Global Change Analysis Model (GCAM) for future energy scenarios – Chesapeake Bay water quality perspectives

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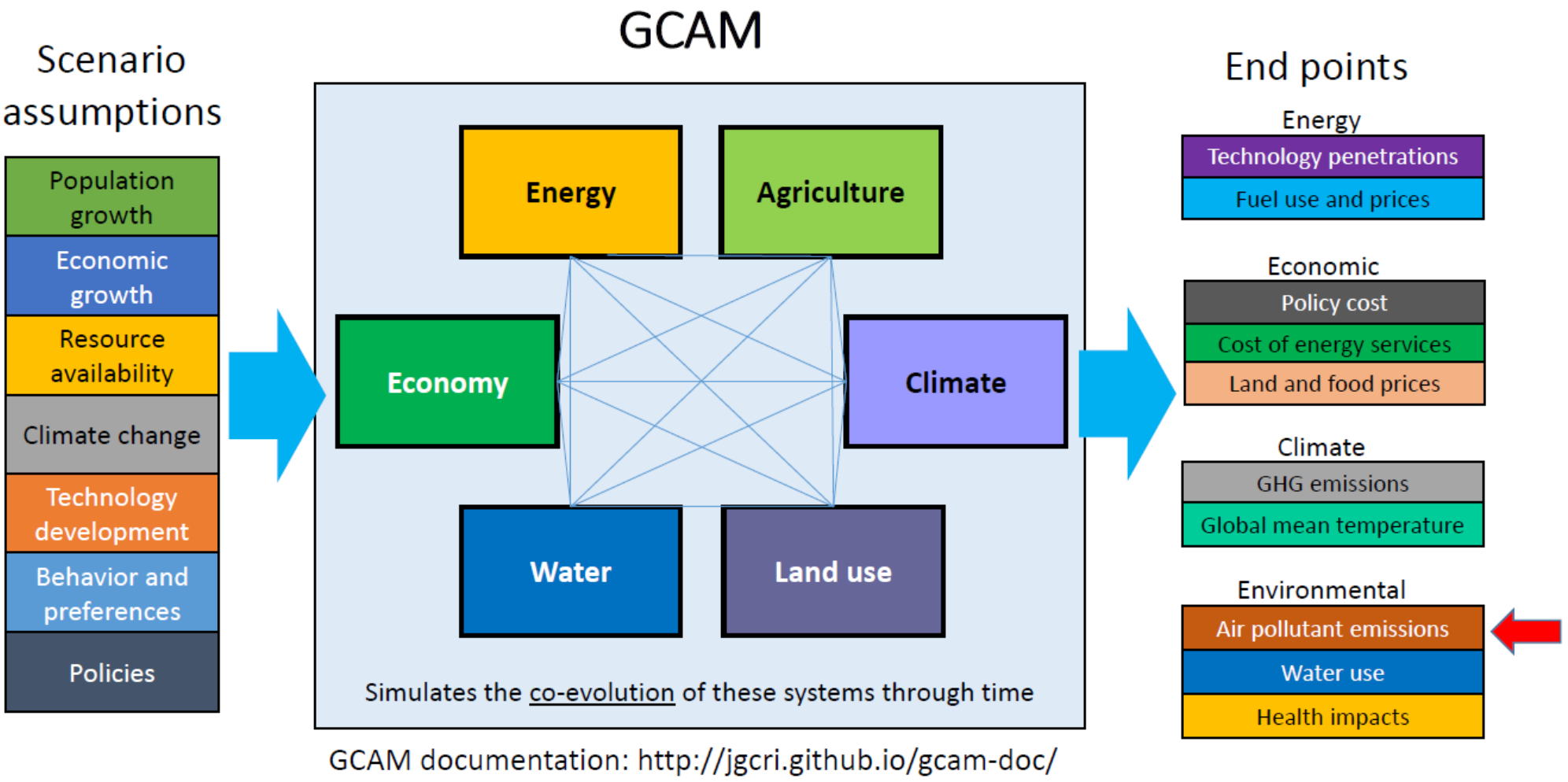
Global Change Analysis Model



