

NOx Emissions Analysis

Meta "Seafox" Data Center — El Paso, Texas

Executive Summary

This report quantifies the estimated nitrogen oxide (NOx) emissions profile of the Meta "Seafox" facility in El Paso, Texas — a nominally 1.0 GW data center powered by a distributed fleet of small-bore natural gas reciprocating engines. Unlike utility-grade power infrastructure, this architecture relies on approximately 2,222 modular 450 kW units originally marketed for commercial backup applications.

The analysis finds that, even under conservative and internally favorable assumptions, the Seafox facility generates NOx emissions equivalent to 475,000 to over one million passenger cars annually — between 2.7× and 6.1× the output of a modern combined-cycle gas turbine plant equipped with Selective Catalytic Reduction (SCR) technology at the same nameplate capacity.

Given El Paso's current trajectory toward federal ozone non-attainment designation, this emission profile presents material regulatory risk, including potential curtailment authority by the Texas Commission on Environmental Quality (TCEQ).

1. Methodology and Core Assumptions

1.1 Fleet Configuration

Parameter	Value	Basis
Total engine count	2,222 units	1,000 MW ÷ 450 kW/unit
Engine nameplate capacity	450 kW per unit	Enchanted Rock specification
Engine brake horsepower	603 bhp per unit	450 kW ÷ 0.7457 kW/hp
Steady-state fleet share	90% (2,000 engines)	Design-state assumption
Transient fleet share	10% (222 engines)	Ramping / start-stop events

1.2 Emission Rates

Two distinct emission states govern the fleet's NOx output:

Steady-state (catalyst-active): 0.07 g/bhp-hr, consistent with CARB Near-Zero certification for spark-ignited stationary engines above 25 hp. This is the manufacturer's advertised performance under stable, warm operating conditions.

Transient (ramping / cold-start): Three scenarios are modeled — 1.0, 2.0, and 3.0 g/bhp-hr. This range reflects the performance degradation that occurs when three-way catalyst (TWC) efficiency is compromised during start-up (pre-light-off, typically below 400°C), load ramping, or frequent cycling. All workload patterns are characterized by significant demand spikes, making transient operation endemic rather than exceptional.

Note: El Paso's elevation of approximately 3,740 feet reduces air density, which further stresses catalyst thermal efficiency during warm-up periods, particularly during summer months. The high-end scenario (3.0 g/bhp-hr) partially accounts for this degradation.

2. Emissions Results

2.1 Hourly NOx Output by Scenario

Scenario	Transient Rate	Steady-State (lbs/hr)	Transient (lbs/hr)	Total (lbs/hr)
Low	1.0 g/bhp-hr	186	295	481
Mid	2.0 g/bhp-hr	186	590	776
High	3.0 g/bhp-hr	186	885	1,071
H-Class + SCR (reference)	—	~175 lbs/hr (full output)	—	~175

The steady-state contribution (186 lbs/hr) is constant across scenarios. The transient component — representing only 10% of the fleet by unit count — accounts for 61% to 83% of total facility NOx depending on the scenario assumed. This disproportionate impact is a structural characteristic of distributed small-engine architectures, not an edge case.

2.2 Annual NOx Output and Passenger Car Equivalents

Annual figures assume continuous full-capacity operation (8,760 hours). Passenger car equivalents are derived using the EPA fleet-average NOx emission rate of 0.35 g/mile and an annual vehicle mileage of 11,500 miles, yielding 4,025 g NOx per vehicle per year.

Scenario	Annual NOx (tons)	Car Equivalent	Multiple vs. H-Class + SCR
Low (1.0 g/bhp-hr transient)	2,107	~475,000 cars	2.7×

Scenario	Annual NOx (tons)	Car Equivalent	Multiple vs. H-Class + SCR
Mid (2.0 g/bhp-hr transient)	3,399	~766,000 cars	4.4×
High (3.0 g/bhp-hr transient)	4,691	~1,057,000 cars	6.1×
H-Class + SCR (reference)	767	~173,000 cars	1.0× (baseline)

Even under the most favorable scenario — accepting every assumption that benefits the Seafox architecture — the facility generates annual NOx output equivalent to adding 475,000 passenger cars to the El Paso air basin. This figure is 2.7 times higher than a modern utility-grade plant at identical nameplate capacity.

3. El Paso Regulatory Context

3.1 Ozone Non-Attainment Status

El Paso currently operates under active EPA scrutiny for ground-level ozone, a pollutant for which NOx is a primary precursor. The region has historically struggled with ozone compliance due to its geographic basin topography, high temperatures, and cross-border emission contributions from Ciudad Juarez.

