Initial Assessment of Decarbonization on Chesapeake Airshed, Watershed, and Tidal Bay Loads

Modeling Workgroup Quarterly Meeting – October 2024

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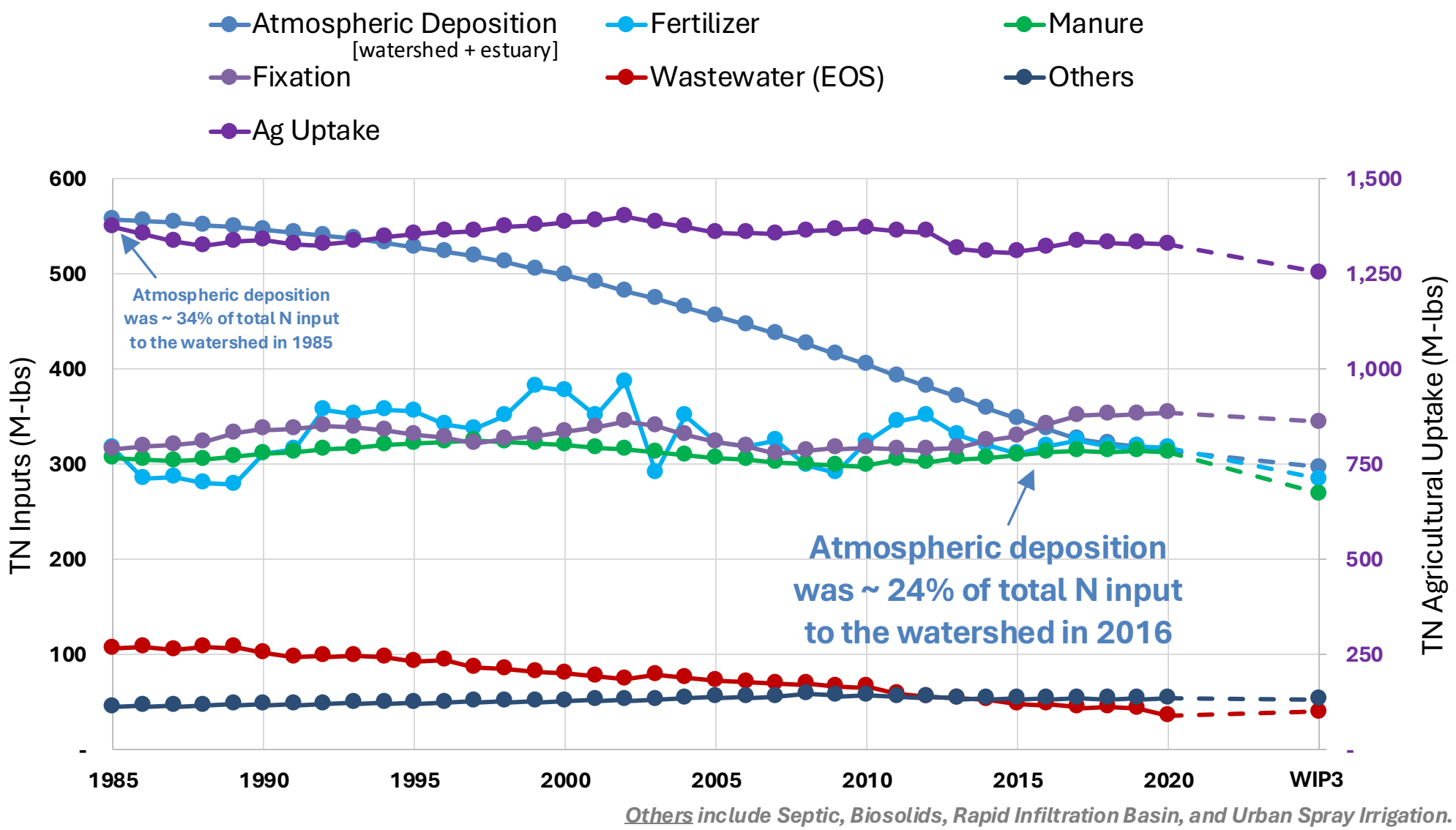
Presentation Outline

1. Brief overview
2. GCAM/CMAQ scenarios
3. Estimated trends in atmospheric N-depositions
4. Summary of estimated changes in N-deliveries to the Bay

