1-Hour NO_2 Adaptive Strategy: Uses of PVMRM and OLM

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1-hour NO_2 NAAQS Difficulty

- NAAQS standard is based on NO_2 measured in atmosphere
- Combustion emissions NO and NO_2
- $NO + O_3 \longrightarrow NO_2 + O_2$
- How to estimate conversion of NO to NO_2?

NO to NO_2 Conversion

- Guideline on Air Quality Models outlines three conversion methods
- Tier I = 100% NO_x is NO_2
- Tier II = 75% of NO_x converts NO_2 on annual average
- Tier III = site-specific NO_2/NO_x ratios (e.g., AERMOD conversion algorithms)

AERMOD Conversion Algorithms

- Ozone Limiting Method (OLM) conversion based on a concentration comparison of maximum NO_x and ambient ozone
- Plume Volume Molar Ratio Method (PVMRM) conversion based on NO_x moles emitted in plume and ozone moles within plume between source and receptor

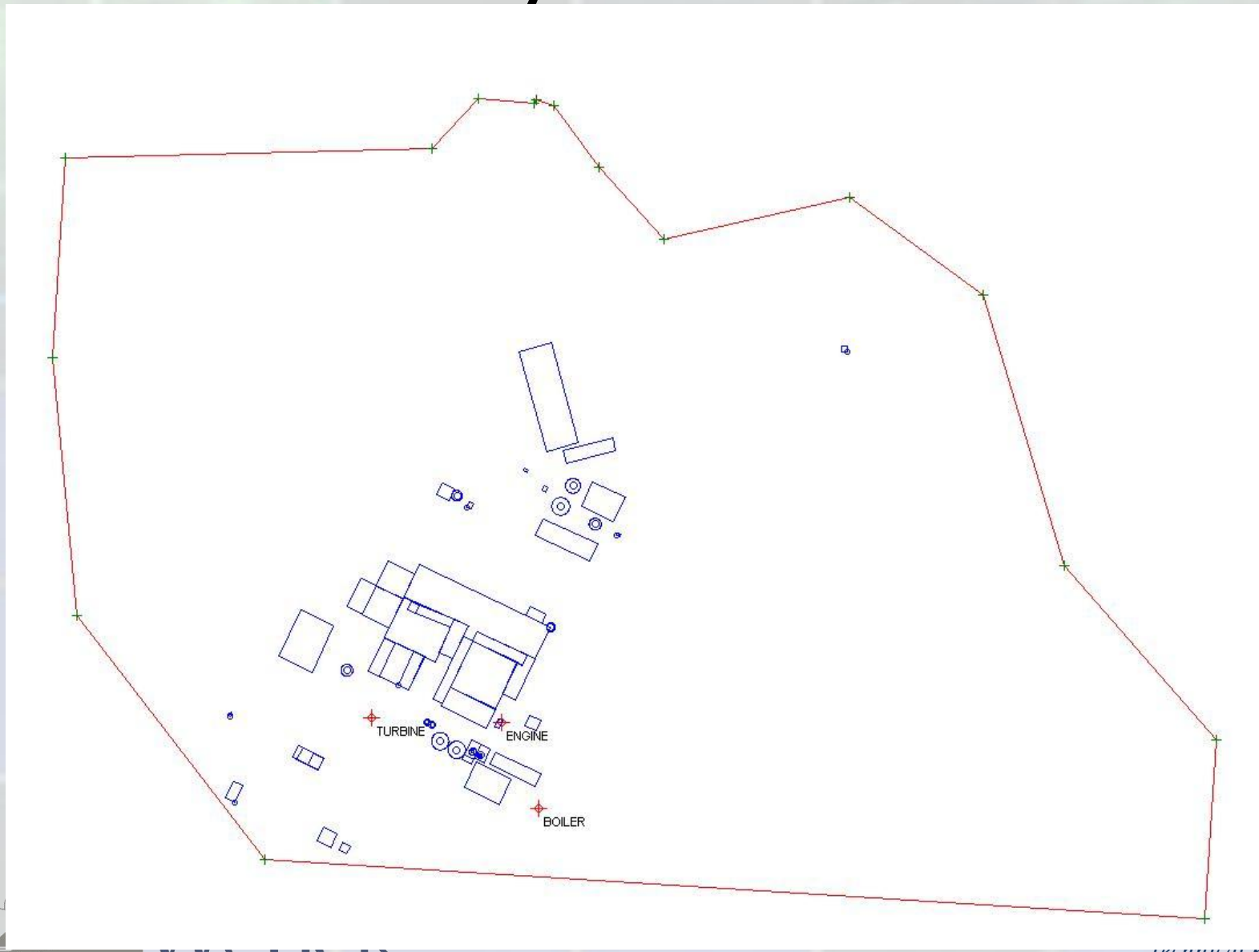
OLM and PVMRM Data Needs

- Algorithms require additional data
  - Ambient ozone concentrations
  - Ambient NO_2/NO_x equilibrium ratio
  - In-stack NO_2/NO_x ratio

