ENVIRONMENTAL INTEGRITY PROJECT

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Submitted via email
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Re: Comments on *Houston-Galveston-Brazoria Severe Area Attainment Demonstration State Implementation Plan Revision for the 2008 Eight-Hour Ozone National Ambient Air Quality Standard,* Project No. 2023-110-SIP-NR.

Dear Ms. De Arman:

On November 29, 2023, the Texas Commission on Environmental Quality (TCEQ) proposed revisions to the State Implementation Plan (SIP) for the Dallas-Fort Worth (DFW) and Houston-Galveston-Brazoria (HGB) areas to demonstrate compliance with the eight-hour ozone limit of 75 parts per billion (ppb) promulgated by the U.S. Environmental Protection Agency in 2008. The proposed SIP revisions were prompted by the U.S. EPA's decision on November 7, 2022, to reclassify DFW and HGB as in "serious" nonattainment with the 75 ppb standard, which should trigger more stringent emission control requirements for nitrogen oxide (NOx) and volatile organic chemical compounds (VOC), the precursors that react with each other to form ozone under meteorological conditions that include sunlight, high temperatures and low wind speeds. The Environmental Integrity Project (EIP), Air Alliance Houston, Public Citizen, and Environment Texas (Commenters) appreciate the opportunity to comment on TCEQ's proposal for the HGB area, which promises to demonstrate full compliance with the 2008 ozone limit no later than July 20, 2027.

As TCEQ explains, compliance with the HGB SIP is achieved when the average of the fourth highest maximum daily 8-hour ozone concentration (MDA8) in each of three succeeding years—the so-called "design value" (DV)—does not exceed 75 ppb at any of the 20 regulatory monitors used that measure hourly ozone concentrations in Brazoria, Chambers, Fort Bend, Galveston, Liberty, Harris, Montgomery, and Waller Counties. The revised SIP is based on an evaluation of the relative contribution of past and projected future precursor emissions from mobile, area and point sources to ozone formation at specific locations and under variable meteorological conditions.

Of particular interest, TCEQ's proposal includes a baseline estimate of NOx and VOC emissions from each source category within the HGB region on June 12, 2019, when six regulatory monitors measured MDA8 ozone above 75 ppb. The model estimated total NOx and VOC emissions of 343.62 and 487.73 tons, respectively, on that day. From that starting point, TCEQ projects that the maximum daily NOx emissions during the 2026 ozone season will not exceed 319.37 tons, about a 7 percent reduction from the 2019 baseline, while maximum daily VOC emissions will actually increase about 1% to 492.35 tons. All of the reductions will come from on and offroad mobile sources.

Although TCEQ has identified 20 regulatory monitors, the Commission publishes hourly ozone collected from a total of 42 stations spread throughout the HGB area, and frequently cites data from these additional monitors in its proposal. Unless otherwise noted, Commenters' evaluation of MDA8 ozone levels and design values will rely on a subset of 36 monitors analyzed in the report recently published by the Environmental Integrity Project, concerning Houston area ozone.[1]

Summary:

1) Violations of the 75 ppb ozone standard in 2023 were more frequent, more severe, and more widespread than they have been in the past 10 years. In light of the 2023 results, TCEQ should re-evaluate whether the models used to guide its proposed SIP revisions are reliable enough to ensure that the HGB area will attain the 2008 ozone standard by July of 2027.

2) TCEQ models are based on dubious assumptions about annual and short-term NOx and VOC emission rates from sources within the HGB areas. In particular, these assumptions do not account for the under-reporting of ozone precursors, especially highly reactive VOC (HRVOC), wide swings in short-term emission rates, and releases triggered by upsets or other emission events. TCEQ should more clearly address the impact these variables will have on the HGB area's ability to comply with the 75 ppb ozone limit.

3) TCEQ's SIP proposal anticipates a 7% decrease in area-wide NOx by 2026 combined with VOC increases that will fall more heavily on the neighborhoods already adversely affected by pollution from petrochemical plants and the Houston Ship Channel. Yet TCEQ's own conceptual model concludes that reducing VOC emissions can be a more effective way to lower ozone levels in some locations, while in others simultaneous reductions in both VOCs and NOx is the best strategy.

4) TCEQ should acknowledge that in recent years, people of color are more likely to live in areas where violations of the 75 ppb limit occur more frequently and explain how its proposed SIP revisions will address these inequities.

5) While the extremely hot weather in the Houston area contributed to frequent and severe violations of the 2008 ozone limit in 2023, TCEQ should acknowledge that global warming models show that temperatures will continue to rise in the HGB area and propose an attainment plan that reflects this reality.

