air ALLIANCE HOUSTON

EMISSION EVENTS IN HARRIS COUNTY

2017-2024

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ACKNOWLEDGMENTS

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INTRODUCTION

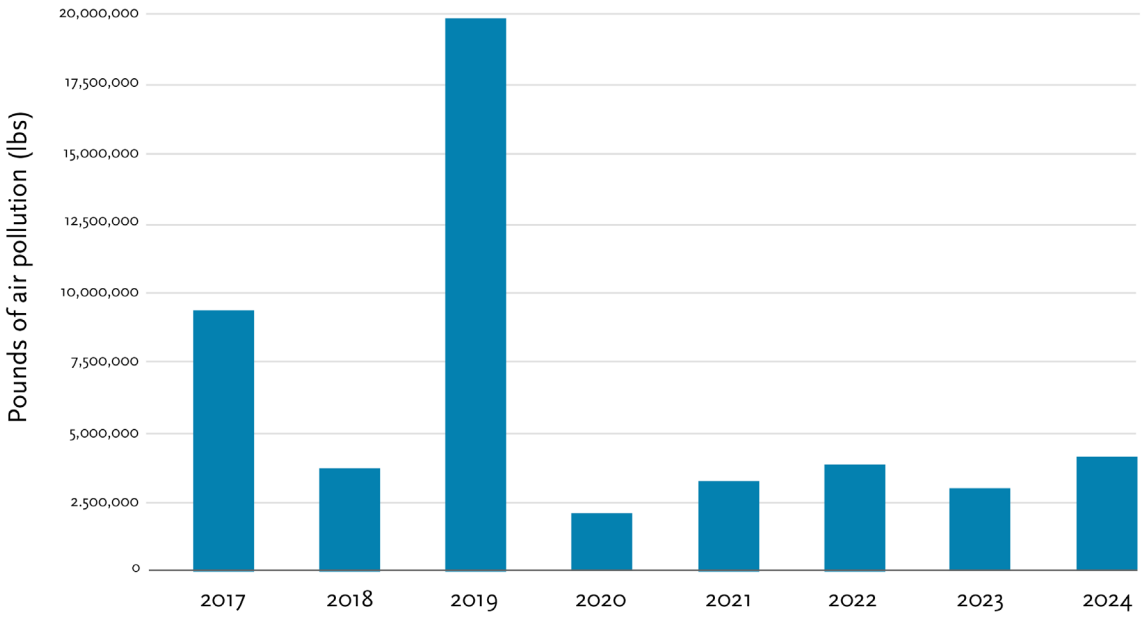
An air emission event is any accident, explosion, fire, or any other maintenance, startup, or shutdown activity that releases unauthorized pollution into the air outside of a facility's routinely occurring emissions.[1] Since they are considered an addition to the pollution that industries release into the air during their regular daily operations, they are therefore required to be reported separately.

When emission events occur, it is easy to view each one individually and miss the repeating pattern of fires, accidents, and explosions that disrupt residents' lives in Harris County. In this report, Air Alliance Houston aimed to address that tendency and shed more light on the underlying issue.

We used the Texas Commission on Environmental Quality's Air Emission Inventory Database2 as our main data source to examine emission events in Harris County from 2017 to 2024. We decided to start with 2017, the year of Hurricane Harvey, due to the large amount of industrial pollution released during that storm, and compared it with the following years. Additionally, 2017-2024 spans two presidential administrations, allowing us to observe patterns in industrial pollution during each.

From 2017 to 2024, facilities in Harris County recorded 1,735 emission events, releasing over 49 million pounds of pollutants into the air. As seen below, the quantity of air pollution released from emission events varies from year to year. While explosions and fires caused by unexpected equipment failures or malfunctions are all too common in Harris County, a significant proportion of emission events also occur during extreme weather events such as hurricanes and winter storms, which this report explores in greater detail.

Total quantity of air pollution released from emission events in Harris County



Source: TCEQ Air Emissions Event Report Database[2]

THE FIVE LARGEST EMISSION EVENTS

Examining the yearly emissions further, the predominance of a few major events becomes readily apparent. **From 2017 to 2024, just five incidents were responsible for over half of the total air pollution released from emission events.** Below, we discuss each event from the highest emission event to the lowest of the top five.

The statements below in italicized quotations are the official causes as provided by the facilities themselves in their respective reports.

ITC's 2019 fire in Deer Park as photographed from Highway 225. Source: AAH Staff

ITC Deer Park

March 17, 2019, 10:01 AM

> 16,471,095 pounds of pollution
> 34% of all emission event-related air pollution from 2017 to 2024
> 200 permit limit violations recorded

"A fire originating in the manifold of Tank 80-8 caused Tank 80-8 and adjacent tanks within the 2nd 80's tank farm to ignite."[3]

Over three days, the massive fire at ITC Deer Park burned through multiple storage tanks housing millions of gallons of toxic petrochemicals, including Benzene, Toluene, and Xylene. It produced a towering plume of black smoke that billowed across the Houston region for days, contaminating the air, water, and soil with these chemicals.

