

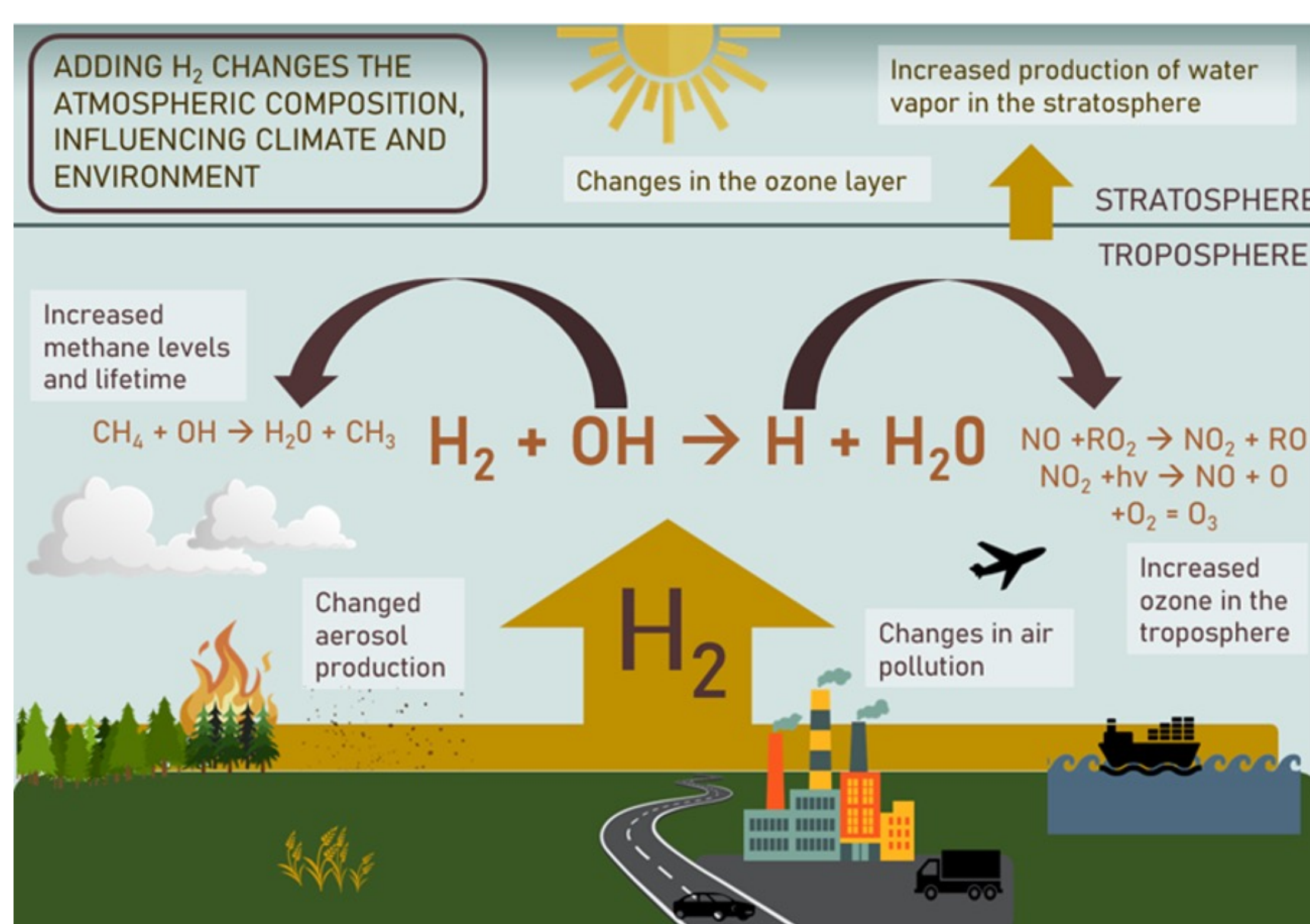
Environmental Risks and Benefits of Global Carbon-Free Electrofuel Deployment