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[1] Environmental Integrity Project, Increase in Houston Ozone Violations Hits Communities of Color Hardest, Nov. 2023, available at: https://environmentalintegrity.org/wp-content/uploads/2023/11/EIP_Report_HoustonOzone_Final.pdf.

Comment 1: TCEQ should revise its proposal to take into account that violations of the 75 ppb limit in 2023 were frequent, widespread, and severe.

TCEQ has identified 2019 ozone values and emissions levels as the starting point for its plan to attain the 2008 standards no later than 2026. But that baseline and the models used to support TCEQ's proposed SIP revisions may no longer suffice given the 2023 ozone data.

- The HGB design value in 2019 was 81 ppb at Deer Park, while the design value was exceeded at five other monitors. The HGB design value in 2023 rose to 83 ppb, based on ozone levels at Bayland Park, while a total of eleven monitors recorded design values exceeding 75 ppb. The 2023 DV is the highest since 2013, which was also the last time that more than eleven monitors recorded design values above 75 ppb.

- The fourth highest ozone value at six monitors exceeded the 75 ppb limit in 2019, with two monitors recording 8 hour averages above 79 ppb. In contrast, the fourth highest value was greater than 75 ppb at 25 locations in 2023, with 16 monitors recording ozone levels ranging from 80 to 90 ppb. That is the highest level since 2012, when the fourth highest ozone level exceeded 75 ppb at 29 monitors. While the exceptionally high levels in 2023 are based on a single year, they will have a significant influence on the three-year rolling averages used to determine the design values in 2024 and 2025.

Based on the results from one or more monitors, the HGB area recorded 8-hour ozone concentrations greater than 75 ppb on 46 days in 2023, or 43 if only data from monitors TCEQ uses for regulatory purposes are included, which is much higher than any year since 2011. The data show that that 2008 ozone limit violations were more frequent and cut a wide swath through the greater Houston area. See Exhibit A for data to compare the number of dates when all HGB monitors exceeded 75 ppb in 2023, Exhibit B for the three-year design values from each monitor since 2010, the fourth highest maximum daily 8-hour ozone average from each monitor since 2008, and the number of days per year each monitor recorded 8 hour averages above the limit. See Exhibit C for a comparison of 2019 to 2023 ozone results at the 20 designated "regulatory monitors." For example, Exhibit C shows that the regulatory monitors recorded 150 MDA8 exceedances of the 75 ppb limit in 2023 versus 53 exceedances in 2019 (note that totals in each year include multiple exceedances at different monitoring locations that occurred on the same day).

The November 29 proposal asserts that, "Based on TCEQ's modeling and available data, the HGB area is expected to attain the 2008 NAAQS by the July 20, 2027 attainment date." Proposal at ES-3. The 2023 ozone season data suggests that TCEQ's confidence may be misplaced, because it did not adequately consider the significant variation in ozone levels from one year to the next that have occurred since the 75 ppb standard took effect for the HGB area in 2011. TCEQ's attainment strategy must consider the likelihood that periods when MDA8 ozone levels are relatively "moderate" will be interspersed with others when ozone violations are frequent and severe. Otherwise, peak ozone years will continue to drive the three-year averages used to demonstrate compliance above the 75 ppb limit.

The 2023 ozone season data will already make it significantly harder for the HGB area to hold the design value at or below the 75 ppb level by 2025. For example, the fourth highest MDA8 at the Bayland Park monitor was 87 ppb in 2023. To demonstrate compliance by 2025, the average of the fourth highest MDA8 this year and next could not exceed 70 ppb. That seems unlikely, as the Bayland Park monitor has never averaged less than 73 ppb over two years since monitoring began in 1998, and most two-year averages at Bayland Park are much higher.

Commenters anticipate that TCEQ may characterize the 2023 ozone season as an "outlier" caused by the extremely hot weather that plagued the Houston area last summer. Unfortunately, global warming models predict that temperatures will continues to rise for HGB and other areas in Texas in future years (see Comment 5).

Comment 2: TCEQ assumes the HGB area will demonstrate compliance with the 2008 limit by the end of the 2026 ozone season, despite projecting only a 7% decrease in NOx emissions and a slight increase in VOC emissions. But TCEQ's Conceptual Model substantially understates emissions, especially for HRVOC that have the greatest impact on ozone formation.