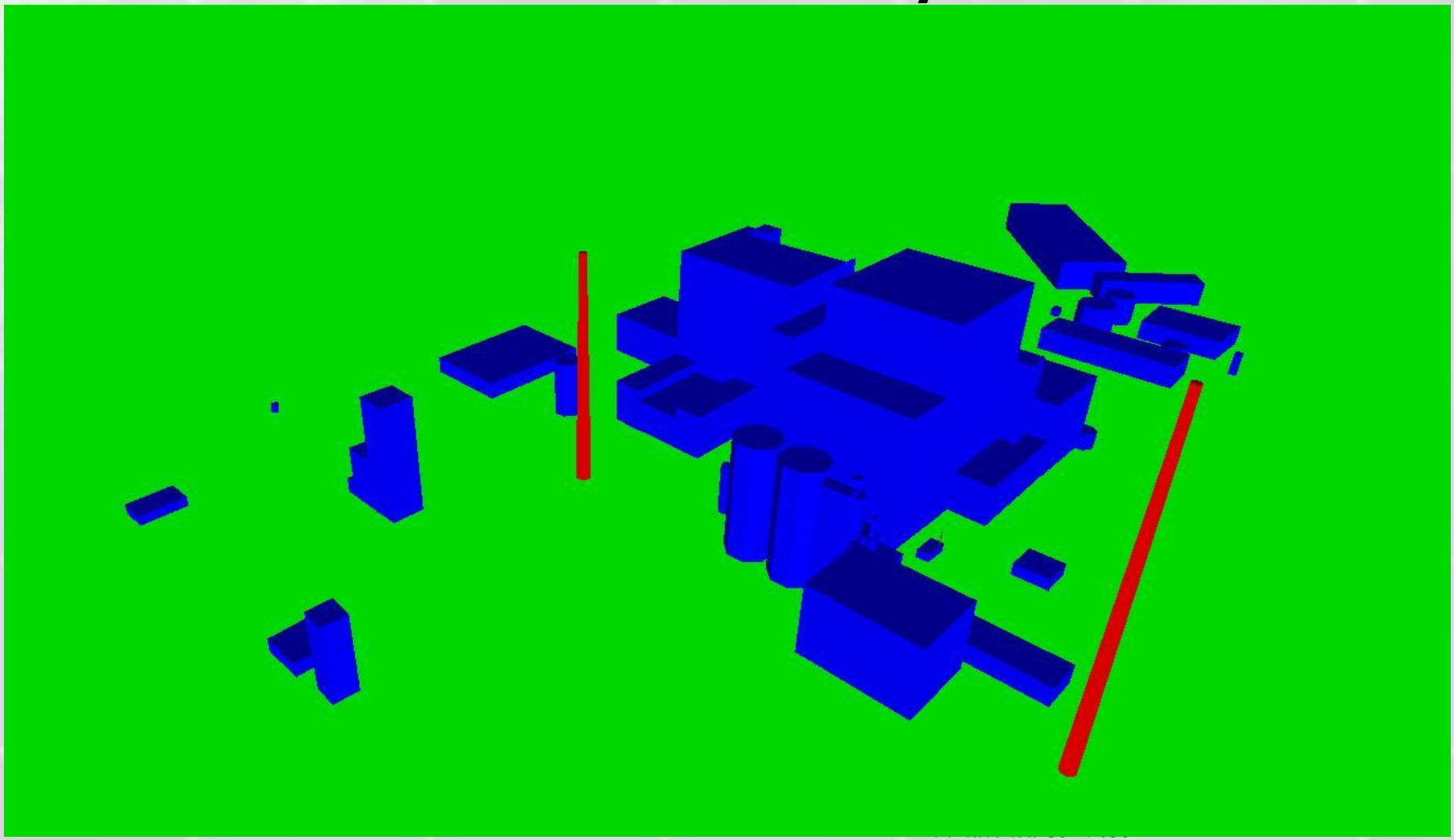
Modeling Case Study

- Which of the three PVMRM/OLM variables affects predicted concentrations the most?
- How do predicted concentrations change when the three variables increase 5%, 10%, and 20%?