Anthony Y. H. Wong, Adam Schlosser, Carlo Palazzi

Contact: ayhwong@mit.edu

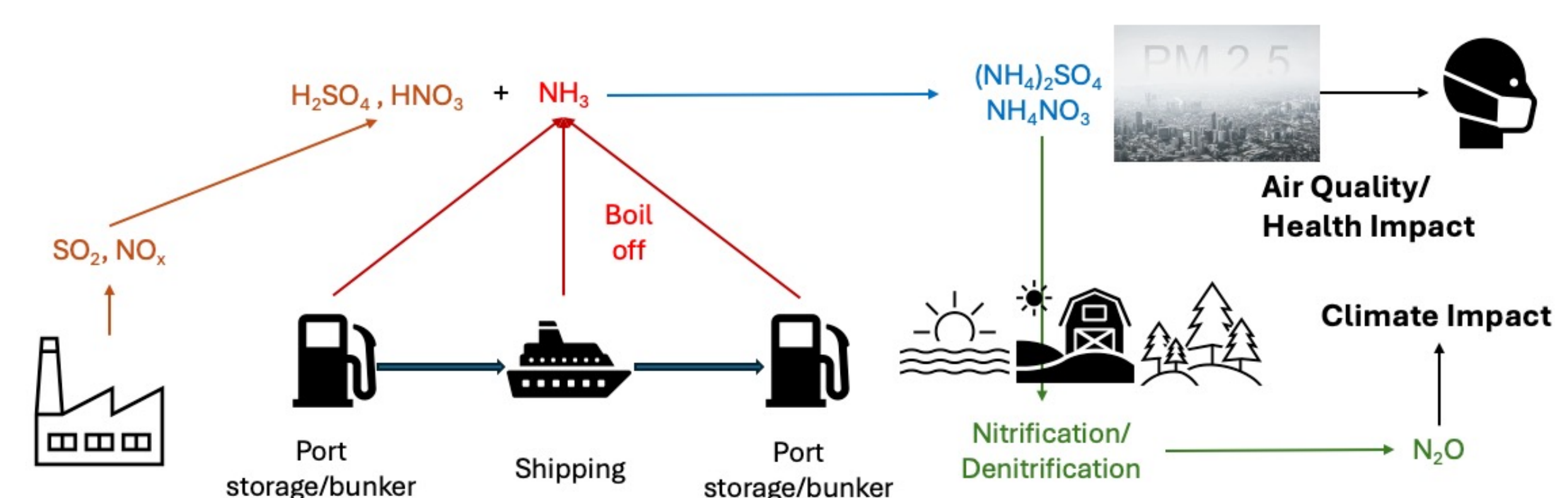
Carbon-free electrofuels: Important energy storage mediums Still have environmental impacts