TCEQ includes detailed emission estimates in its photochemical model for several categories of emissions. For Electric Generating Units (EGU), hourly emissions are calculated from continuous monitoring data. For mobile sources, the emissions are estimated using area-specific parameters as inputs to U.S. EPA's Motor Vehicle Emission Simulator version 3 (MOVES3). For industrial non-EGU sources, TCEQ has apparently relied primarily on the annual emission reports that various sources submit to the State of Texas Air Reporting System (STARS). According to the Technical Support Document, Proposal Appendix A, the STARS data base includes, "four types of emission rates: annual, Ozone Season Daily (OSD) which spans from May to September, annual Emission Events (EE), and annual scheduled maintenance startup and shutdown." Proposal App. A 3.3.1.3 at A-18.

Where sources do not provide sufficient data, TCEQ makes assumptions, e.g., estimating daily emissions based on "summer use percentages" for the months of June, July, and August, although the most frequent and severe ozone exceedances in 2023 occurred in May and September. While Appendix A suggests that OSD emission rates include releases of NOx and VOC caused by EEs—presumably determined based on the daily average of the sum of EE emissions reported to STEERS in a year—elsewhere, in the Conceptual model, TCEQ does not appear to address EEs at all.

Commenters appreciate the difficulty of establishing a reliable baseline of precursor emissions that can provide a basis for the emissions used to predict ozone formation under various meteorological conditions. But the approach adopted by TCEQ is likely to substantially under-predict emissions of VOC and NOx for a variety of reasons:

a. Annual Emission Inventory Reports are Frequently Inaccurate and Undercount VOC

Texas and other states allow even the largest facilities to report annual emissions of VOC based on AP42 and other emission factors, or on "engineering judgments" that are unsupported. The AP42 emission factors are decades out of date, and many are based on data that may not be representative of the sources to which they apply. *See*, *e.g.*, D rated emission factors for refinery cooling towers and oil-water separators at AP 42-5.1-16. Significantly, efforts to predict fenceline concentrations of toxic VOC like benzene or butadiene at refineries or chemical plants based on the emissions reported by those sources have fallen short.

For example, based on refinery emission reports, EPA projected that only one refinery should see net annual concentrations of benzene at 9 micrograms per cubic meter, the action level adopted in the 2015 rule. Since that regulation took effect between 2018 and 2019, 29 refineries have reported annual fenceline concentrations above the nine-microgram level.[2] The extensive sampling at multiple plants that was used to inform EPA's proposed new standards for organic chemical plants revealed the same broad gap, with fenceline concentrations of multiple VOC carcinogens much higher than predicted from emission reports.[3]

b. While reducing HRVOC emissions is critical to reducing ozone levels in or downwind of the Ship Channel, TCEQ has not addressed the under-reporting of these super-charged ozone precursors.

Texas has acknowledged that ethylene, propylene and other highly reactive VOC (HRVOC) have a disproportionate impact on ozone in the greater Houston area. Proposal App. B, 3-12. When weighted for maximum incremental reactivity (MIR), TCEQ estimates that HRVOC account for between 20% and 50% of ozone forming potential in HGB, although a closer look at Table 3-10 in Appendix B suggests that the contribution is significantly higher at some monitoring locations. Taking this data into account, TCEQ concluded that, "The reactivity weighted composition of VOC in the HGB area is composed of mostly HRVOC; reductions in these compounds are likely to be more impactful on the ozone concentrations compared to equal reductions in less reactive VOC." Proposal App. B, Executive Summary.

Despite this awareness, TCEQ has little to say about the undercounting of the HRVOC emissions that are so critical to an ozone attainment strategy, a problem that was uncovered two decades ago. For example, the TexAQS 2000 and TexAQS II air quality studies evaluated trends in concentrations of ozone and ozone in the HGB region. The studies found that the inventory

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[2] Environmental Integrity Project, Monitoring for Benzene at Refinery Fencelines: 10 Oil Refineries Across U.S. Emitted Cancer-Causing Benzene Above EPA Action Level, Feb. 6, 2020; Environmental Integrity Project et al, New Source Performance Standards for the Synthetic Organic Chemical Manufacturing Industry and National Emission Standards for Hazardous Air Pollutants for the Synthetic Organic Chemical Manufacturing Industry and Group I & II Polymers and Resins Industry, 88 Fed. Reg. 25,080 (Apr. 25, 2023) [Docket No. EPA-HQ-OAR-2022-0730]: Comments of Environmental Integrity Project, Sierra Club, and California Communities Against Toxics, submitted July 7, 2023, Attachments A1a and A1b.