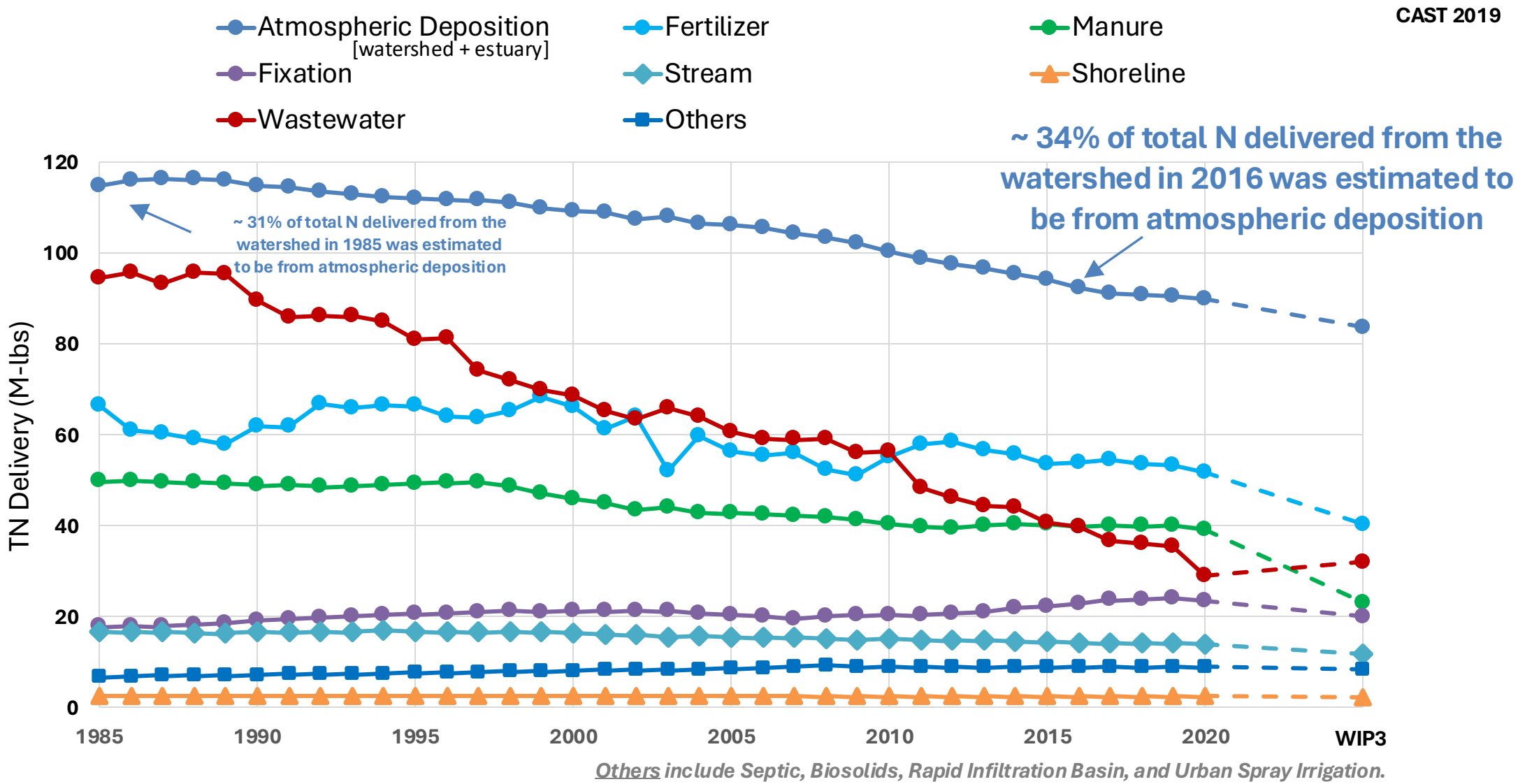
Phase 6 estimates of Total Nitrogen (TN) input to the Chesapeake Bay Watershed



Others include Septic, Biosolids, Rapid Infiltration Basin, and Urban Spray Irrigation.

https://d18lev1ok5leia.cloudfront.net/chesapeakebay/documents/20231017-BHATT-Integrated-Source-Apportionment-Analysis-of-Atmospheric-N-Deposition.pdf

Phase 6 estimates of Total Nitrogen (TN) delivery to the Chesapeake Bay



Others include Septic, Biosolids, Rapid Infiltration Basin, and Urban Spray Irrigation.

Estimated decreasing TN delivery is due to a combination of changes in inputs, BMPs, and management actions.