GCAM documentation: http://jgcri.github.io/gcam-doc/

Bash et al., Oct. 2024

EPA United States Environmental Protection Agency

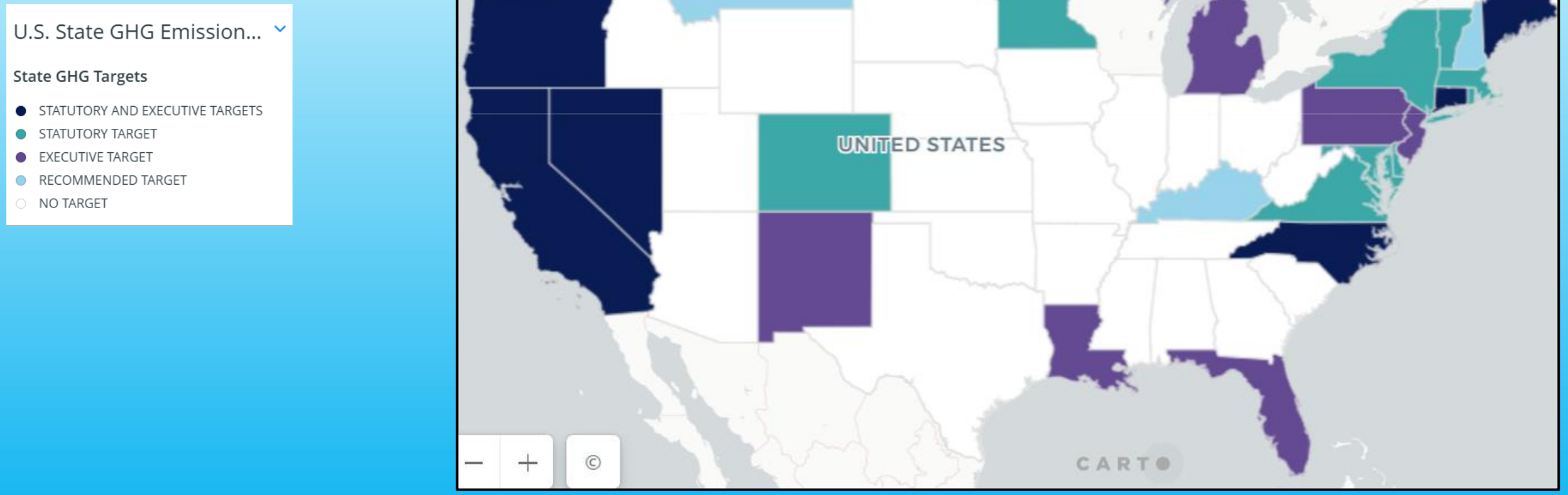
Scenario Design

- *Reference*: A baseline scenario that includes:
  - **limited GHG mitigation, Inflation Reduction Act**, and no additional air pollutant control requirements
- *StateTargets:* A mitigation scenario that includes:
  - State GHG reduction goals, implemented as regional CO_2 targets
  - New CA light-duty electrification targets adopted by Section 177 states
  - Medium- and Heavy-Duty Electrification MOU adopted by signatory states (MOU: Memorandum of Understanding)
- *NetZeroZEV*: A mitigation scenario that includes:
  - A national, economy-wide declining CO_2 cap reaches Net-Zero by 2050
  - Transportation electrification targets in *StateTargets* adopted nationally

By 2035

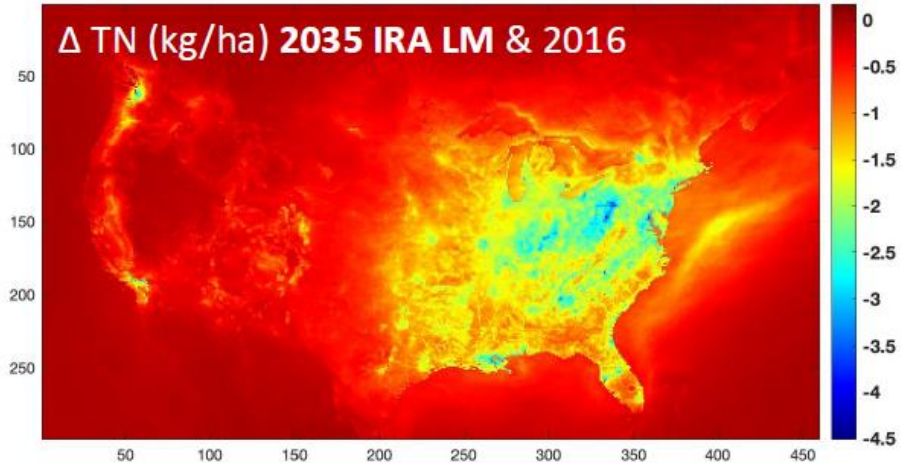
By 2040; 30% by 2030; 18 states.

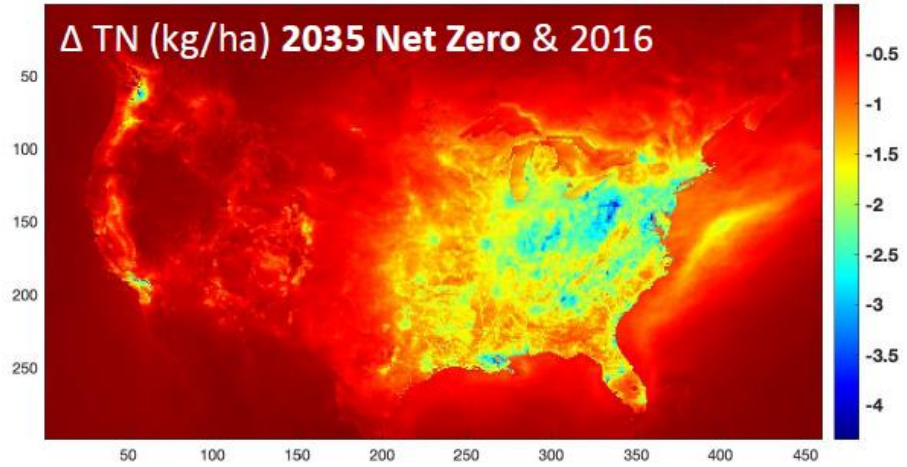
U.S. State Greenhouse Gas Emissions Targets