[3] U.S. EPA, Memorandum to EPA Docket No. EPA-HQ-OAR-2022-0730 regarding "Clean Air Act Section 112(d)(6) Technology Review for Fenceline Monitoring located in the SOCMI Source Category that are Associated with Processes Subject to HON and for Fenceline Monitoring that are Associated with Processes Subject to Group I Polymers and Resins NESHAP" (Mar. 2023) at 11-18

undercounted emissions of VOC and HRVOC and verified that observed HRVOC in the Houston area are associated with industrial emissions. Data collected during TexAQS 2000 showed that estimates of VOC emissions from petrochemical facilities, in particular alkenes such as ethylene and propylene, were significantly underestimated.[4] The TexAQS II study, conducted in 2005 and 2006, found that, while emissions of HRVOC had decreased, the inventory estimates were still undercounting regulated HRVOC emissions by approximately an order of magnitude.[5]

These underestimates can arise from a variety of causes. Emissions from flares, for example, may be under-reported due to over-steaming, gusting winds, or other operational factors that reduce combustion efficiency. The destruction efficiency of VOCs by flares is estimated rather than measured—U.S. EPA regulations require monitoring of flare operating parameters, but direct measurement of the emissions is not required.[6] However, the efficiency varies and can be much lower than assumed depending on factors such as wind and operating conditions.[7] As noted earlier, the emission factors used to report HRVOC emissions from many sources are inaccurate and outdated, as evidenced by fenceline monitoring results. Some highly reactive VOC like formaldehyde are not recognized by TCEQ at all.

Apparently, neither reported emissions nor ambient concentrations of HRVOC changed significantly between 2012 and 2021, Proposal App. B at 3-17, although median concentrations increased between 10 and 15% in 2021–2022 compared to 2012. But TCEQ does not examine whether the sources of these super-charged ozone precursors are reporting HRVOC emissions any more accurately than they were in 2005 and 2006. TCEQ suggests several that several large sources are responsible for high HRVOC concentrations at several monitoring sites at 3-10 in Appendix B:

> The other more centralized auto-GC, including Lynchburg, Channelview, CView Water Tower, HRM 3, HRM 16, and Deer Park, all indicate the existence of a large source of propylene and to a lesser extent ethylene. This source appears to be in the area south of Lynchburg, southeast of Cview Water Tower, and northeast of HRM16…. There appears to be a large HRVOC source of mostly butenes to the southeast of Galena Park. There also appears to be a large 1,3-butadiene source to the southwest of Milby Park and the north of Cesar.

Proposal App. B at 3-10. But TCEQ goes no further after deciding that it cannot pinpoint the "exact" source of these emissions. Given the disproportionate impact of these facilities on ozone formation, Commenters respectfully suggest that TCEQ identify these upwind sources, require

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[4] Ryerson, T. B., et al., Effect of petrochemical industrial emissions of reactive alkenes and NOx on tropospheric ozone formation in Houston, Texas, J. Geophys. Rsch., Apr. 2003 at 21.
[5] Parrish, D. D., et al., Overview of the Second Texas Air Quality Study (TexAQS II) and the Gulf of Mexico Atmospheric Composition and Climate Study (GoMACCS), J. Geophys. Rsch., Apr. 2009, at 2, 8.
[6] 40 CFR 60.18(b), 40 CFR 63.670; U.S. EPA, 40 CFR Parts 60 and 63
[Docket No. EPA–HQ–OAR–2022–0730; FRL–9327–01–OAR] RIN 2060–AV71 New Source Performance Standards for the Synthetic Organic Chemical Manufacturing Industry and National Emission Standards for Hazardous Air Pollutants for the Synthetic Organic Chemical Manufacturing Industry and Group I & II Polymers and Resins Industry Section III.D.1 (88 FR 25147, Apr. 23, 2023)
[7] U.S. EPA, Parameters for Properly Designed and Operated Flares, Apr. 2012.

sampling and emissions testing to more accurately characterize their HRVOC emissions and develop appropriate strategies to reduce them.

c. TCEQ's proposed SIP revisions do not address the contribution that Emission Events can make to high ozone levels.