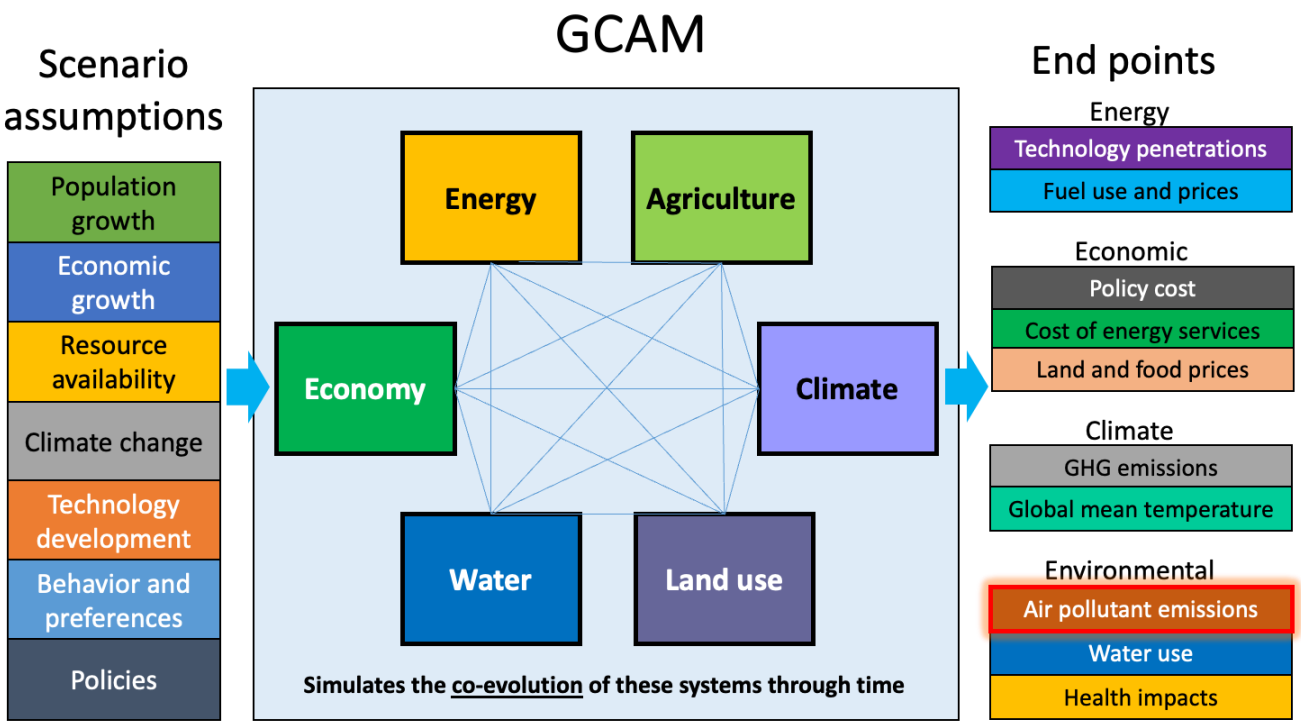
Motivation

- Understand the water quality effects of future energy scenarios
- Improve our future analyses of climate change assessment, growth, and management scenarios

Global Change Analysis Model (GCAM)

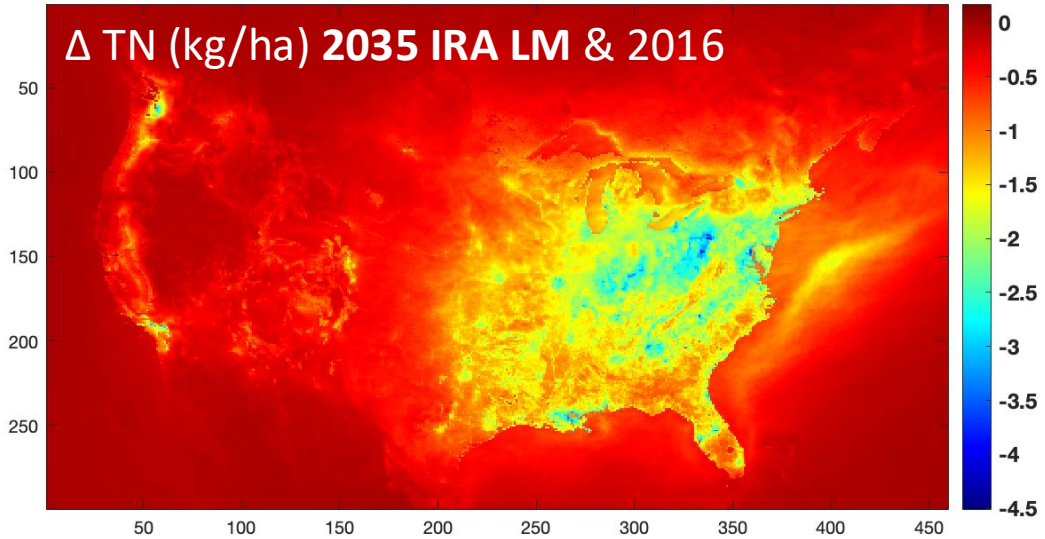
- GCAM simulates the co-evolution of climate, economy, energy, agriculture, land use and water systems through time.