A major new stationary NOx source — particularly one operating continuously — would be evaluated against both Prevention of Significant Deterioration (PSD) thresholds under federal Clean Air Act regulations and TCEQ's State Implementation Plan (SIP) obligations. Depending on final operating permit conditions, the facility could be classified as a Major Source subject to Best Available Control Technology (BACT) requirements.

3.2 TCEQ Curtailment Risk

In the event El Paso is formally designated as an ozone non-attainment area, the TCEQ acquires enhanced authority to impose emission reduction orders on large stationary sources. Mechanisms include:

- Episodic curtailment during high-ozone days (common in El Paso summers, May through September)
- Mandatory load reduction orders tied to Air Quality Index thresholds
- Permit condition triggers that cap annual NOx tonnage, requiring operational throttling to stay within limits

For a facility whose economic value depends on continuous, high-availability power delivery to AI compute infrastructure, a 30–50% curtailment obligation during peak summer months would represent a material operational and contractual liability. Data center SLA commitments are incompatible with environmentally-mandated power reductions.

4. Structural Considerations

4.1 The Transient Emissions Problem at Scale

The Seafox facility's distributed architecture creates an emissions dynamic that centralized power plants do not face. A utility-grade combined-cycle turbine operates continuously at stable load; its transient exposure is limited to planned startup and shutdown events, typically a few times per year.

A 2,222-engine fleet serving AI infrastructure faces fundamentally different operating conditions. AI compute loads are bursty and unpredictable, with rapid demand swings driven by model inference and training batch scheduling. Each demand spike requires a subset of engines to ramp from idle or cold-start — entering the transient emissions state modeled above. If 15–20% of the fleet is in a transient state at any given time (rather than the conservative 10% used here), the emission figures scale proportionally upward.

4.2 Catalyst Performance Degradation

Three-way catalysts require sustained exhaust temperatures of approximately 400°C or higher to achieve rated conversion efficiency. In the El Paso operating environment:

- Summer ambient temperatures above 100°F reduce the delta-T available for rapid catalyst warm-up
- Elevation at 3,740 feet reduces air density, affecting combustion stoichiometry and exhaust enthalpy
- Frequent start-stop cycles accelerate thermal fatigue on catalyst substrates, reducing long-term conversion efficiency

These factors collectively suggest that steady-state NO_x performance below 0.07 g/bhp-hr — let alone the transient rates modeled here — may be optimistic for year-round El Paso operation.

5. Comparison to Utility-Grade Architecture

A modern H-Class combined-cycle gas turbine plant equipped with SCR technology represents the current state of the art for utility-scale power generation. At 1 GW output, such a plant emits approximately 150–200 lbs of NO_x per hour under normal operations — concentrated at a single permitted point source with continuous emissions monitoring equipment (CEMS) and established regulatory compliance infrastructure.

The distributed Seafox fleet, by contrast, operates as 2,222 independent emission points. Collectively, even under conservative assumptions, the fleet emits 2.7 to 6.1 times more NO_x annually. Additionally, distributed sources are structurally harder to monitor, harder to retrofit with post-combustion controls, and more susceptible to maintenance variability across a large fleet.

Attribute	Seafox Fleet (Low Scenario)	H-Class + SCR
Annual NOx	2,107 tons	767 tons
Car equivalent	~475,000	~173,000
Emission points	2,222 distributed	1 centralized
Continuous monitoring	Not standard at unit level	CEMS required
Curtailment flexibility	Limited (AI load constraints)	High (grid dispatchable)
Catalyst retrofit path	Per-unit, impractical at scale	Single SCR installation

6. Conclusion

The Meta Seafox facility in El Paso presents a NOx emissions profile that is materially and structurally worse than utility-grade alternatives, under any defensible set of operating assumptions. The distributed small-engine architecture that enables rapid deployment also creates an inherent transient emissions problem that grows with the facility's operational dynamism.

For the El Paso air basin — already under federal scrutiny for ozone — this represents a significant and measurable environmental burden. The regulatory exposure, particularly the risk of mandatory curtailment during the summer months when AI compute demand is highest, creates a direct conflict between the facility's operating model and its air quality obligations.

In contrast, a utility-grade, centralized power architecture with post-combustion controls (SCR) delivers equivalent or superior generating capacity at a fraction of the NOx output, with a well-established regulatory compliance pathway and no inherent conflict between peak demand periods and air quality management requirements.