Hydrogen



Climate and air quality impacts through methane and ozone feedback

Ammonia

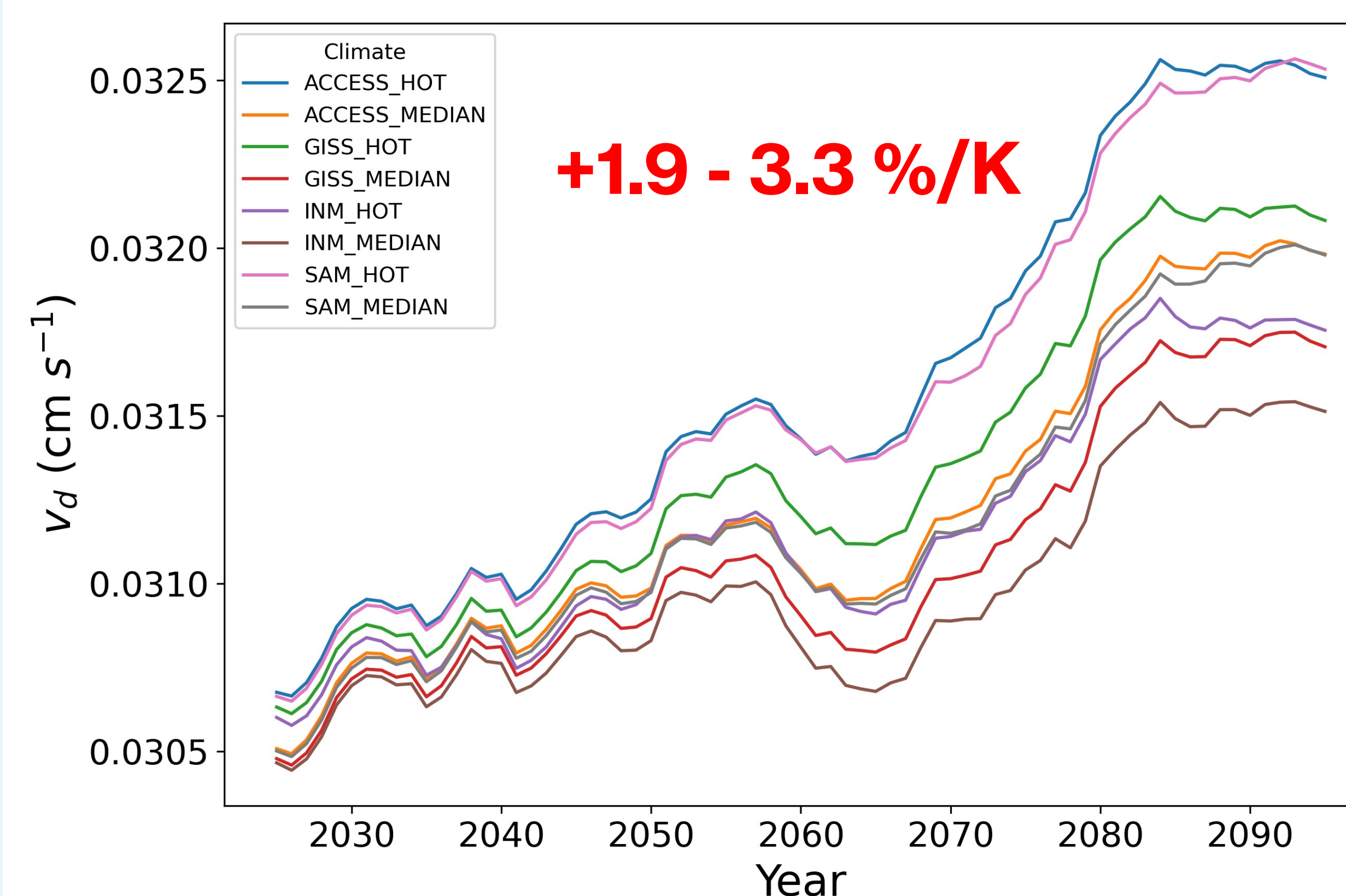