Model 2D Layout



Model Source 3D Layout



Modeled Emission Sources

Emission Unit	NO_x Emission Rate (lb/hr)	Stack Height (ft)	Stack Temperature (F)	Exhaust Air Flowrate (acfm)	Stack Diameter (ft)
Boiler	906	380	340	300,000	15.5
Turbine	245	200	160	596,000	19.0
Engine	70	30	900	14,000	1.33

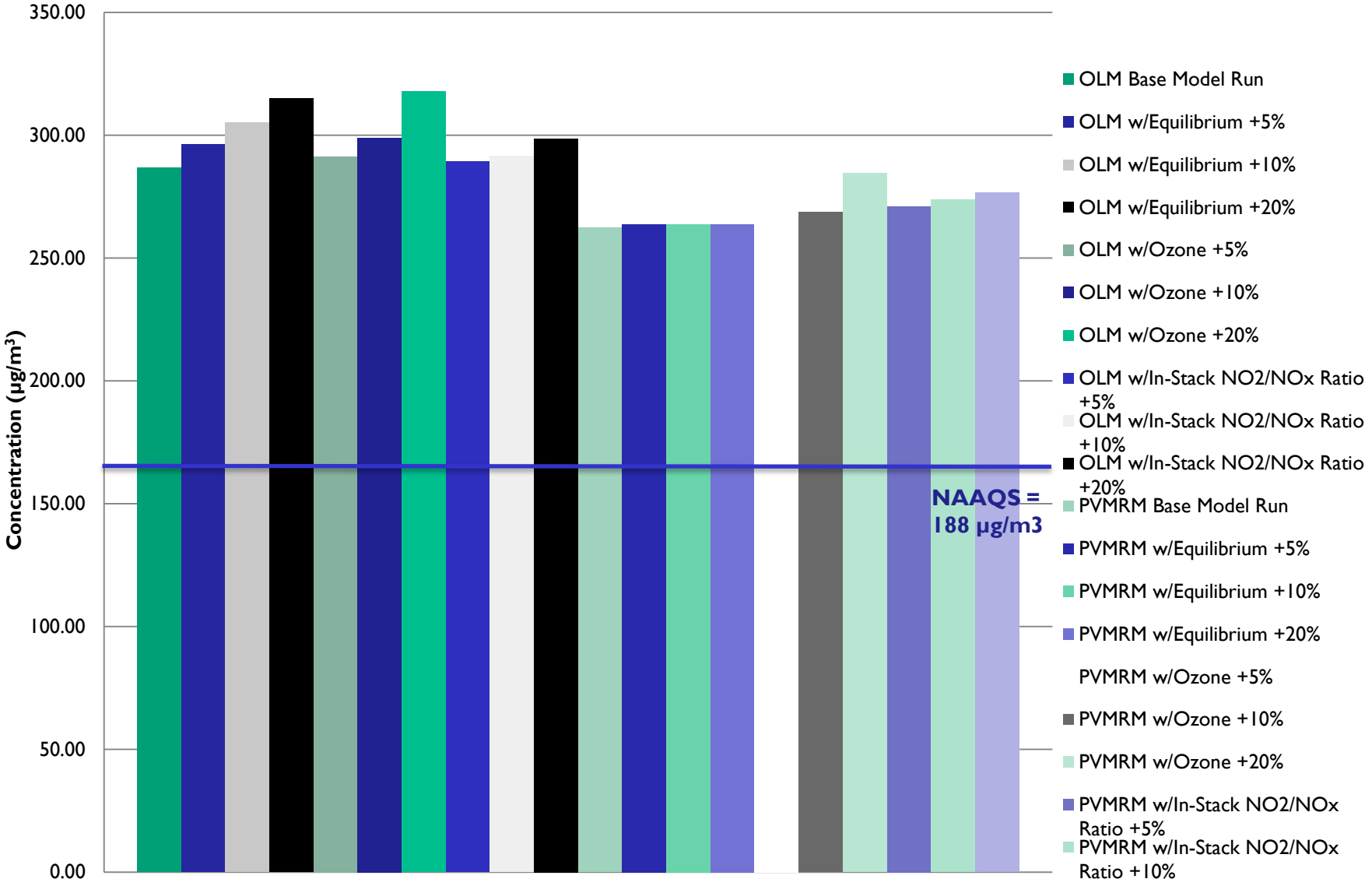