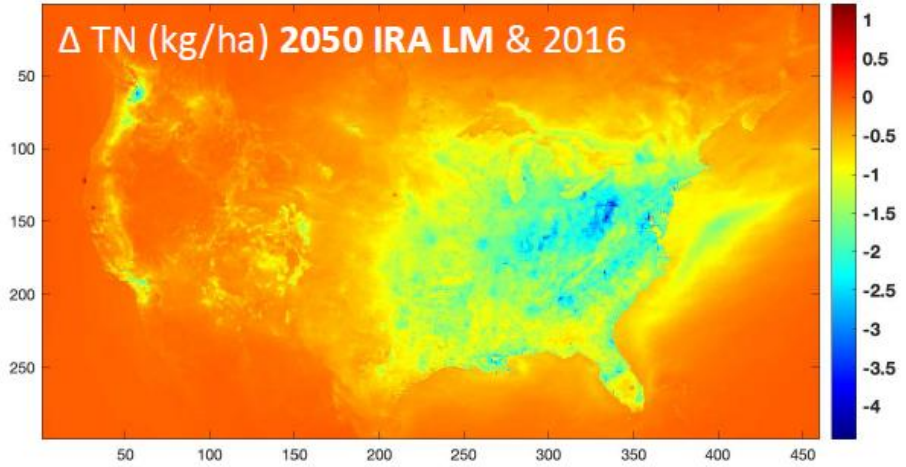


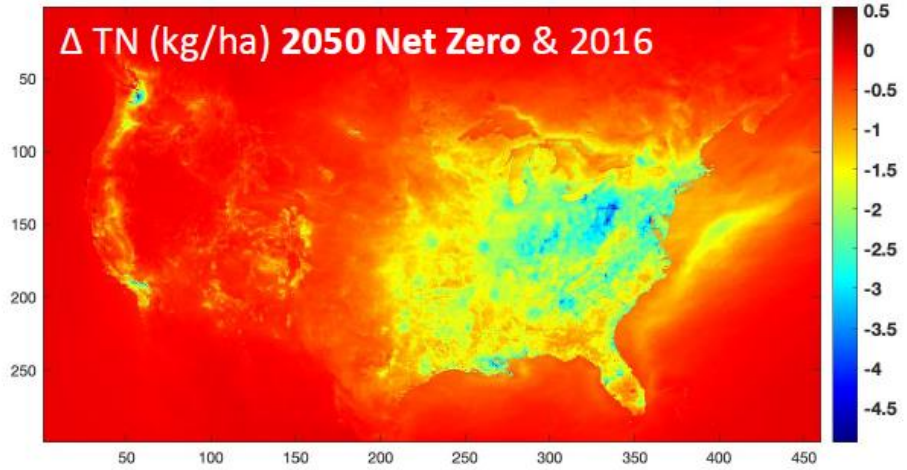
https://www.c2es.org/document/greenhouse-gas-emissions-targets/

- 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**).