Last but not least, EEs can suddenly release large clouds of ethylene, propylene, butadiene, butenes, pentenes and other HRVOC without warning over a few days or even a few hours, adding significantly to the load of highly reactive chemicals the state concedes are a major factor in ozone formation. For example:

1) Between July 16 and July 26, 2019, the Chevron Cedar Bayou plant reported releasing 379 tons of VOC during an EE, including 117 tons of ethylene along with 10 tons of 1,3-butadiene and other HRVOC. See Incident 316022, TCEQ Air Emission Event Report Database.
2) Between June 14 and June 20, 2023, Chevron Cedar Bayou reported an EE releasing 175 tons of VOC, including nearly 56 tons of ethylene, 1,3-butadiene, and other HRVOC. See Incident 402354.
3) Between May 5 and August 5 in 2023, the EE caused by the fire and its aftermath at the Shell Deer Park Chemical Plant released more than 410 tons of VOC, including 57 tons of 1,3-butadiene, ethylene, propylene, and other HRVOC. See Incident 400010.
4) Between September 28 and September 30 in 2023, the Chocolate Bayou Plant in Brazoria County released more than 46 tons of ethylene and other HRVOC during a 28-hour EE. See Incident 410557.
5) A 2019 fire at Intercontinental Terminals, located along the Houston Ship Channel, resulted in emissions of thousands of tons of VOC between March 17, when the fire broke out, and July 1, when the emission event was determined to be "complete." Total emissions included more than 2,600 tons of VOC, of which more at least 907 tons were non-regulated HRVOC such as xylenes (522 tons) and toluene (385 tons) along with regulated HRVOC such as 1,3-butadiene (3 tons). See Incident 304871.

These reported emissions are likely lower than actual emissions given that the estimates relied on emission factors and other computational methods rather than actual measurements.[8] Commenters do not argue that each of these EE contributed to exceedances of the 75 ppb MDA8 standard, as the impact that precursor emissions have on ozone formation depends on meteorology and other factors, e.g., the availability of NOx. Nevertheless, Commenters do not believe any proposal for attaining compliance with the 2008 standard in the HGB area can fail to consider the impact that EE releasing HRVOC in large quantities over short periods of time can have on ozone levels in the HGB area. TCEQ's proposal does not address these impacts in any understandable way.

[8] "Basis Used to Determine Quantities and Any Additional Information Necessary to Evaluate the Event: Emission factors, mass balance, and engineering analysis were used to determine the emissions resulting from the event." TCEQ Air Emission Event Report Database Incident 304871 (https://www2.tceq.texas.gov/oce/eer/index.cfm?fuseaction=main.getDetails&target=304871, accessed on Jan. 12, 2024)

While TCEQ includes annualized upset emissions in its photochemical model, as discussed above, the Conceptual Model appears to exclude EE and Maintenance, Startup, and Shutdown (MSS) emissions. In their discussion of point source emissions trends, only "Annual Emissions" reported in the Emissions Inventory are included in the figures showing VOC and HRVOC emissions by site. The figures do not include EE and MSS emissions, as Figure 1 below demonstrates.

Upsets are a fact of life in the petrochemical corridor and represent a significant proportion of total VOC and HRVOC emissions that contribute to ground level ozone formation. The agency's conceptual model should reflect the total VOC and HRVOC emissions from point sources, including EE and MSS events, to provide an accurate accounting of ozone precursor emissions.