Appendix: Calculation Reference

Engine horsepower conversion:

$450 \text{ kW} \div 0.7457 \text{ kW/hp} = 603 \text{ bhp per engine}$

Steady-state NOx (hourly):

$2,000 \text{ engines} \times 603 \text{ bhp} \times 0.07 \text{ g/bhp-hr} = 84,420 \text{ g/hr} = 186 \text{ lbs/hr}$

Transient NOx (hourly, mid scenario):

$222 \text{ engines} \times 603 \text{ bhp} \times 2.0 \text{ g/bhp-hr} = 267,732 \text{ g/hr} = 590 \text{ lbs/hr}$

Annual total (mid scenario):

$776 \text{ lbs/hr} \times 8,760 \text{ hrs/yr} = 6,798,000 \text{ lbs} = 3,399 \text{ short tons}$

Car equivalent derivation:

EPA fleet average: $0.35 \text{ g NOx/mile} \times 11,500 \text{ miles/yr} = 4,025 \text{ g NOx/vehicle/yr} = 8.87 \text{ lbs/vehicle/yr}$

Mid scenario: $6,798,000 \text{ lbs} \div 8.87 \text{ lbs/vehicle} = \sim 766,000 \text{ vehicle equivalents}$

United States Senate

WASHINGTON, DC 20510

March 13, 2026

Mark Zuckerberg
Meta Platforms, Inc.
Chief Executive Officer
1 Meta Way
Menlo Park, CA 94025

Dear Mr. Zuckerberg:

I write to request information about Meta's plans to power hyperscale data centers in Ohio and Texas with new gas-fired power generation facilities. At 400 megawatts and up to 1 gigawatt respectively, the Socrates and Meta El Paso Data Center projects will thousands of tons of health-harming local pollutants and millions of tons of greenhouse gases every year. You are undoubtedly aware that your local air pollutants—including nitrogen oxides, volatile organic compounds, particulate matter, carbon monoxide, and benzene—will pollute the air surrounding the project, creating health issues for your neighbors, including asthma, heart attacks, stroke, reproductive issues, and cancer, with possible lethal effects.¹ You must also know that the millions of tons of greenhouse gases that the Socrates and Meta El Paso Data Center projects will emit every year will create climate harms lasting generations.

It's well established that climate upheaval and huge economic impacts will result if we fail to limit global temperature increase to no more than 1.5 degrees Celsius above pre-industrial levels.² That requires reducing greenhouse gas emissions by 45% by 2030 and reaching net zero by 2050,³ which in turn means that advanced economies' energy sectors must achieve overall net-zero emissions by 2035.⁴

I would ask that you explain how your actions are consistent with this goal, and if they are not, why you don't think that matters. It appears that if all the gas projects currently under

¹ See, e.g., Environmental Protection Agency, "Health and Environmental Effects of Particulate Matter (PM)" (May 23, 2025), <https://perma.cc/T58A-748U>; Li Yang et al, "Long-term exposure to particulate matter pollution and incidence of ischemic and hemorrhagic stroke: A prospective cohort study in Eastern China", *Environmental Pollution*, Vol. 358 (Oct. 1, 2024), <https://www.sciencedirect.com/science/article/abs/pii/S0269749124011606>; U.S. EPA, "Basic Information about Carbon Monoxide (CO) Outdoor Air Pollution", <https://www.epa.gov/co-pollution/basic-information-about-carbon-monoxide-co-outdoor-air-pollution>; American Lung Association, "Volatile Organic Compounds", <https://www.lung.org/clean-air/indoor-air/indoor-air-pollutants/volatile-organic-compounds>; EPA, "Basic Information About NO₂", <https://www.epa.gov/no2-pollution/basic-information-about-no2>; Centers for Disease Control and Prevention, "Benzene", <https://www.cdc.gov/chemical-emergencies/chemical-fact-sheets/benzene.html>.

² United Nations, Climate Action: "For a livable climate: Net-zero commitments must be backed by credible action", <https://www.un.org/en/climatechange/net-zero-coalition>.

³ *Id.*

⁴ See generally the International Energy Agency's comprehensive study finding that in order to achieve a net zero world by 2050, advanced economies must achieve overall net-zero emissions in their electricity sectors. International Energy Agency, "Net Zero by 2025: A Roadmap for the Global Energy Sector", IEA (Oct. 2021), https://iea.blob.core.windows.net/assets/deebef5d-0c34-4539-9d0c-10b13d840027/NetZeroBy2050-ARoadmapfortheGlobalEnergySector_CORR.pdf at 20.

development in the United States, including yours, are completed, they will add a combined 12.1 billion tons of carbon dioxide emissions in their lifetimes,⁵ double the annual emissions from *all other sources* in the U.S. today.⁶

Please describe your consideration of measures to capture or offset emissions from gas-fired generation, or investing instead in renewable energy and storage. Solar and wind are the cheapest and most abundant sources of energy available⁷ and can be coupled with energy storage systems, whose costs have dropped significantly in recent years and are continuing to fall.⁸

Other large hyperscale projects have invested in renewable options like these as well as in zero-carbon nuclear energy.⁹ And other gas projects are implementing 90 percent carbon capture, a proven and scalable approach to significantly reduce greenhouse gas emissions from fossil-powered projects.¹⁰ Some gas suppliers are reducing methane leaks, vents, and releases, certified by third party accounting of their embedded emissions intensity. You may know that without adequate methane mitigation measures in place, combusting gas to generate electricity can have an equivalent carbon intensity to combusting coal.¹¹

To help us better understand your decision-making process and plans related to the Socrates and Meta El Paso Data Center projects, please provide responses to the following interrogatories and document requests by March 27, 2026:

1. Why did you decide to rely primarily on gas to power your hyperscale data center, rather than carbon-free energy sources such as solar, wind, storage, geothermal, and nuclear power? Do you dispute the health and climate harms described above that will result from your decision?