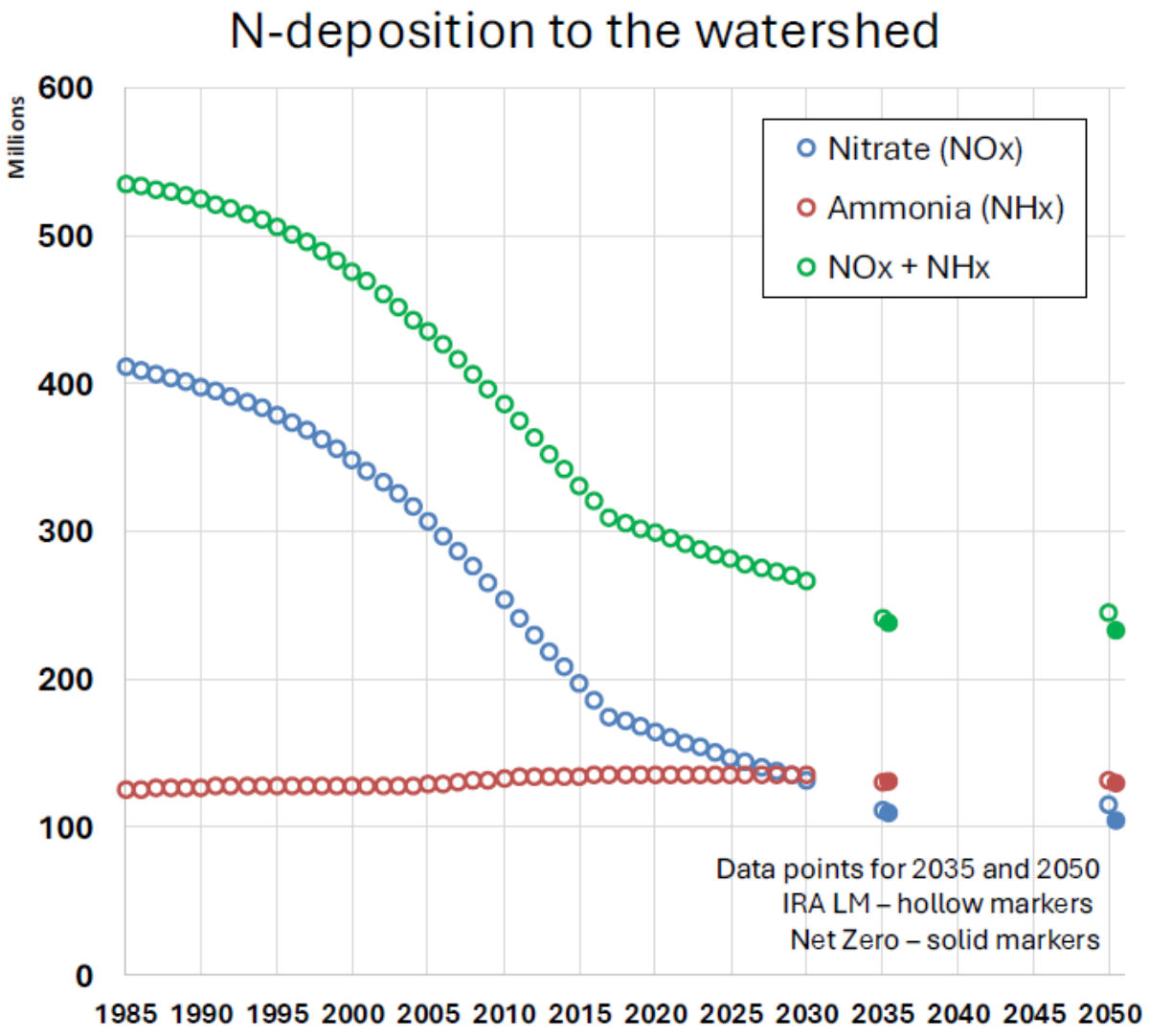


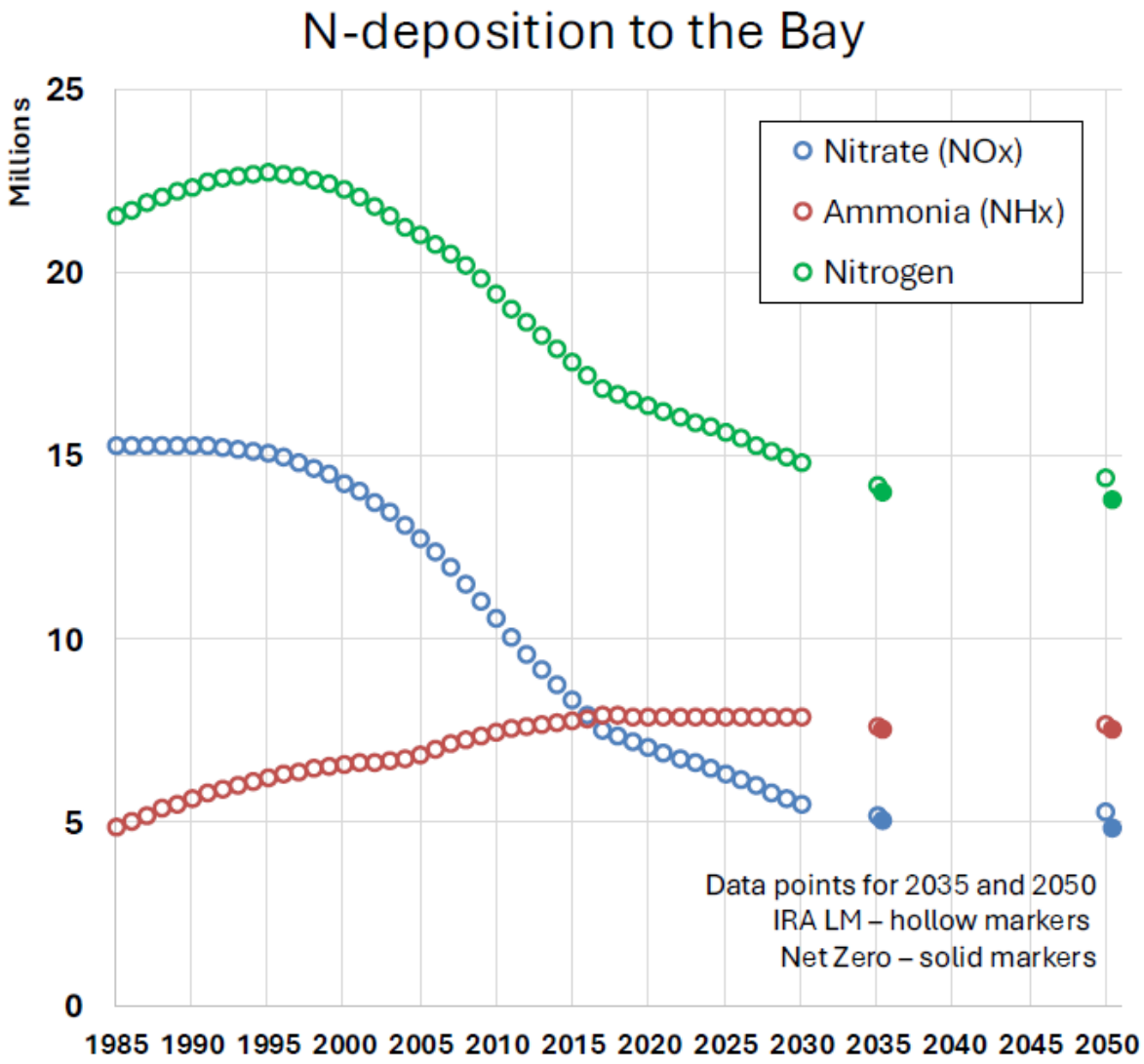




Gopal Bhatt, Oct., 2024

Estimated trends in atmospheric N-deposition





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