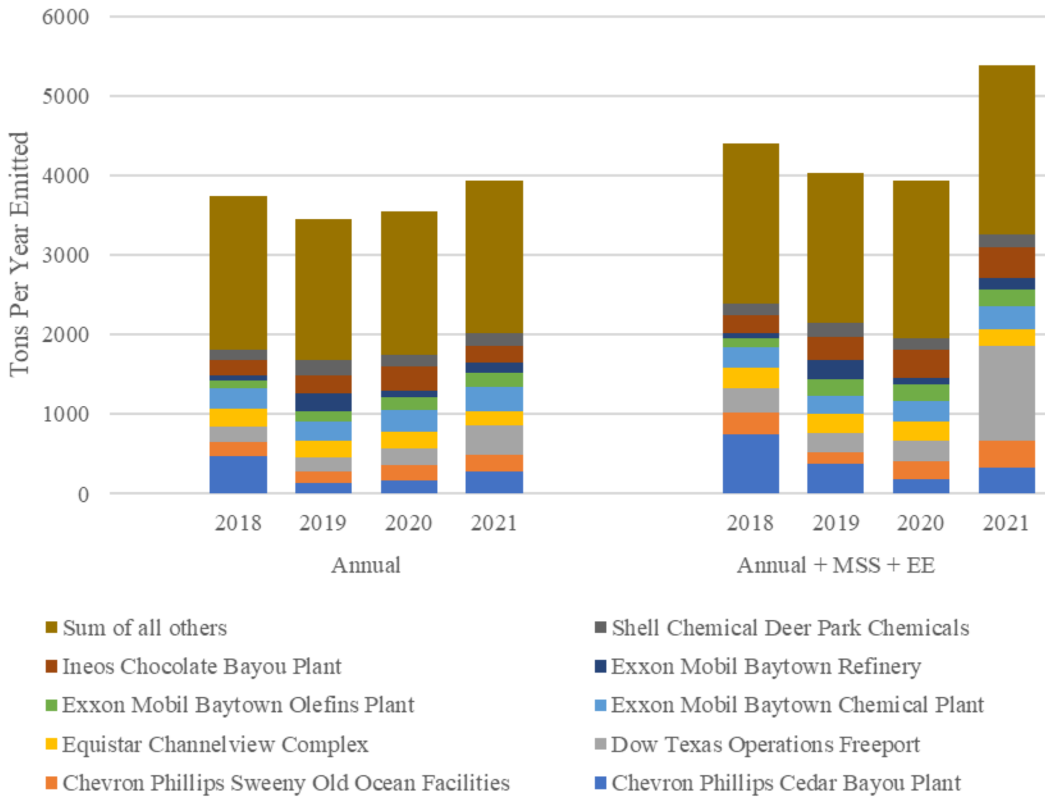

Figure 1. HGB 2008 Nonattainment Area Point Source HRVOC Emissions by Site. Texas Detailed Emissions Inventory 2018–2021. SIP Plan identified only Annual Emissions in its Conceptual Model and should also include Maintenance, Startup and Shutdown emissions and Emission Events. Proposal App. B Fig. 5-10; Proposal App. B Fig. 3-14

Comment 3: VOC-to-NOx ratios show that a balanced approach to controlling both NOx and VOC precursors is needed to reduce ozone formation in the HGB nonattainment area. In particular, the strategy needs to address the VOC-sensitive areas that affect ozone concentrations in communities within or downwind from the industrial sources in the Houston Ship Channel.

TCEQ's assertion that attainment can be achieved by reducing NOx emissions alone is based on photochemical modeling. However, the results of a single modeled scenario should not be relied on to support this assertion. As discussed above, TCEQ's analysis of VOC and NOx observations found that the VOC-to-NOx ratio was primarily in the transitional range, meaning that ozone formation could be reduced by reducing either VOC or NOx. In its modeling guidance, U.S. EPA notes that these ratios should be used with caution as there may be a range of values that can characterize whether the atmospheric chemistry is VOC or NOx limited and, particularly when the observations indicate a transitional regime, "agreement between predictions and observations does not necessarily imply that the response to controls as predicted by the model is correct."[9] To fully test the validity of the model results, TCEQ should conduct a robust analysis of multiple scenarios, including reduction in VOC and HRVOC from point sources, to evaluate options for achieving attainment.

TCEQ explains ozone chemistry in Chapter 4 of its Conceptual Model document, and that the VOC-to-NOx ratio indicates which precursors are most important to ozone formation in the HGB area.

> A NOx limited regime occurs when the radicals from VOC oxidation are abundant, and therefore ozone formation is more sensitive to the amount of NOx present in the atmosphere. In these regimes, controlling NOx would be more effective in reducing ozone concentrations. In VOC limited regimes, NOx is abundant, and therefore ozone formation is more sensitive to the number of radicals from VOC oxidation present in the atmosphere. In VOC limited regimes, controlling VOC emissions would be more effective in reducing ozone concentrations. Areas where ozone formation is not strongly limited by either VOC or NOx are considered transitional and controlling either VOC or NOx emissions would reduce ozone concentrations in these regions.

Proposal App. B at 4-1. Figures 4-1 and 4-2 show that the VOC-to-NOx ratios at several air monitoring stations are on the low end of the "Transitional Region" and cross over into the VOC-Sensitive Region. These VOC-limited monitors (Clinton, Lynchburg Ferry, Haden Rd) are located near the Houston Ship Channel and some of the greatest point sources of VOC and HRVOC emissions.

TCEQ acknowledges that "The area around the Houston Ship Channel exhibits more VOC limited conditions while other parts of the HGB area exhibit more transitional to NOx limited conditions." The final sentence of TCEQ's conceptual model concludes that ozone formation

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[9] U.S. EPA, Modeling Guidance for Demonstrating Air Quality Goals for Ozone *(*EPA 454/R-18-009), Nov. 2018 at 93.

may respond to VOC, in particular HRVOC, emissions reductions in some parts of the metro area (i.e. the Ship Channel). However, TCEQ proposes no strategies to achieve such reductions in VOC and HRVOC emissions.