Climate and air quality impacts through PM_{2.5}/indirect N₂O emissions

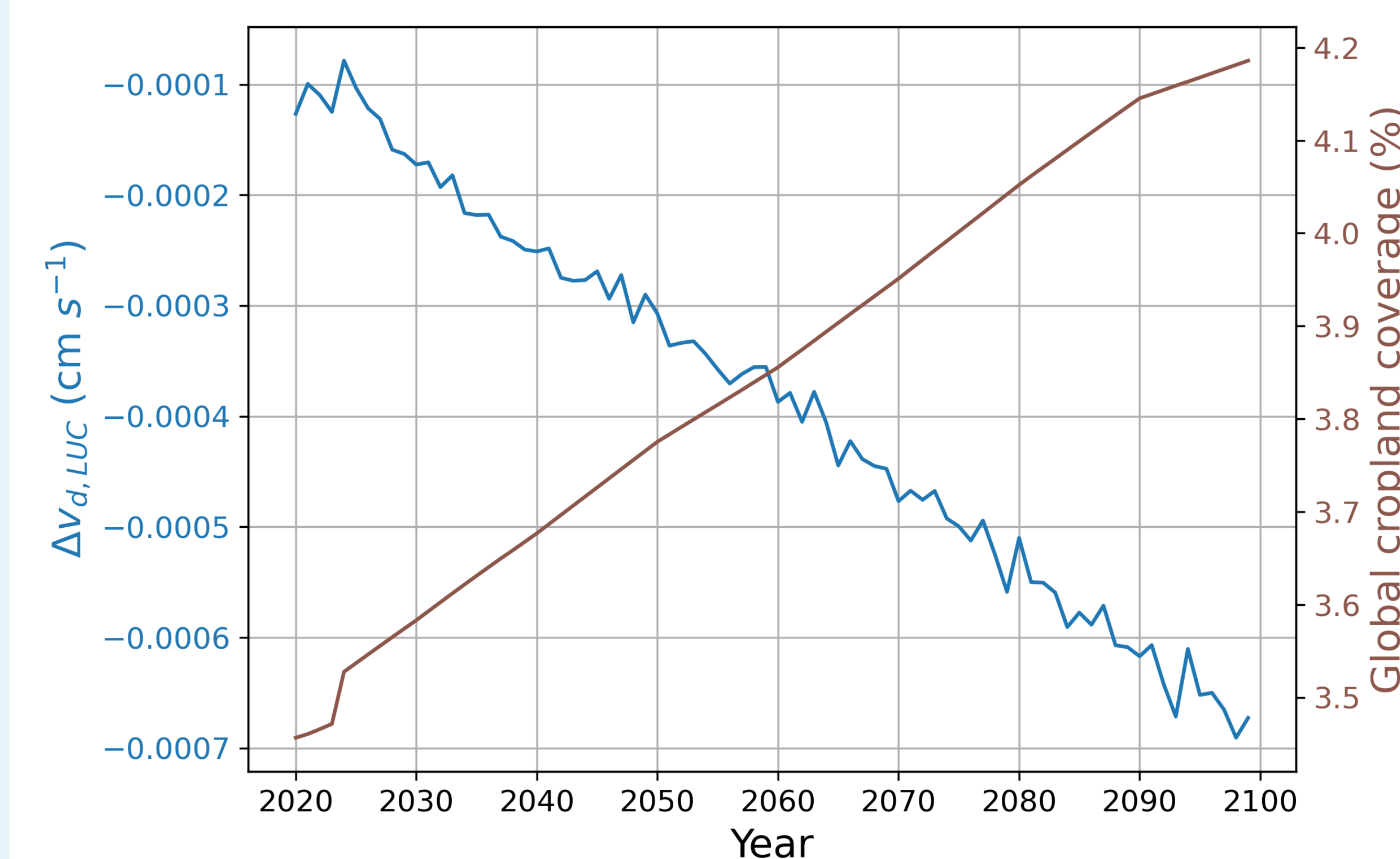
How would these effects fair in the future?