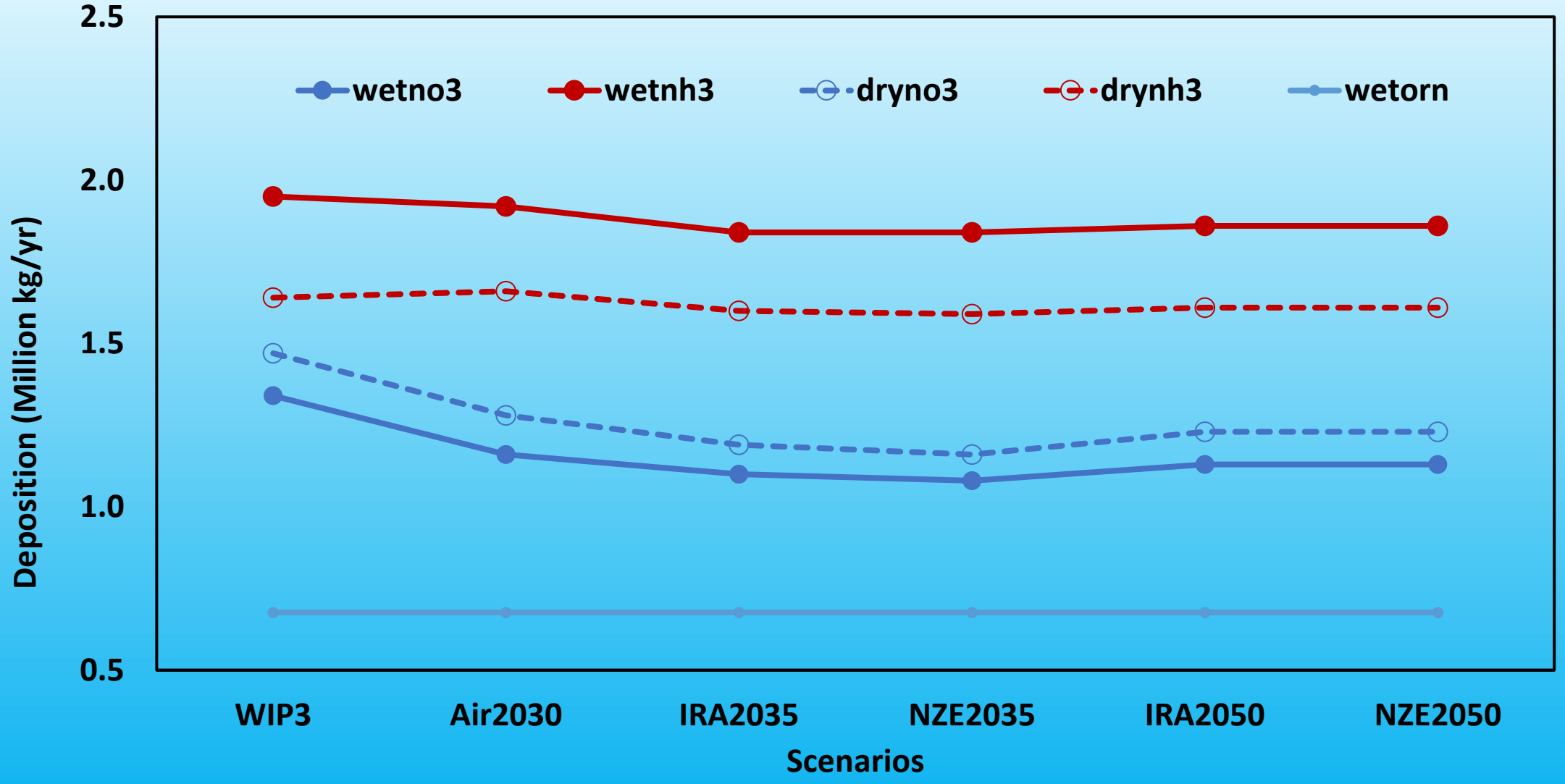
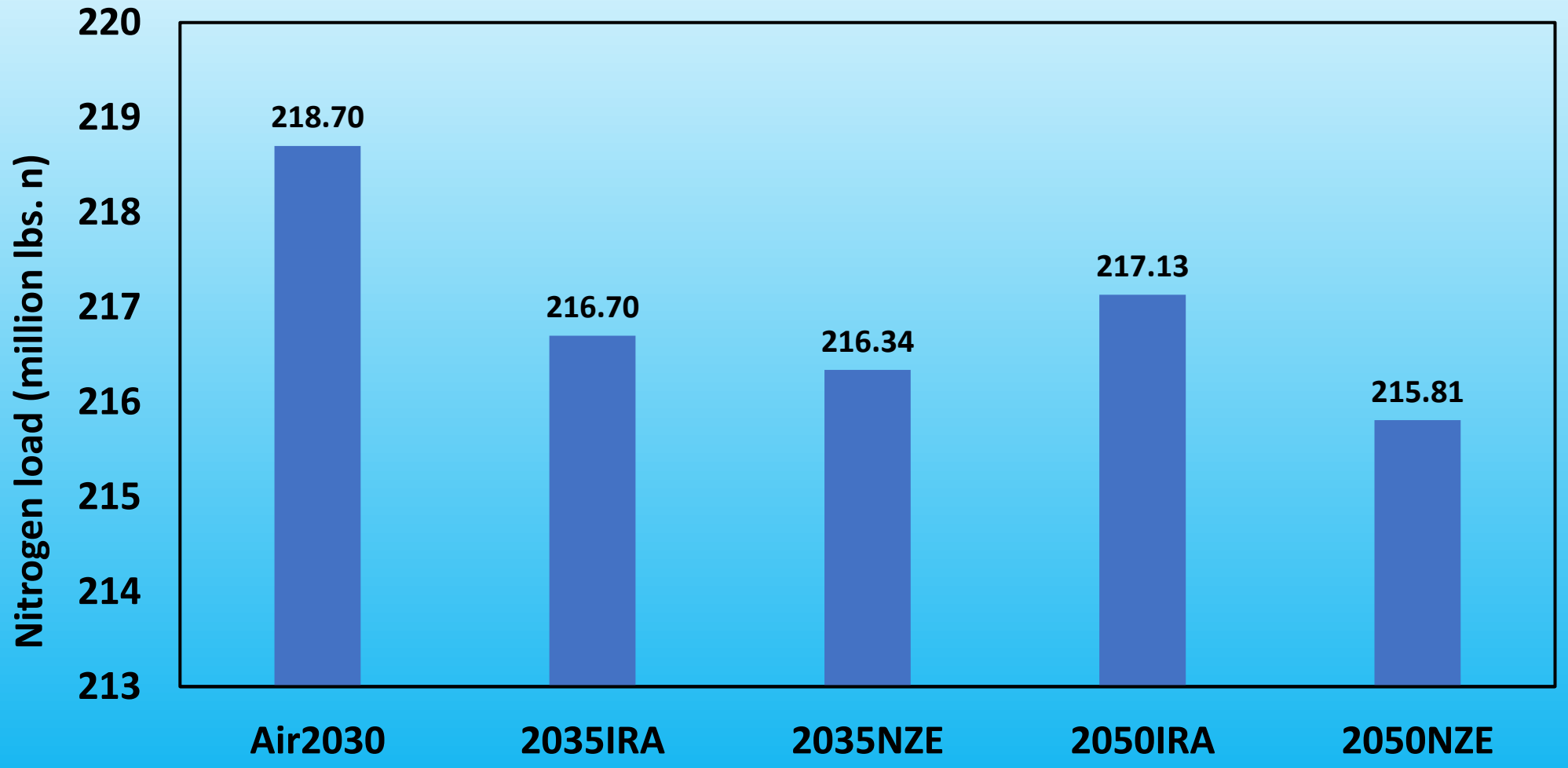
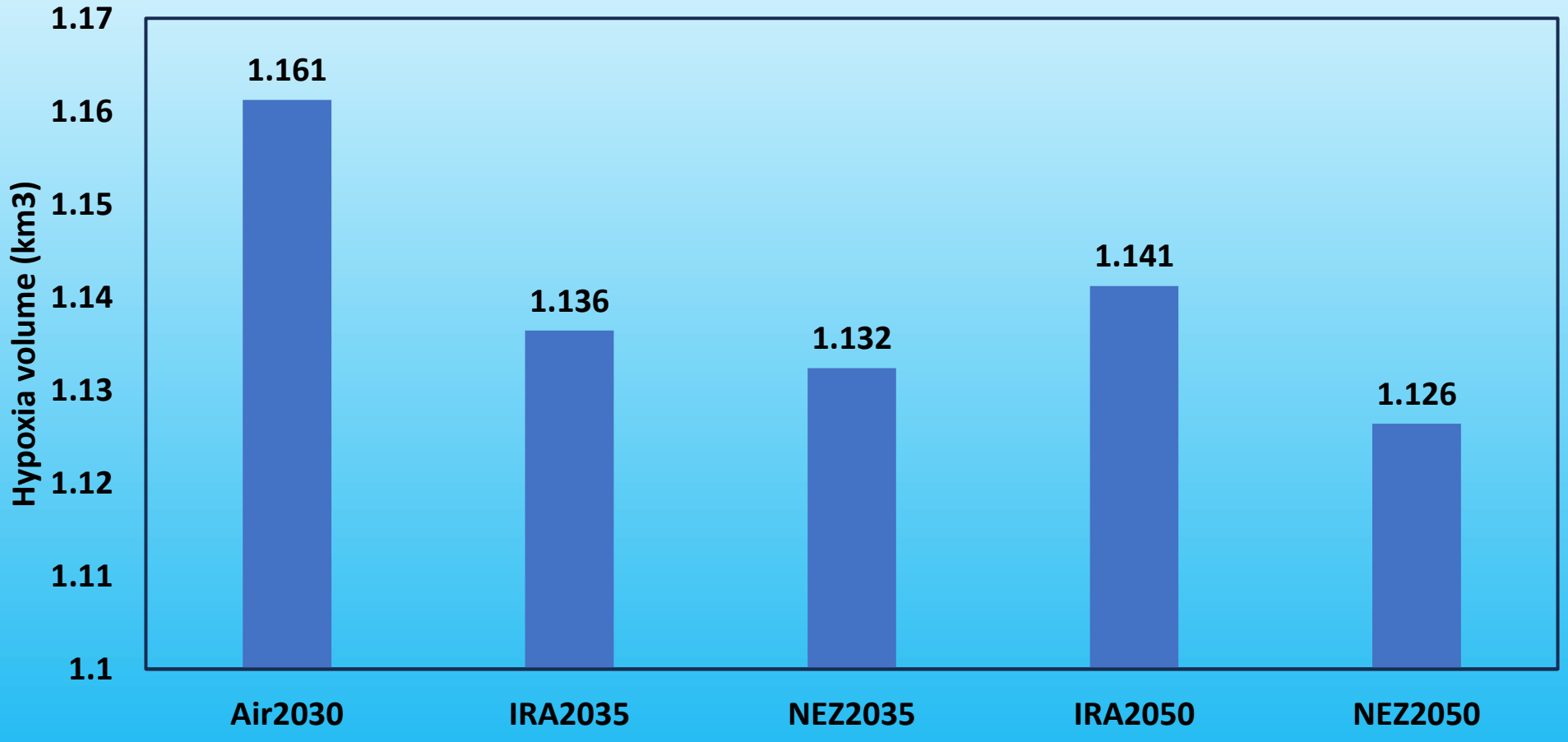
Speciation of atmospheric deposition to the tidal Bay