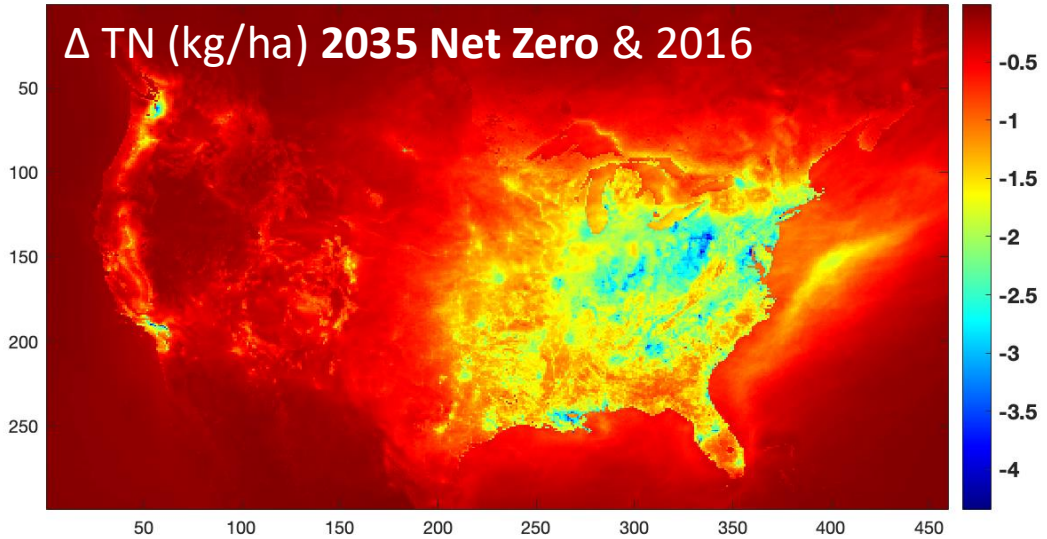
- GCAM's energy related changes were incorporated as state and sector specific emissions through scaling factors into Community Multistate Air Quality (CMAQ) model.

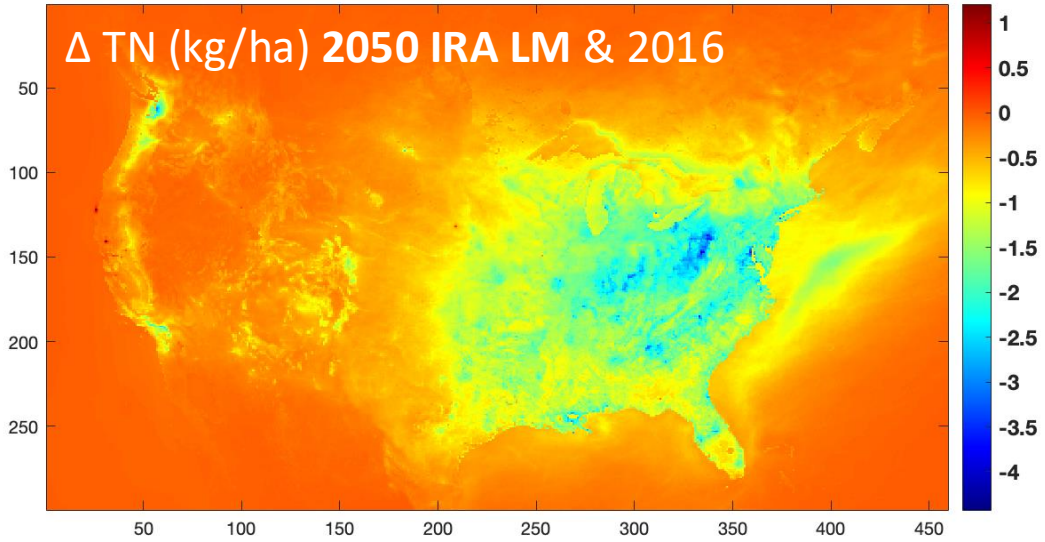


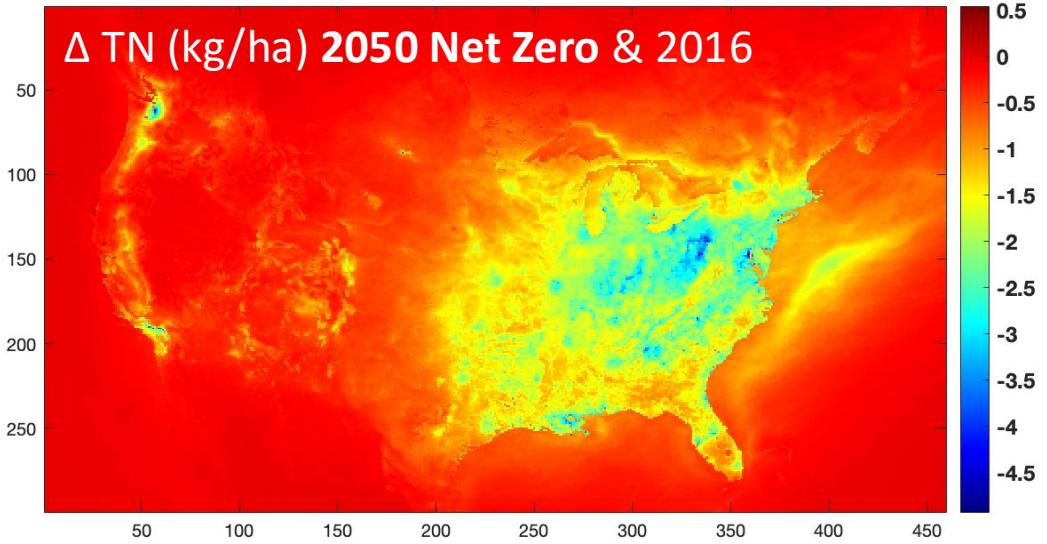
Jesse Bash, Chris Nolte, Dan Loughlin, and Ben Murphy

- We received CMAQ data for 2016 along with the data for 2035 and 2050 under scenarios of **(a)** Inflation Reduction Act & Limited GHG Mitigation (**IRA LM**) and **(b)** Net Zero by 2050 with national scale implementations of state GHG reduction goals (**Net Zero**).