Biggest hydrogen sink (soil) is affected by climate and land use change

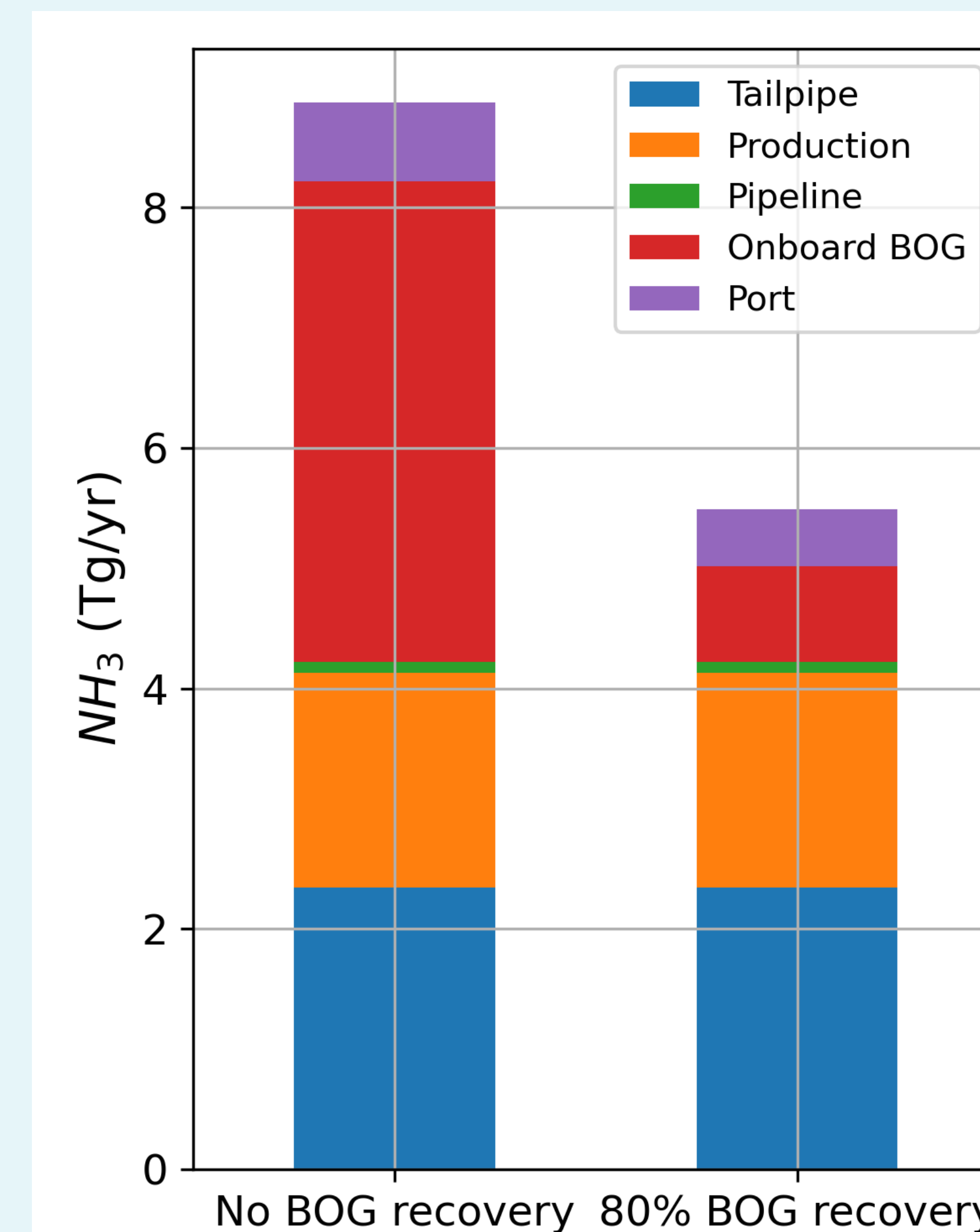
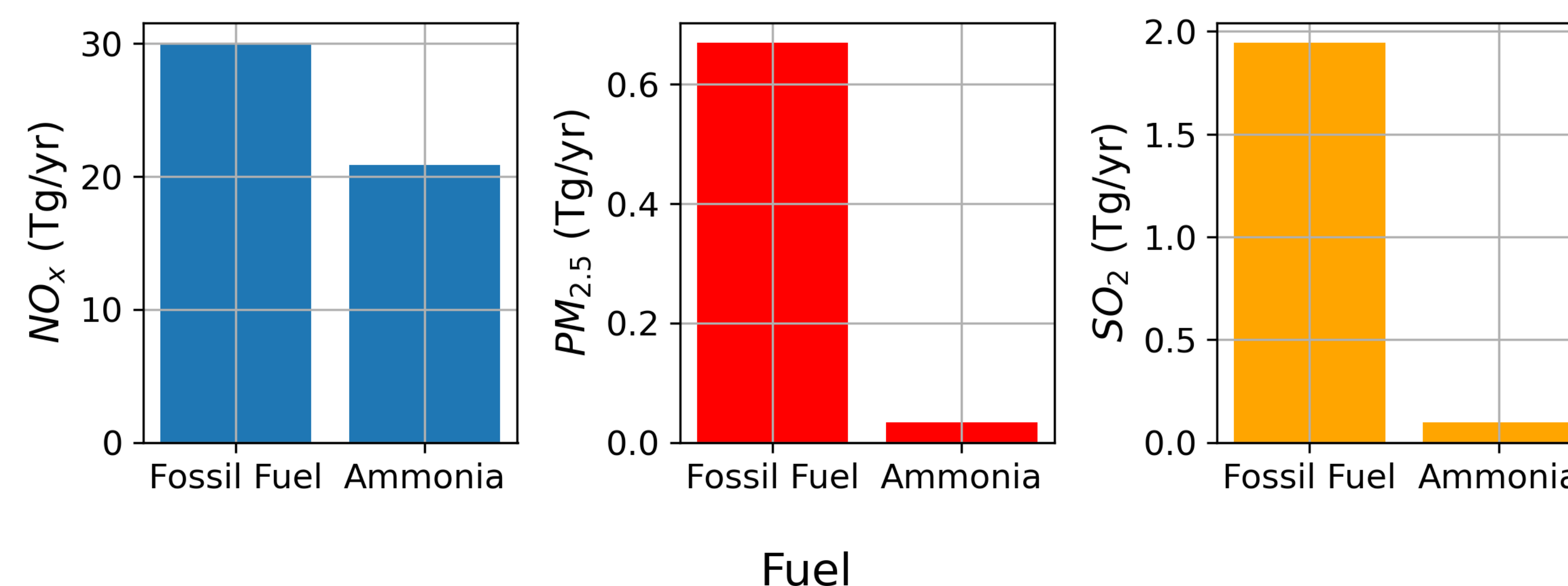
Warming promotes uptake



Cropland expansion reduce uptake



Updated pollutant emission estimate of ammonia vs fossil fuel for international shipping @ 2050 (Post-2025 IMO regulation)



- Newest MAN/WINGD/IHI engine testing data suggests lower traditional pollutant and GHG emissions from ammonia engines (PM/SO₂ from pilot fuel)
- Tailpipe ammonia emissions (~2Tg/yr) is not the dominant part of life-cycle ammonia emissions from marine ammonia combustion
- Boil-off gas (BOG) recovery can effectively manage onboard and port boil off emissions, while production and tailpipe emission require other ways to manage
- Impacts on global air quality, climate and ecosystems will be compared subsequently