

# Texas data centres could erase decades of air quality gains, HARC report finds

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Texas Data Centers and Air Quality: An Assessment of Potential Impacts

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Texas cut its major air pollutants sharply between 2002 and 2024, particularly from transportation, industry and the power generation sectors, even as the state's population grew by millions and its economy roughly doubled. That progress will be tested by a new wave of electricity demand from the fast-growing data center industry. To better understand the potential impacts, HARC modeled how four power supply scenarios could affect five pollutant emission volumes over the next five years, based on three projections of data center energy demand.

Key Findings

Texas's power and industrial sectors could see harmful NO<sub>x</sub> and VOC emissions return to volumes not observed since the early 2000s: Under a scenario in which all new data center demand is met by the projected grid mix, 2031 NO<sub>x</sub> would increase 136% and approach its 2004 volume, while VOCs would exceed the 2002 volume by 32% and PM<sub>2.5</sub> would increase to its 2006 volume — reversing most or all of two decades of improvement. Under the same scenario, SO<sub>2</sub> emissions would increase 18% but would remain below their 2002 volume.

Power-supply choice drives enormous swings: NO<sub>x</sub> emissions from data center power generation could be 2 to 10 times higher if all new demand were met with combustion instead of grid supply paired with solar and wind, depending on which demand forecast is used — the single largest factor in the range, larger than data center growth itself.

Even under the cleanest power supply configuration, data center power demand leads to an increase in pollutants

above the no-data-center baseline : The sheer volume of new electricity demand pushes emissions up even when it's supplied as cleanly as possible.

These projections, made available in an interactive chart , allow policymakers and stakeholders to better understand the trade-offs posed by the electricity generation sources that may be used to meet the anticipated demand posed by data centers. Note: A full methodology along with study limitations are also available below.

#### Implications

Power plant emission controls and fuel switching, vehicle tailpipe standards, and the retirement of coal-fired generation drove the reduction in CO<sub>2</sub>, NO<sub>x</sub>, and SO<sub>2</sub>, emissions statewide. Looking by sector, those most amenable to federal regulation — power generation and on-road transportation — delivered dramatic, sustained reductions through enforceable technology standards applied at the point of manufacture or operation. (Table 1)

Table 1. Change in Annual Emissions in 2024 vs. 2002, by Sector and Pollutant

Sector CO<sub>2</sub> NO<sub>x</sub> SO<sub>2</sub> PM<sub>2.5</sub> VOCs

Power Generation -52% -67% -80% -60% -37%

Industrial -27% -13% -71% -6% +63%

On-Road -71% -83% -95% -78% -78%

Off-Road -39% -71% -98% -73% -49%

Others +436% +141% +110% +72% +419%

Power generation and industry are the sectors associated with the coming data center build-out, depending on whether they are supplied by the grid or by on-site generation. Their trajectory, especially during a period of profound growth, is a critical determinant of the state's overall emissions footprint.

This assessment yielded 77 modeled trajectories covering five pollutants under three data center growth projections, all demonstrating a potential shift in direction for the state's air quality. Holding the demand forecast constant, VOC emissions alone could run 2 to 165 times higher if new demand were met through on-site combustion instead of grid supply paired with solar and wind — power-supply choice is what drives the outcome. At the low end of outcomes, one year of data-center emissions would be negligible — a rounding error against what Texas already emits. At the high end, for CO<sub>2</sub> and NO<sub>x</sub> especially, the addition would exceed everything Texas currently emits in a year for those two pollutants combined. The gap between those two outcomes is entirely a function of power-supply technology, which underscores the potential cumulative impact of data centers.

These conclusions may never come to pass. Texas lawmakers and industry leaders have the opportunity to shape the state's air quality for decades to come.

Bottom line: Texas's air quality gains since 2002 were real, sustained, and concentrated in the power generation sector. The scale of the projected data center build-out means that sector's future emissions trajectory now depends heavily on decisions about how the new electricity demand is supplied — decisions that, on this modeling, could plausibly range from a marginal addition to a reversal of two decades of progress.

#### Methodology and data sources

Data center capacity: Three sources are used for data center capacity, in megawatts: ERCOT's Adjusted Large Load Breakdown , Transmission Service Providers (TSP) Large Load Breakdown , and BAXTEL . ERCOT and TSP figures are used directly, without adjustment. BAXTEL's figure for a given year is calculated by adding that year's newly operational, under-construction, and planned capacity to the cumulative total carried over from the previous year.

Electricity and cooling demand: All data centers in a given year are assumed to operate continuously — 24 hours a day, 365 days a year (8,760 hours) at 80% capacity. Total electricity demand is the data center capacity (megawatt hours) for that year multiplied by 8,760 and then by 0.8. About 40% of that electricity demand is assumed to go toward cooling, consistent with published estimates from the Congressional Research Service , McKinsey , and Deloitte . The corresponding cooling load is calculated assuming a coefficient of performance (COP) of 4.69.

Electricity and fuel usage: For every scenario except Grid Only and On-Site Natural Gas Engines, NRL's REopt tool was used to simulate the electricity and fuel mix for a single representative 1-gigawatt data center — including, for the net-zero Grid + PV + Wind scenario, the split between grid, solar, and wind supply. For the reciprocating-engine and cogeneration scenarios, DOE factsheet and REopt estimates were used respectively to size the fuel usage of reciprocating engines and combustion turbines. For the carbon capture scenario, a post-combustion capture system was assumed, sized to the fuel usage of a cogeneration system serving the same 1-gigawatt facility. Once the electricity/fuel mix is established for that 1-gigawatt reference facility, usage for Texas's full projected data center capacity in a given year is calculated by linear scaling.