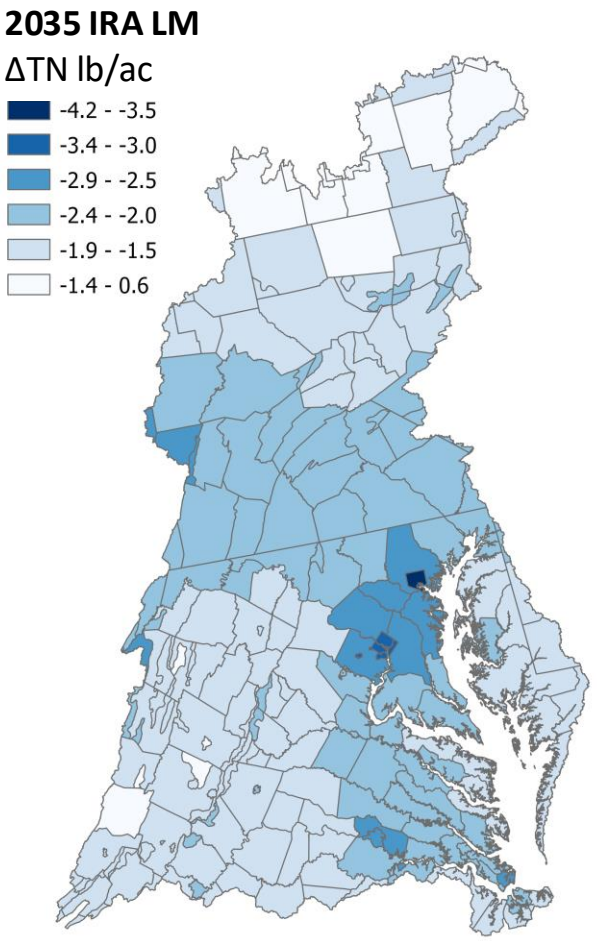


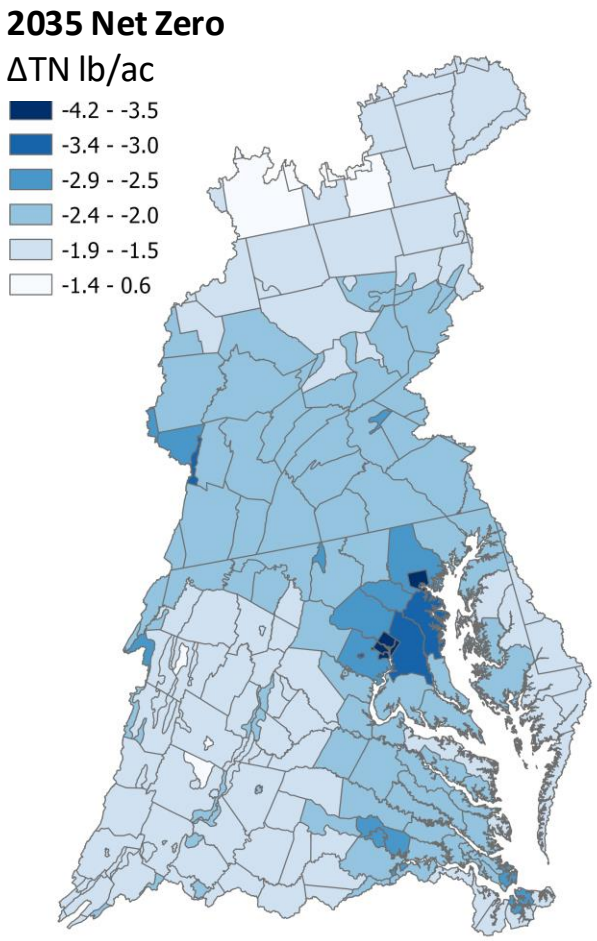


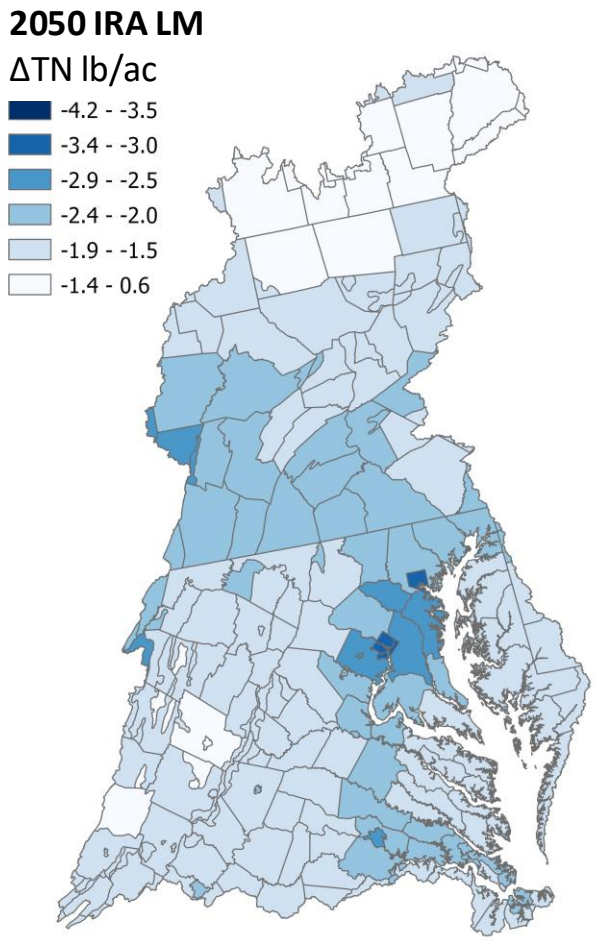


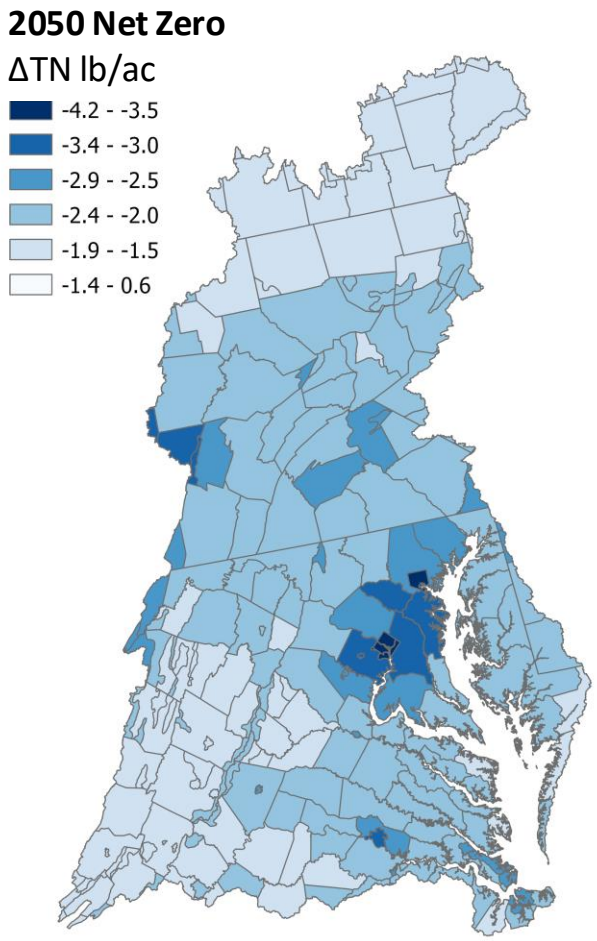


- Three deposition pathways: (1) watershed, (2) direct to Bay, and (3) mid-Atlantic bight
- Delta change in **wet** and **dry**, **oxidized** and **reduced**, N depositions were calculated for **(i) land segment** and (**ii) the Bay**, and then incorporated then into CBP Phase 6 Airshed Model estimated rainfall normalized trends.