⁵ Oliver Milman, “US leads record global surge in gas-fired power driven by AI demands, with big costs for the climate”, *The Guardian* (Jan. 29, 2026).

⁶ *Id.*

⁷ United Nations, “Renewables: Cheapest form of power” (July 19, 2022), <https://www.un.org/en/climatechange/renewables-cheapest-form-power>; “Renewable energy remains cheapest power builds as new gas plants get pricier”, *Reuters* (June 16, 2025), <https://www.reuters.com/sustainability/climate-energy/renewable-energy-remains-cheapest-power-builds-new-gas-plants-get-pricier-2025-06-16/>.

⁸ Center for Climate and Energy Solutions, “Electric Energy Storage”, <https://www.c2es.org/content/electric-energy-storage/>.

⁹ See, e.g., “Power Hungry Data Centers Are Driving Green Energy Demand”, *Bloomberg NEF* (Aug. 26, 2025), <https://about.bnef.com/insights/clean-energy/power-hungry-data-centers-are-driving-green-energy-demand/>; Jeffrey Tomich, “Google, Xcel pitch large-scale renewables for data center”, *E&E Energywire* (Feb. 25, 2026), <https://subscriber.politicopro.com/article/eenews/2026/02/25/google-xcel-pitch-large-scale-renewables-for-data-center-00795911>.

¹⁰ Dominic Genetti, “2025: Taking carbon capture and storage from momentum to impact”, *ExxonMobil* (Jan. 26, 2026), <https://corporate.exxonmobil.com/news/viewpoints/2025-taking-carbon-capture-and-storage-from-momentum-to-impact>; Mathilde Fajardy, Carl Greenfield, and Josephine Tweneboah Koduah, “CCUS projects around the world are reaching new milestones”, *International Energy Agency* (Apr. 30, 2025), <https://www.iea.org/commentaries/ccus-projects-around-the-world-are-reaching-new-milestones>.

¹¹ Analysis from the Rocky Mountain Institute (RMI) found that a methane leak rate of just 0.2% puts the climate risk of natural gas on par with coal. Deborah Gordon, Shannon Hughes, “Reality Check: Natural Gas’s True Climate Risk”, *RMI* (July 13, 2023), <https://rmi.org/reality-check-natural-gas-true-climate-risk/>.

2. Are you planning to implement 90 percent carbon capture at the Socrates and Meta El Paso Data Center projects, or otherwise reduce greenhouse gas emissions by 88.4% by 2032 as required under existing law? Are you planning to implement any carbon capture? If yes, what percent of total carbon emissions do you plan to capture?
3. Do you plan to trace your natural gas suppliers' actual emissions intensity? Will you use only certified gas suppliers who responsibly reduce their methane leaks, vents, and releases?
4. Do you plan to use combined-cycle gas fired turbines, or do you plan to use mobile gas-fired generators, aeroderivative turbines, or reciprocating turbines? How did you make your decision?
5. Do you have plans in place to offset your greenhouse gas emissions, including the embedded emissions associated with the fuel you purchase? If yes, please describe in detail. If not, why not?
6. Did you conduct or commission any analyses, data, or calculations to assess whether the new gas plants realized through your plans align with the IPCC's directive for a net-zero world by 2050? If yes, please produce all relevant documents. If not, why not?
7. Reporting suggests that hyperscale data center operators often experience significant rates of return on investment.¹² Please disclose your expected rate of return on this project. Would your project fail financially if you took any of the above responsible steps to reduce pollution and emissions?

Sincerely,



Sheldon Whitehouse
United States Senator
Ranking Member
Committee on Environment
and Public Works



Martin Heinrich
United States Senator
Ranking Member, Committee
on Energy and Natural
Resources

¹² Software company Accordant reported in July of last year that internal rates of return for “ground-up hyperscale projects [were] tracking between 25 percent and 40 percent over three-to four-year hold periods.” Accordant, “Numbers Supporting 30%+ IRR Returns in Hyperscale Data Center Development”, (July 3, 2025), https://www.accordantinvestments.com/blog/the-numbers-supporting-30-irr-returns-in-hyperscale-data-center-development#:~:text=*30%25+%20IRR%20Returns%E2%80%9D%20refers,8.