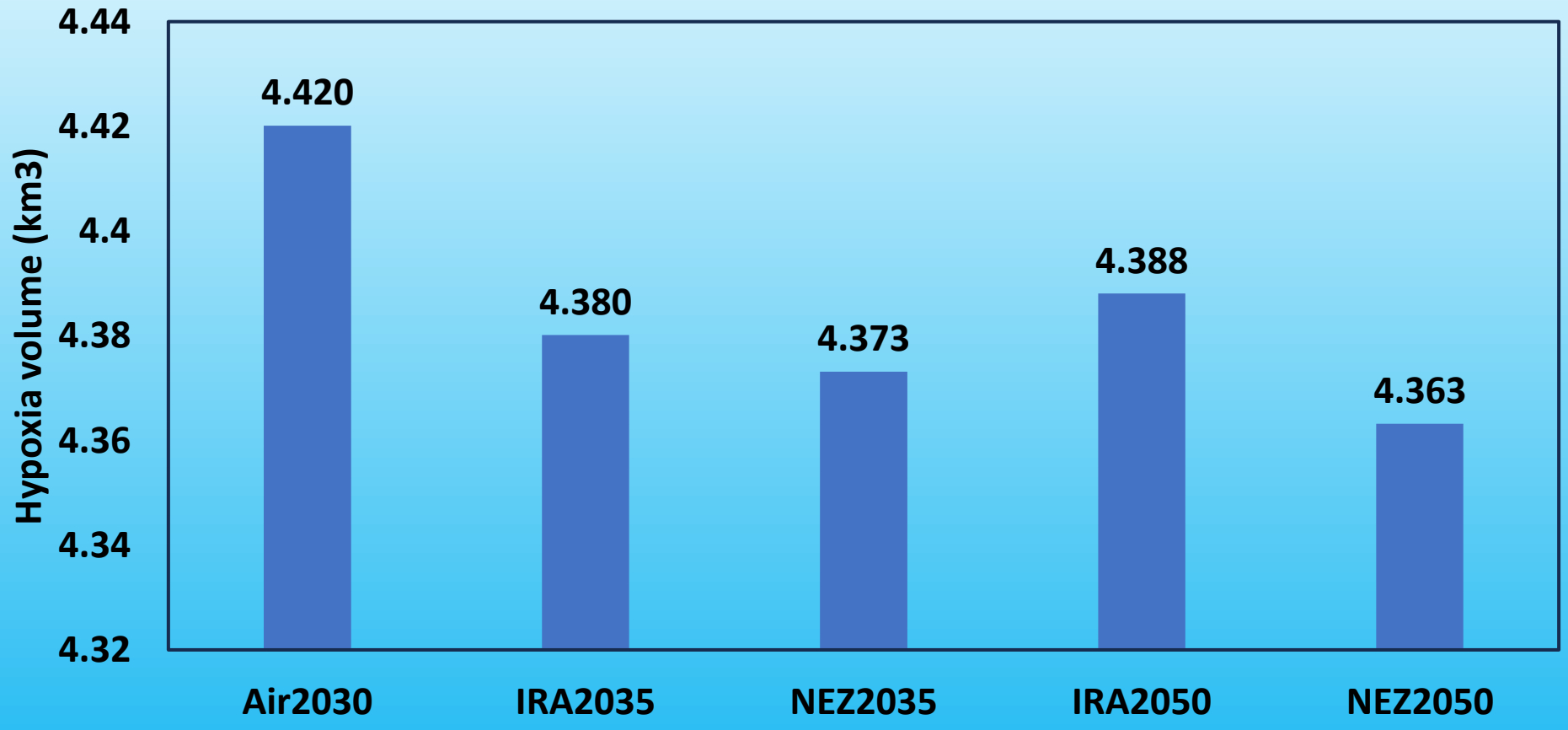
Total nitrogen load to the Bay (million lbs. N)