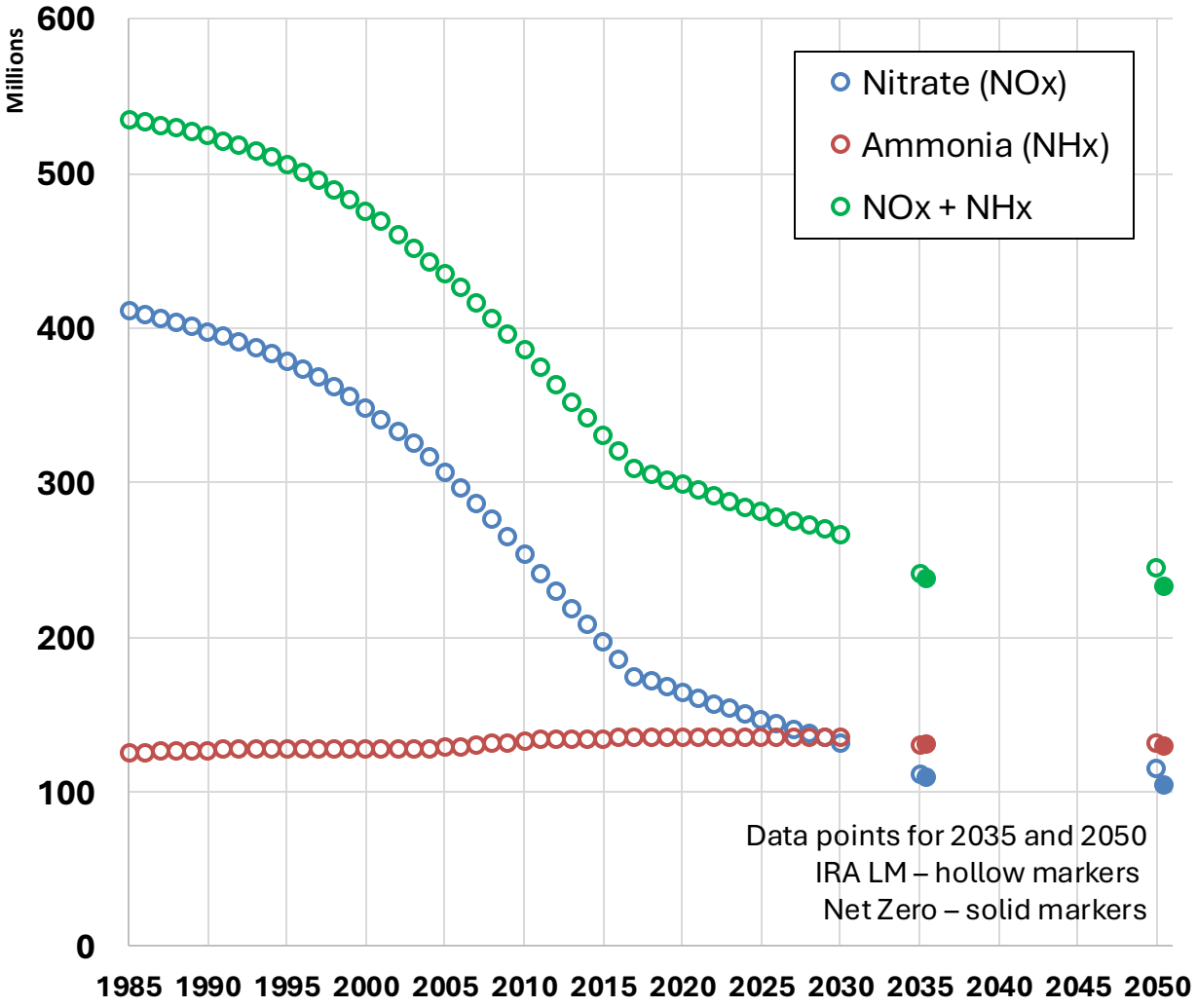




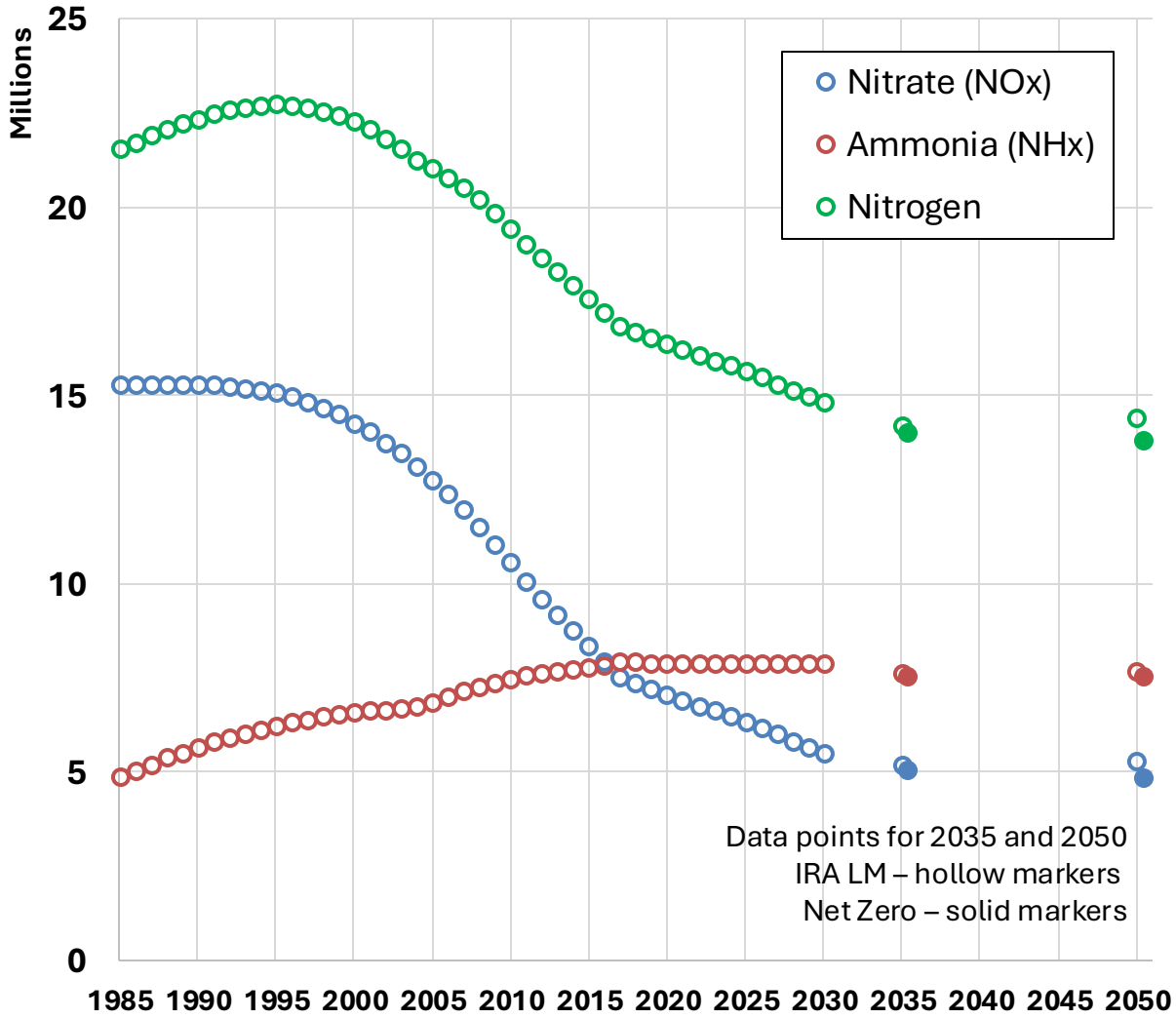
Δ from 2016 are shown

Estimated trends in atmospheric N-deposition

N-deposition to the watershed



N-deposition to the Bay



Atmospheric N-deposition Inputs

Atmospheric Deposition	2016 Air	2030 Air	2035 IRA LM	2035 Net Zero	2050 IRA LM	2050 Net Zero
Chesapeake Bay Watershed	319.80	266.70	241.39	238.28	245.25	233.26
Direct to Chesapeake Bay	17.15	14.77	14.16	13.99	14.35	13.75
Total Input	**336.95**	**281.47**	**255.55**	**252.27**	**259.60**	**247.00**

Δ Atmospheric Deposition	2016 Air	2030 Air	2035 IRA LM	2035 Net Zero	2050 IRA LM	2050 Net Zero
Chesapeake Bay Watershed		0	-25.31	-28.42	-21.44	-33.44
Direct to Chesapeake Bay		0	-0.61	-0.78	-0.42	-1.03
Total Input		**0**	**-25.92**	**-29.20**	**-21.87**	**-34.46**

TN delivery to the Bay (WIP3 management in CAST-19)

TN Delivery	2016 Air	2030 Air	2035 IRA LM	2035 Net Zero	2050 IRA LM	2050 Net Zero
DC Potomac	2.32	2.31	2.30	2.30	2.30	2.30
DE Eastern Shore	4.94	4.88	4.88	4.87	4.88	4.87
MD Eastern Shore	15.91	15.63	15.57	15.55	15.59	15.53
MD Patuxent	3.08	3.01	2.99	2.99	3.00	2.98
MD Potomac	16.25	16.00	15.89	15.88	15.91	15.85
MD Susquehanna	1.67	1.64	1.63	1.63	1.63	1.62
MD Western Shore	9.13	8.99	8.93	8.92	8.94	8.91