PVMRM and OLM Data Inputs

Emission Unit	In-stack NO_2/NO_x Ratio (%)	Ozone Concentration (ppb)	NO_2/NO_x Equilibrium Ratio (%)
Boiler	7 – Test Data	100 Maximum value 2006-2008 from St. Michael monitor	75 EPA Annual Average Default
Turbine	50 – EPA Default		
Engine	10 – Literature		

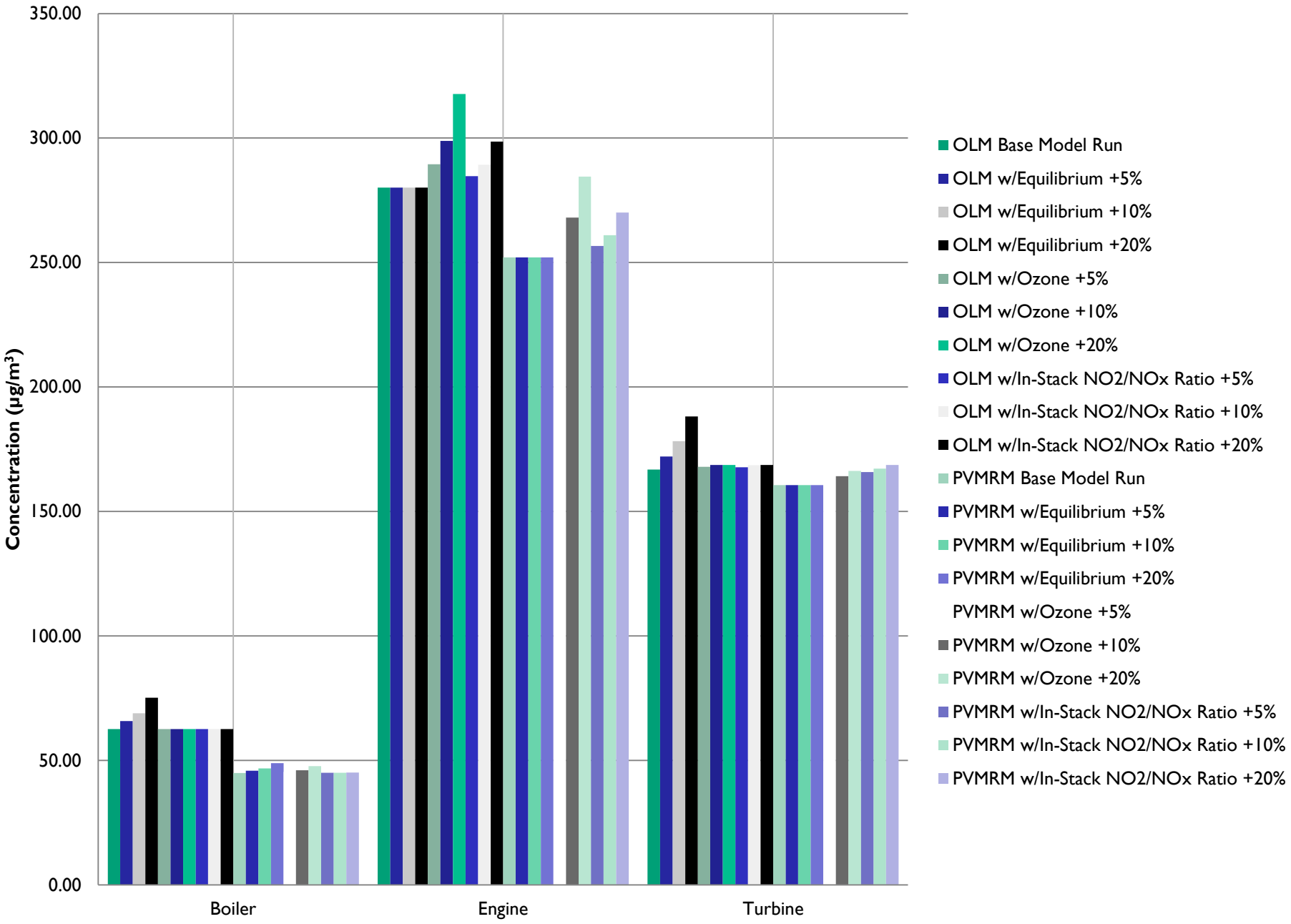
Model Results ($\mu g/m^3$)