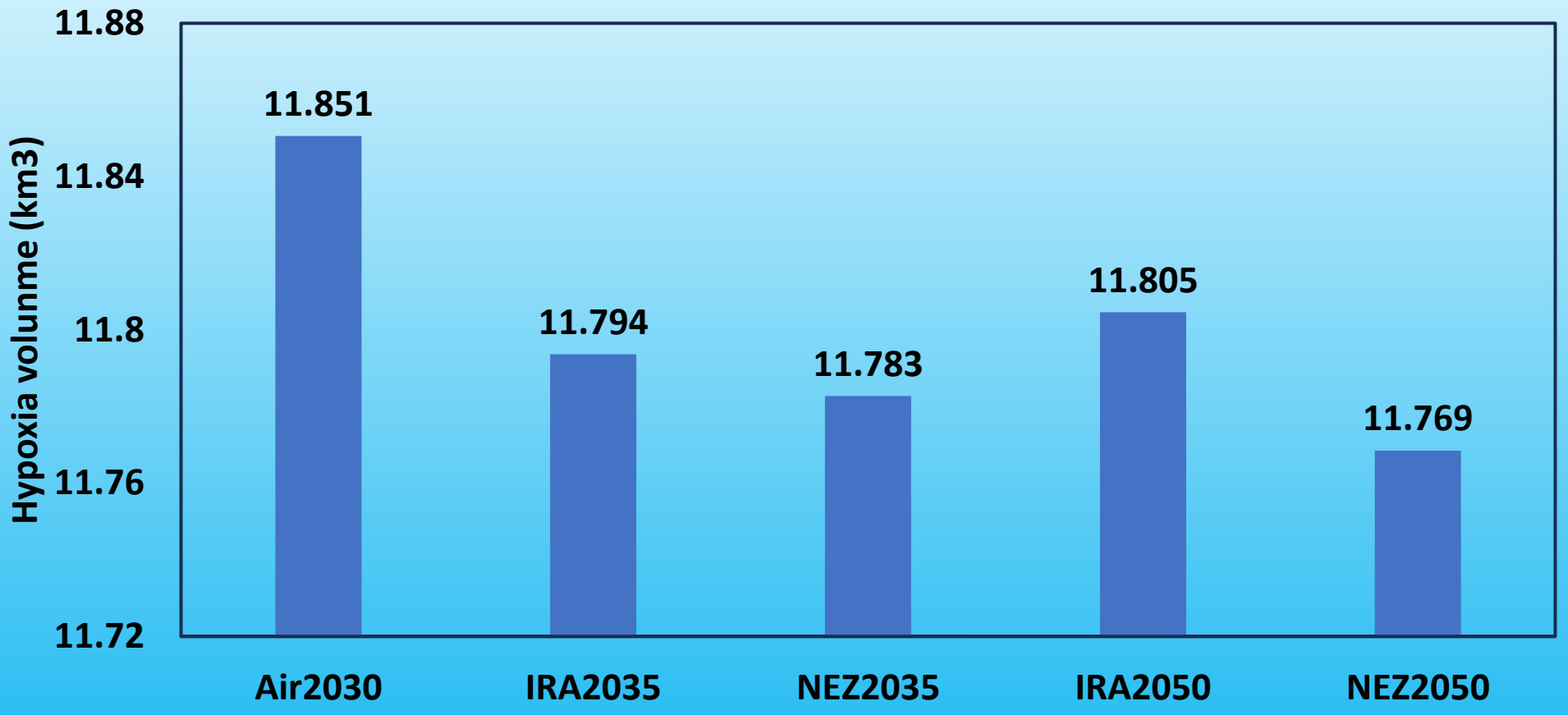
Average Hypoxia volume (km3 <=1mg/l) Jun.-Sep. over 10 yrs.