NY Susquehanna	11.75	11.60	11.53	11.52	11.54	11.51
PA Eastern Shore	0.54	0.53	0.53	0.53	0.53	0.53
PA Potomac	6.75	6.66	6.60	6.60	6.61	6.59
PA Susquehanna	76.35	75.22	74.62	74.54	74.73	74.44
PA Western Shore	0.02	0.02	0.02	0.02	0.02	0.02
VA Eastern Shore	1.54	1.51	1.51	1.51	1.51	1.51
VA James	21.26	20.93	20.79	20.77	20.81	20.74
VA Potomac	15.67	15.46	15.35	15.34	15.36	15.31
VA Rappahannock	6.59	6.49	6.45	6.44	6.45	6.43
VA York	5.41	5.30	5.26	5.26	5.27	5.25
WV James	0.05	0.05	0.05	0.05	0.05	0.05
WV Potomac	7.82	7.71	7.64	7.64	7.65	7.62
Total Watershed Delivery	**207.05**	**203.93**	**202.54**	**202.35**	**202.78**	**202.06**

ΔTN delivery to the Bay

Δ Atmospheric Deposition	2016 Air	2030 Air	2035 IRA LM	2035 Net Zero	2050 IRA LM	2050 Net Zero
Chesapeake Bay Watershed		0	-25.31	-28.42	-21.44	-33.44
Direct to Chesapeake Bay		**0**	**-0.61**	**-0.78**	**-0.42**	**-1.03**
Total Input		0	-25.92	-29.20	-21.87	-34.46
States (*wrt* 2030 Air)						
DC		0	-0.003	-0.004	-0.003	-0.006
DE		0	-0.007	-0.011	-0.002	-0.015
MD		0	-0.252	-0.301	-0.195	-0.379
NY		0	-0.071	-0.081	-0.058	-0.093
PA		0	-0.660	-0.741	-0.547	-0.850
VA		0	-0.328	-0.370	-0.282	-0.444
WV		0	-0.069	-0.074	-0.062	-0.087
Total		**0**	**-1.390**	**-1.581**	**-1.149**	**-1.875**
		0	**-2.003**	**-2.365**	**-1.572**	**-2.901**

- The end.