HRVOC emissions, in particular, may have an even greater influence on ozone formation than is currently understood. TCEQ currently does not account for the reactivity of the VOC species in their calculations of VOC-to-NOx ratios. TCEQ should calculate reactivity-weighted VOC-to-NOx ratios to more accurately account for VOC and NOx limitation across the nonattainment area. TCEQ identified a 12 percent median increase of HRVOCs between 2012 and 2022, which has some potential to shift our understanding of VOC and NOx limitation across the area. Since the selection of appropriate ozone reduction strategies will rely on an accurate understanding of VOC and NOx limitation, TCEQ should consider maximum incremental reactivity (MIR) weighted VOC-to-NOx ratios.

As a potential ozone control strategy, Texas should evaluate expanding the current definition of HRVOC to include more compounds. HRVOC are currently defined as ethylene, propylene, 1,3-butadiene, and butenes in Harris County, and as ethylene and propylene throughout the rest of the nonattainment area. 30 TAC § 115.10. However, the MIR-weighted percentages of VOC species at HGB monitoring stations, presented in Conceptual Model Figure 3-10, show that butanes and pentanes make up an even greater proportion of reactive VOCs observed in the HGB. Butanes and pentanes are not included in the existing definition of HRVOC even though they appear to contribute more to the ozone soup than do butenes, which are classified as HRVOC. Compounds including pentanes, butanes, and aromatics, may have an as great or greater impact on ozone formation than do compounds currently regulated as HRVOCs. TCEQ should update their analysis of the contributions of HRVOC species and consider updating its regulations accordingly to bring more VOC emissions under the hourly HRVOC emission limits and annual caps.

Formaldehyde is another HRVOC of particular concern in Houston, not only for its toxicity and carcinogenicity but also for its role in ozone formation.[10] Formaldehyde is only measured at two of TCEQ's ambient air quality monitors, and was measured at both in higher concentrations than ethylene. During the 2023 ozone season, the average concentrations of formaldehyde exceeded those of ethylene at both the Houston Deer Park and Clinton monitors, as shown in Table 1. Formaldehyde has a very similar MIR value to ethylene and is therefore similarly efficient at producing ground-level ozone. TCEQ should expand its formaldehyde monitoring throughout the HGB, further study the contributions of formaldehyde and other compounds not currently regulated as HRVOC, and consider amending its HRVOC rules to incorporate other highly reactive compounds promoting ozone formation in the HGB nonattainment area.

[10] Environmental Integrity Project, Formaldehyde Air Pollution in Houston, Nov. 2021, available at https://environmentalintegrity.org/wp-content/uploads/2021/07/Houston-Formaldehyde-Report-Final-2021.pdf

Table 1: 24-hr Canister sample measurements at Houston Deer Park #2, March–October 2023

Parameter	Average concentration (ppb)	Max concentration (ppb)	Currently regulated as HRVOCs?	Maximum Incremental Reactivity (MIR) value
Formaldehyde	2.45	5.32	No	8.97
Ethylene	1.59	5.85	Yes	9.08
Propylene	0.94	5.77	Yes	11.58

Comment 4: Addressing ozone is an environmental justice issue. Communities of color and low-income communities experience high-ozone conditions more frequently.

In a recently published report by EIP about ozone levels in the Greater Houston Area, EIP discovered that people of color and low-income residents were more likely to live where ozone concentrations reached the highest levels in the summer of 2023 and over the three years from 2021 to 2023.

The report identified six locations in the Houston area that recorded at least one 8-hour ozone level higher than 100 ppb in 2023, which is far above the current ozone limits. At least 90 percent of those living within three miles of four of these monitors—Houston East, Clinton, Haden Road, and Park Place—are people of color, who also account for 73 percent of the population near a fifth monitor at Baytown Garth. While 34 percent of Texans statewide live in low-income households, the proportion is much higher among the populations within three miles of four of these six locations, ranging from 46 percent (Haden Road) to 53 percent (Park Place).

Based on the three-year average from 2021 to 2023, eleven locations measured ozone levels high enough to exceed 75 ppb for 2021–2023. People of color account for more than three quarters of those living within three miles of eight of these eleven locations and more than 90 percent at five of them. Measured in percentages, the proportion of people of color within 10 of these eleven ozone hotspots is significantly higher than either the state or county-wide averages. More than 40 percent of the people living in neighborhoods that surround seven of the eleven monitoring locations with the highest 2021–2023 ozone levels qualify as low-income, according to EPA's EJScreen, which is significantly more than the statewide average.