Method	Impact	Base Run	Equilibrium			Ozone			In-stack Ratios		
			5%	10%	20%	5%	10%	20%	5%	10%	20%
OLM	Boiler	63	66	69	75	63	63	63	63	63	63
	Engine	280	280	280	280	289	299	318	285	289	299
	Turbine	167	172	178	188	168	169	169	168	169	169
	All	287	296	305	315	291	299	318	289	292	299
PVMRM	Boiler	45	46	47	49	45	46	48	45	45	45
	Engine	252	252	252	252	260	268	284	257	261	270
	Turbine	161	161	161	161	162	164	166	166	167	169
	All	262	264	264	264	266	269	284	271	274	277

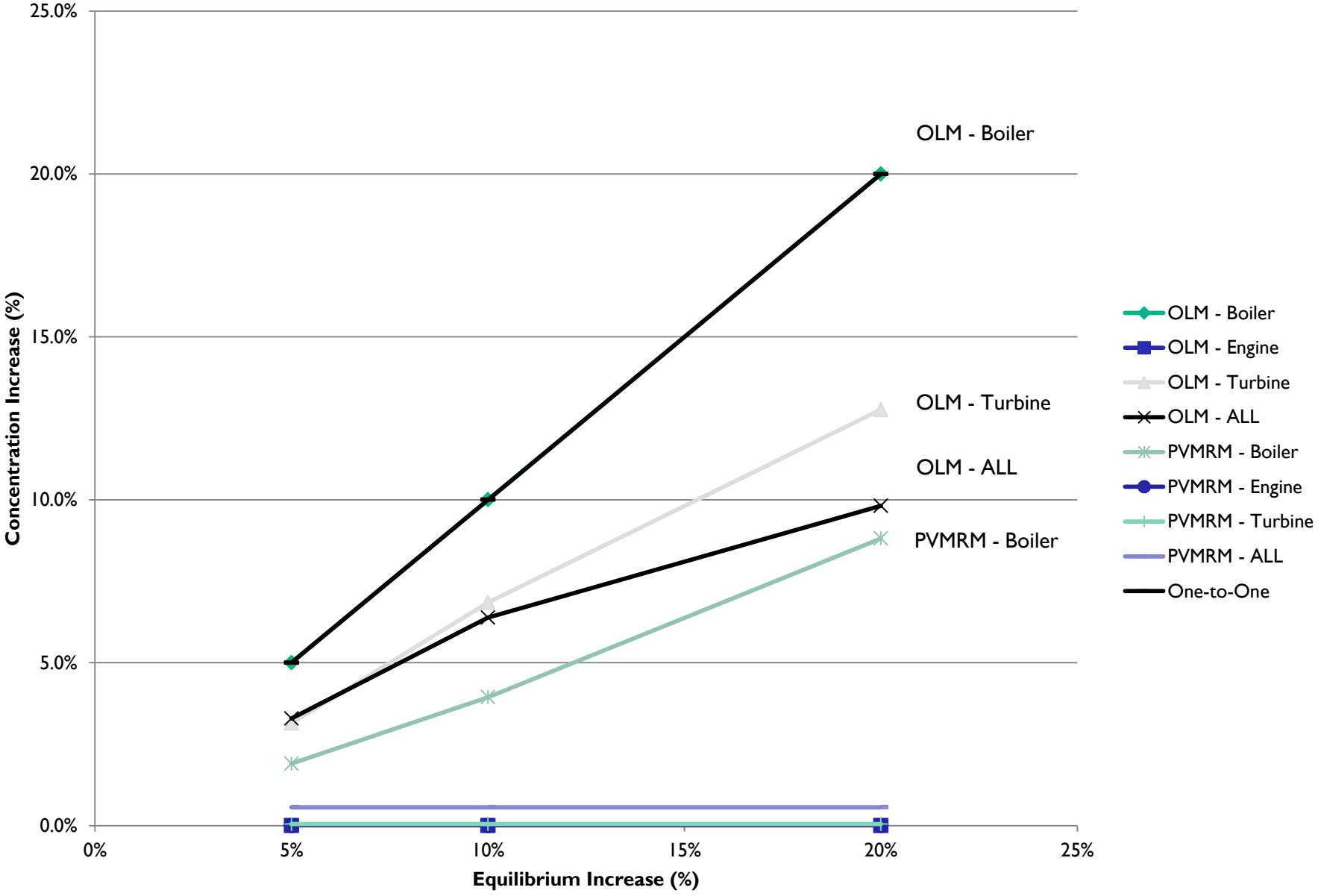
Maximum Ambient Impact - ALL Source Group



