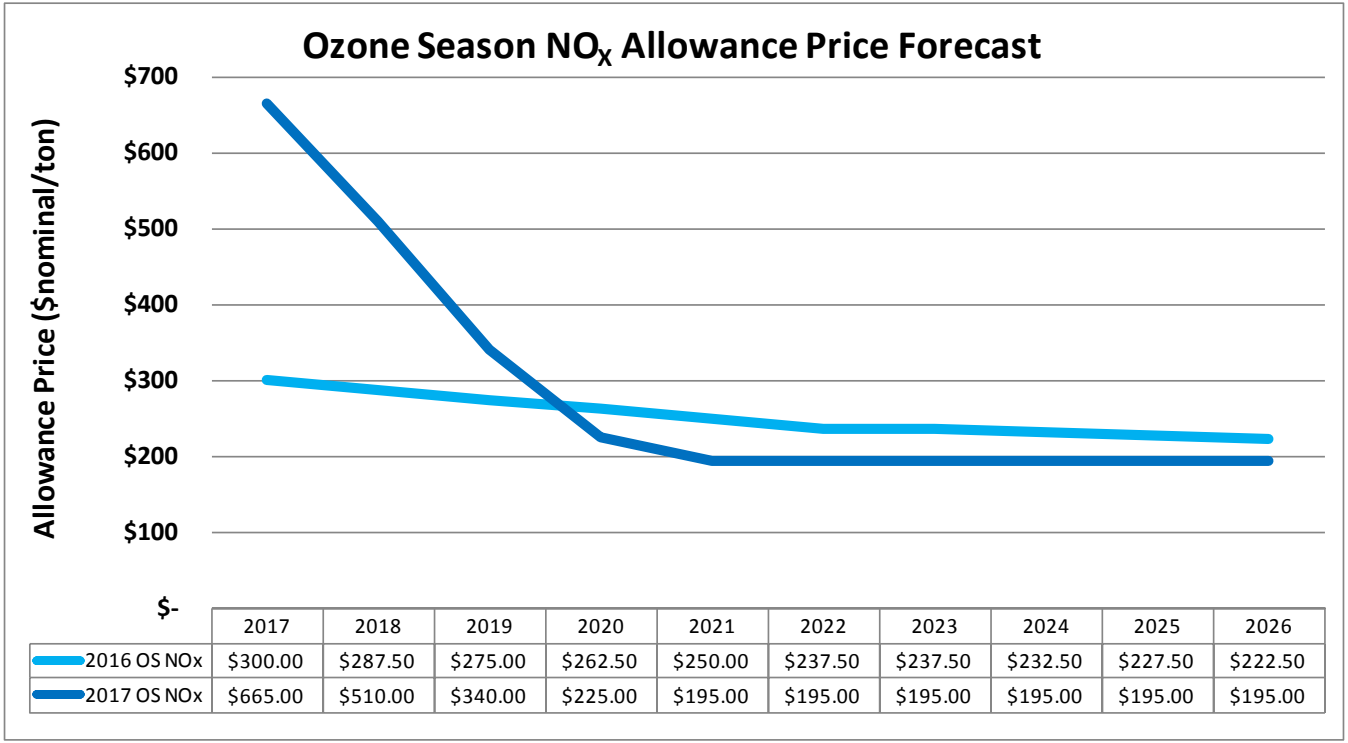
Comparison to 2016 CARIS 2



	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
2016 ANOx	$60.00	$55.00	$50.00	$45.00	$40.00	$55.00	$50.00	$45.00	$40.00	$35.00
2017 ANOx	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00

Seasonal NO_X Allowance Price Forecasts

Comparison to 2016 CARIS 2



	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
2016 OS NOx	$300.00	$287.50	$275.00	$262.50	$250.00	$237.50	$237.50	$232.50	$227.50	$222.50
2017 OS NOx	$665.00	$510.00	$340.00	$225.00	$195.00	$195.00	$195.00	$195.00	$195.00	$195.00

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- Maintaining and enhancing regional reliability
- Operating open, fair and competitive wholesale electricity markets
- Planning the power system for the future
- Providing factual information to policy makers, stakeholders and investors in the power system

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