Average Hypoxia volume (km3 <=3mg/l) Jun.-Sep. over 10 yrs.



Average Hypoxia volume (km3 <=5mg/l) Jun.-Sep. over 10 yrs.



Deep Channel criteria assessment of GCAM scenarios

Scenario	2030Air	2035IRA	2035NetZero	2050IRA	2050NetZero
TN load (M lbs)	218.7	216.7	216.34	217.13	215.81
CB3MH	0.00%	0.00%	0.00%	0.00%	0.00%
CB4MH	10.89%	10.29%	10.20%	10.45%	10.04%
CB5MH_MD	0.00%	0.00%	0.00%	0.00%	0.00%
CB5MH_VA	0.00%	0.00%	0.00%	0.00%	0.00%
POTMH_MD	0.00%	0.00%	0.00%	0.00%	0.00%
RPPMH	0.00%	0.00%	0.00%	0.00%	0.00%
CHSMH	0.00%	0.00%	0.00%	0.00%	0.00%
EASMH	6.05%	6.07%	6.04%	6.07%	5.98%
PATMH	0.00%	0.00%	0.00%	0.00%	0.00%

Deep water criteria assessment of GCAM scenarios

Scenario	2030Air	2035IRA	2035NetZero	2050IRA	2050NetZero
TN load (M lbs)	218.7	216.7	216.34	217.13	215.81
CB3MH	0.06%	0.06%	0.06%	0.06%	0.06%
CB4MH	6.62%	6.50%	6.49%	6.54%	6.46%
CB5MH_MD	2.07%	2.03%	2.00%	2.03%	2.00%
CB5MH_VA	0.00%	0.00%	0.00%	0.00%	0.00%
CB6PH	0.00%	0.00%	0.00%	0.00%	0.00%
CB7PH	0.00%	0.00%	0.00%	0.00%	0.00%
PATMH	0.00%	0.00%	0.00%	0.00%	0.00%
MAGMH	0.00%	0.00%	0.00%	0.00%	0.00%
SOUMH	0.00%	0.00%	0.00%	0.00%	0.00%
SEVMH	0.00%	0.00%	0.00%	0.00%	0.00%
PAXMH	0.00%	0.00%	0.00%	0.00%	0.00%
POTMH_MD	0.10%	0.07%	0.07%	0.07%	0.07%
RPPMH	0.15%	0.13%	0.13%	0.14%	0.13%
YRKPH	0.00%	0.00%	0.00%	0.00%	0.00%
SBEMH	0.00%	0.00%	0.00%	0.00%	0.00%
CHSMH	0.00%	0.00%	0.00%	0.00%	0.00%
EASMH	0.00%	0.00%	0.00%	0.00%	0.00%

Open water criteria assessment of GCAM scenarios

Scenario	2030Air	2035IRA	2035NetZero	2050IRA	2050NetZero
TN load (M lbs)	218.7	216.7	216.34	217.13	215.81
CB6PH	0.16%	0.14%	0.13%	0.14%	0.13%
CB7PH	1.37%	1.29%	1.27%	1.30%	1.25%
GUNOH	4.59%	4.59%	4.59%	4.59%	4.59%
WSTMH	0.01%	0.01%	0.01%	0.01%	0.01%
PAXTF	2.34%	2.34%	2.40%	2.34%	2.40%
WBRTF	0.00%	0.00%	0.00%	0.00%	0.00%
PAXOH	0.27%	0.22%	0.17%	0.24%	0.13%
PAXMH	0.00%	0.00%	0.00%	0.00%	0.00%
ANATF_DC	4.49%	4.32%	4.27%	4.35%	4.22%
ANATF_MD	15.21%	14.75%	14.75%	14.86%	14.31%
PISTF	4.47%	4.47%	4.47%	4.47%	4.47%
CRRMH	7.88%	6.00%	6.00%	6.00%	6.00%
PMKTF	11.01%	11.01%	11.01%	11.01%	11.01%
YRKMH	2.57%	2.33%	2.24%	2.38%	2.20%
APPTF	4.59%	4.59%	4.59%	4.59%	4.59%
CHKOH	3.55%	0.02%	0.02%	0.02%	0.02%
WBEMH	7.80%	7.80%	7.80%	7.80%	7.80%
SBEMH	25.03%	24.58%	24.51%	24.67%	24.30%
EBEMH	15.46%	15.46%	15.46%	15.46%	15.46%

Summary

- **Signals of change were observed in hypoxia volume and criteria assessment.**
- **The magnitudes of change are around 1% (Equivalent load reduction about half of CC).**