Emissions factors: Grid electricity emissions factors are built from EPA's eGRID data combined with ERCOT's own generation data, by fuel type. Using ERCOT's 2017–2025 GWh production and MW capacity by fuel type, a capacity factor is calculated for each fuel type; MW capacity for biogas, nuclear, coal, and hydro is held constant, while future capacity for other fuel types is drawn from ERCOT's Capacity Changes by Fuel Type resource. A year-over-year trend is fit to each fuel type's historical capacity factor and projected forward with a damping factor of 0.8, then combined with projected capacity to estimate future generation (GWh) by fuel type. Applying eGRID's plant-level emissions factors to that projected generation mix produces the future total grid emissions factor.

The CO<sub>2</sub> emissions factor for natural gas was determined using EPA's emissions factors. A Higher Heating Value (HHV) is considered for the calculation. Because the natural gas emissions factor does not change over time, a single constant value is applied to onsite fuel combustion in all years.

For Natural Gas Engines, NO<sub>x</sub>, VOC, PM<sub>2.5</sub> and SO<sub>2</sub> factors were determined using TCEQ Title 30, and EPA Natural Gas-fired Reciprocating Engines document. For Cogeneration + Carbon Capture, these factors were determined using TCEQ Title 30, EPA Stationary Gas Turbines document. The case without PCS represents the regulatory limits set by either the state or nation or uncontrolled values.

For the PCS case; the natural gas power generation systems are equipped with PCS to reduce the NO<sub>x</sub> and VOC emissions from uncontrolled scenario (higher than the regulatory limits). For Natural Gas Engines PCS reductions were considered from EPA Natural Gas-fired Reciprocating Engines document and EPA CHP Catalog Section 2 for NO<sub>x</sub> and VOC respectively. For Cogeneration + Carbon Capture these values were determined using EPA CHP Catalog Section 3 and EPA Stationary Combustion Turbines NESHAP Report. The uncontrolled emissions factors were determined using these documents for Natural Gas Engines and Cogeneration + Carbon Capture.

Baseline emissions: To isolate the emissions increase attributable to data centers, a baseline case is established in which no new data centers are built and Texas grid emissions continue on their existing trajectory. Texas Commission on Environmental Quality's (TCEQ) point source emissions from 2018 to 2024 are utilized. According to TCEQ: The Point Source Emissions Inventory is an annual survey of chemical plants, refineries, electric utility plants and other industrial sites that meet the reporting criteria in the TCEQ emissions inventory rule (30 TAC §101.10). Pollutants such as NO<sub>x</sub>, VOC, SO<sub>2</sub> and PM<sub>2.5</sub> are reported in the Point Source Emissions Inventory. EPA's National Emissions Inventory (NEI) 2020 (latest available) is used to estimate the percentage of point source emissions associated with Texas grid. This grid-related share of point source emissions is assumed to hold constant across all years. Using the data from TCEQ, the average percentage change in emissions is determined and used to estimate emissions trend for future years from 2025. It is assumed that the point source emissions will follow a similar trend it has been following in recent years.

For CO<sub>2</sub> emissions related to Texas grid, EIA's Table CO2.T6 is utilized for a similar time frame as TCEQ's point source emissions data. From these data, the average percentage change in emissions is determined and used to estimate emissions trend for future years from 2025. It is assumed that CO<sub>2</sub> emissions will follow a similar trend to what it has been following in recent years.

Together, these values form the baseline for all five pollutants: no new data centers are added, and emissions continue along their recent trend.

Combining data center impact with baseline: For every combination of data source, scenario, and pollutant, the modeled data center emissions for a given year are added to that year's baseline to produce total projected emissions. This is done for all three data sources and all four scenarios, for every pollutant, across the full 2018–2031 period. For 2031 specifically, the minimum and maximum projected values — and their percentage change from 2025 — are calculated across the four scenarios, by source and by pollutant.

## Assumptions & limitations

Each scenario assumes that all new data center demand is served by the selected power generation mix. Actual buildout is likely to mix approaches, so actual outcomes should fall somewhere between the modeled lines rather than on any one of them.

Electricity and fuel usage are simulated once for a single representative 1-gigawatt facility, then scaled linearly to full projected capacity. This does not capture facility-to-facility variation in design, location, or efficiency.

The baseline emissions trend is projected forward from TCEQ/EIA data spanning 2018–2024, and the future grid emissions factor from ERCOT/eGRID fuel-mix data spanning 2017–2025 (damped by a factor of 0.8 to temper the projection). A faster or slower change in Texas's grid mix or industrial emissions than those recent trends — in either direction — would shift every line in this dashboard, baseline included.

The BAXTEL data source assumes announced and planned data centers come online on the schedule their developers have given. Delays or cancellations, common in large infrastructure buildouts, would push that source's curve later or lower than shown.

Natural gas combustion emissions factors are held constant across the full period, consistent with current EPA documentation.

In power supply scenarios 3 and 4, it is assumed that the facilities will be able to reach the regulatory emissions limits through various means as per the owner's discretion; these values are smaller or equal to uncontrolled emissions.

In power supply scenarios 5 and 6, it is assumed that the PCS will be added to reduce uncontrolled emissions; these PCS considerably reduce the emissions to values closer to the industry standards. Still, the increase in pollutant emissions is considerable due to the high increase in power demand the data center sector will be experiencing.

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