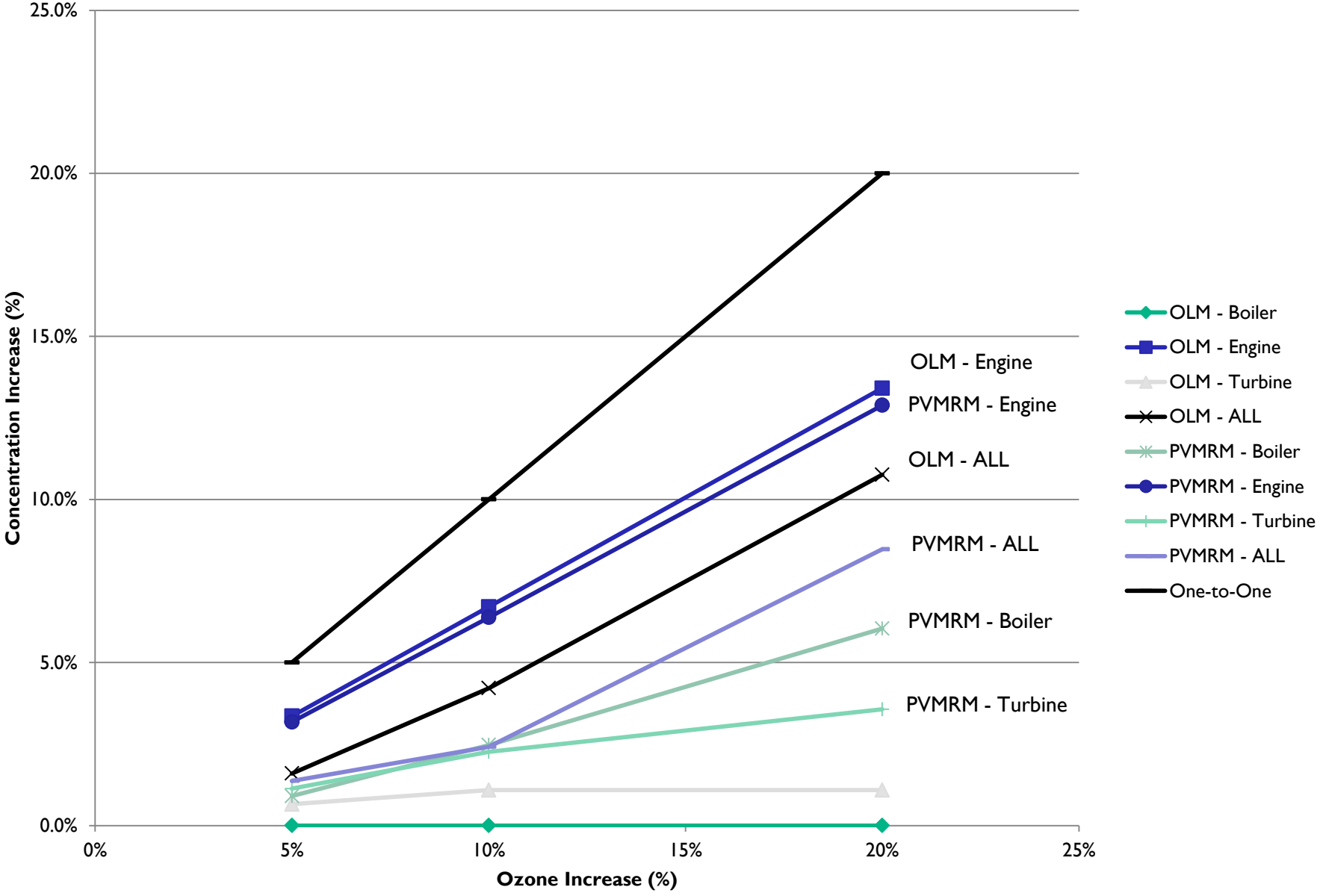
Individual Source Group Impacts



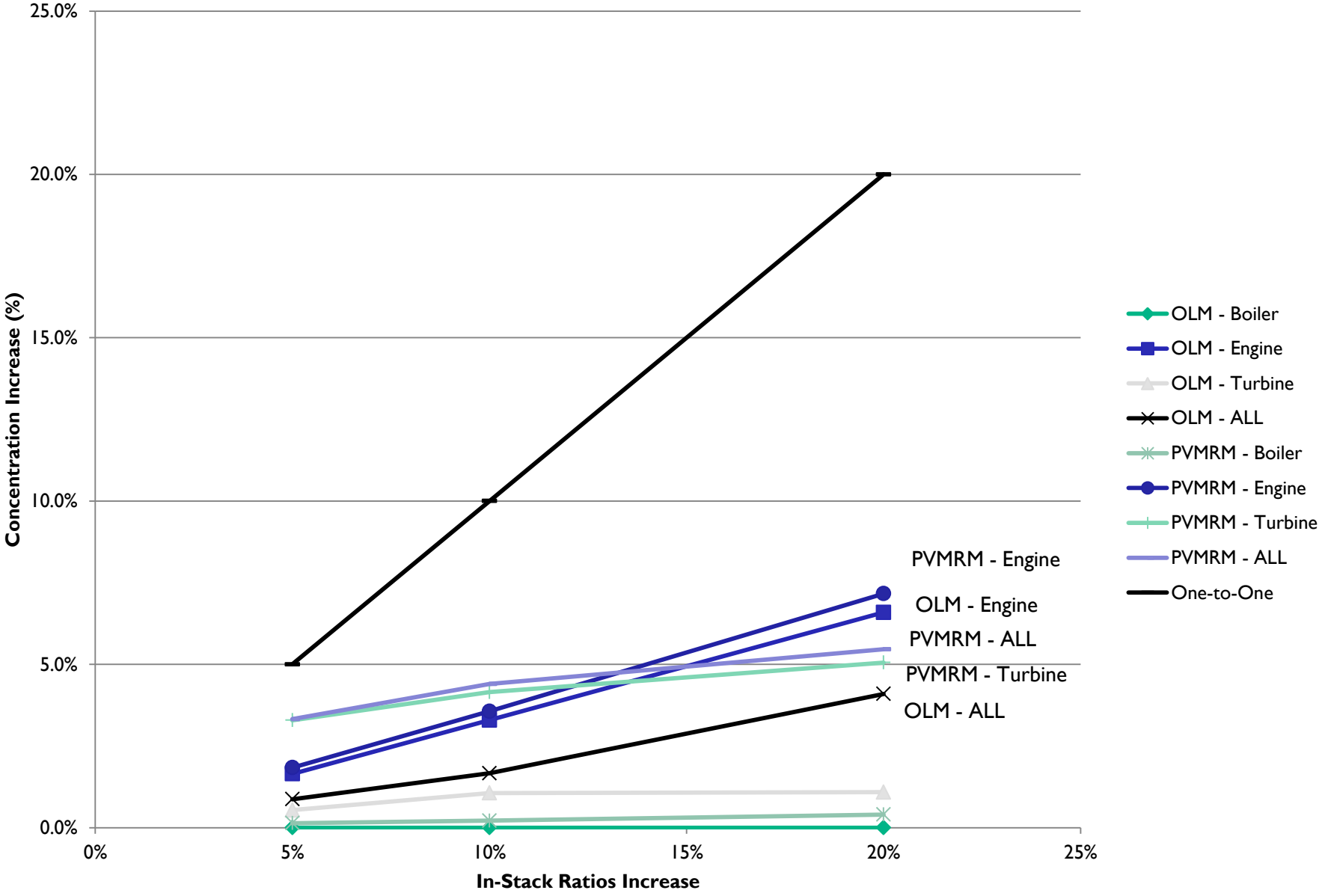
Varying Equilibrium



Varying Ozone



Varying In-Stack Ratios



Case Study Conclusions

- Ambient NO_2/NO_x equilibrium ratio seems to affect the boiler and turbine impacts the most
- Ambient ozone concentrations appear to affect engine impacts the most
- In-stack NO_2/NO_x ratios seem to affect impacts the least

Questions?

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