Ozone at eight of the 10 locations with the highest concentrations in 2021–2023 are about the same or even a little worse than they were in 2008–2010. People of color account for between 76 and 94 percent of the population within three miles of six of the eight monitors where high ozone levels in 2021–2023 are unchanged or have worsened since 2008–2010.

The ozone data used in this analysis was downloaded from the Texas Commission on Environmental Quality yearly air quality monitor summary reports for each monitoring location and the demographic data estimates within three miles of the monitors mentioned came from EPA's Environmental Justice Screening and Mapping Tool Version 2.2 (EJSCREEN 2.2). For more information, see EIP's report, *Increase in Houston Ozone Violations Hits Communities of Color Hardest*.[11]

Comment 5: Meteorological trends, including increasing temperatures, demonstrate the importance of reducing local emissions of ozone precursors.

Temperature is an important indicator of conditions that promote ozone formation. As TCEQ notes in its conceptual model, high temperatures are often also associated with sunny, cloudless conditions which contribute to ozone formation. Proposal App. B at 5-1. The annual number of days of extreme heat in Texas and in the Houston area have increased and are projected to continue to do so. In a recent climate impact assessment conducted for the City of Houston, the authors found that temperatures were expected to increase leading not only to more days with extreme heat, but also extending the duration of the warm weather seasons that make up the ozone season.[12] This is corroborated by the State Climatologist's prediction of increasing numbers of days with extreme heat, particularly in urban areas, with the yearly number of 100-degree days nearly doubled by 2036 when compared with 2001–2020 temperatures.[13] As ozone season temperatures continue to trend higher, the pattern of ozone exceedances experienced in 2023—when the design value exceeded 75 ppb at eight monitors, with a the highest value of 87 ppb at Bayland Park—can be expected to occur more frequently, as discussed in Comment 1. An appropriate episode year should include more such days, reflecting these well-documented trends.

High ozone days are also associated with low-winds, consistent with the findings of TCEQ's conceptual model. TCEQ observed that on high ozone days there were low wind speeds (less than 10 mph), particularly in the morning and that the winds originate from areas near the Houston Ship Channel. Proposal App. B p 5-5 – 5-9. The conceptual model also evaluates upper-level winds, which represent potential sources outside the region. This analysis found that, in the 72-hour period preceding nearly half of the days in with MDA8 ozone greater than 70 ppb (120 of 251 days), there were slow, recirculating winds which allow locally generated pollution to accumulate and recirculate through the area. Proposal App B, Section 5.4.3. Both of these wind patterns demonstrate the influence of local sources on the region's ozone and the importance of addressing locally produced precursor emissions from industrial point sources.

Conclusion:

The number of high-ozone days experienced in the HGB area this past summer, particularly in communities along the Houston Ship Channel, highlight the importance of addressing emissions

[11] Environmental Integrity Project, Increase in Houston Ozone Violations Hits Communities of Color Hardest, Nov. 2023, available at: https://environmentalintegrity.org/wp-content/uploads/2023/11/EIP_Report_HoustonOzone_Final.pdf.

[12] Stoner, A. and Hayhoe, K, Climate Impact Assessment for the City of Houston, Aug. 2020, at 21, available at https://www.houstontx.gov/mayor/Climate-Impact-Assessment-2020-August.pdf.

[13] Nielsen-Gammon, J. et al, Assessment of Historic and Future Trends of Extreme Weather in Texas, 1900–2036, Office of the State Climatologist, Texas A&M University, Oct. 7, 2021.

of VOC and NOx to reduce ozone formation in the HGB region. As discussed above, reducing industrial emissions, in particular VOC and HRVOC emissions, must be a component of TCEQ's plan to achieve ozone attainment. While the control strategies implemented by TCEQ to date have reduced emissions of ozone precursors in the region, the ongoing occurrence of high-ozone days and MDA8 exceedances demonstrate the importance of aggressively controlling precursor emissions from local industrial sources to prevent ozone formation and protect the health of local residents.

Thank you for your consideration of these comments.

Sincerely,

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CC: Exhibits
Exhibit A: Dates in 2023 where at least one monitor in HGB region exceeded an MDA8 value of 75ppb
Exhibit B: Fourth highest MDA8 ozone levels and three-year design values for HGB monitors, 2008 to 2023
Exhibit C: Exceedance days and ozone conditions at HGB regulatory monitors April to October, 2019 and 2023