Despite initial reports by authorities and industry officials claiming 'no harms posed to surrounding communities,' in-depth studies by researchers at UTHealth and Baylor College of Medicine, along with analyses of air monitoring data by the Texas Tribune, found that dangerously high levels of Volatile Organic Compounds (VOCs), Benzene, and Fine Particulate Matter persisted in the air for weeks after the fire was extinguished and shelter-in-place orders were lifted. This was further supported by increased local clinic visits and calls to the Texas Poison Center Network hotline regarding chemical exposure, as well as health surveys of residents who reported breathing difficulties, respiratory problems, and post-traumatic stress both during and after the fire.[4]

In 2023, the U.S. Chemical Safety and Hazard Investigation Board released its official report highlighting poor facility design and a severe lack of proper preventative systems at the plant, including flammable gas detection systems, pump sensors, and emergency valves. Additionally, ITC exploited regulatory loopholes to avoid implementing certain Occupational Safety and Health Administration (OSHA) safety rules that could have prevented the fire.[5,6]

Drone footage of Exxon Baytown after Hurricane Harvey. Source: USA Today.[8]

ExxonMobil Baytown

August 27, 2017, 4:00 AM

> 4,171,258.9 pounds of pollution
> 8.5% of all emission event-related air pollution from 2017 to 2024
> 39 permit limit violations recorded

"Planned controlled shutdown of the ExxonMobil Baytown Refinery (BTRF) due to Hurricane Harvey and the excess rain event."[7]

As Hurricane Harvey thundered into the Houston area, inundating the region with up to 52 inches of rainfall, the ExxonMobil Baytown complex endured significant damage to its storage tanks. In particular, a series of floating roofs collapsed under the pressure of the unrelenting rain, which soon released thousands of pounds of pollution into the air. As equipment failures and emergency shutdowns commenced across the complex in response to these malfunctions, the facility began flaring off excess chemicals into the air.

Overall, over 4 million pounds of air pollution, including 38 different chemicals, were released during this emission event spanning several weeks. The release involved hazardous air pollutants, volatile organic compounds, and combustion-related emissions. Insufficient weatherization of industrial facilities and a severe lack of hurricane preparedness appear to be the leading causes, as multiple accidents like this began occurring across the Houston Ship Channel during the hurricane.

Juan Flores near Magellan Galena Park following Hurricane Harvey. Source: NPR. [10]

Magellan Galena Park Terminal

August 31, 2017, 11:30 PM

> 2,472,401.9 pounds of pollution
> 5% of all emission event-related air pollution from 2017 to 2024
> 66 permit limit violations recorded

"In the aftermath of Hurricane Harvey, Magellan personnel identified elevated lower explosive limit (LEL) readings at Outfall 001 and at the Colex. Vapors were also reported with a hydrocarbon odor. It was discovered that Tanks 517 and 518 had floated and released their contents (approximately 10,988 barrels of gasoline) into the standing floodwater." [9]

Hurricane Harvey posed serious risks to areas along major water bodies, such as bayous, waterways, and channels, which quickly overflowed. These raging floodwaters undermined the foundations of Magellan's petroleum tanks at its Galena Park terminal, causing leaks and releasing gallons of gasoline into the floodwater over the following 12 days.

A highly volatile liquid, gasoline quickly releases toxic vapors when spilled. As a result, nearly 2.5 million pounds of Benzene, Toluene, and other Volatile Organic Compounds entered the air from Magellan's spill. These fumes soon drifted into nearby homes, leading to widespread community reports of strong gasoline odors, along with health effects such as burning eyes, throat irritation, headaches, and nausea[11]. Since flooded streets prevented residents from leaving, they had no choice but to continue inhaling these toxic chemicals for days without any alerts or guidance from the plant or regulators. Officials only reported the full extent of the incident weeks later[11]. The fact that the spill entered the rising floodwaters made containment more difficult and eventually caused contaminants to leach into the Houston Ship Channel.[11,12]

Of all industrial facilities reporting emission events during the hurricane, Magellan had the largest emission and the most permit violations by a wide margin. The facility emitted more pollution than legally allowed 101 times. After investigations, Harris County officials found that Magellan did not even have the permits required to locate its storage tanks within the floodplain.[13]

Active flaring captured at Exxon Baytown during Winter Storm Uri. Source: KHOU[11][15]

ExxonMobil Baytown

February 15, 2021, 2:41 AM

> 960,643.9 pounds of pollution
> 2% of all emission event-related air pollution from 2017 to 2024
> 18 permit limit violations recorded

"Loss of utilities including, but not limited to, third-party natural gas supply, instrument air systems, and steam due to severe inclement weather resulted in the shutdown of multiple process units and safe utilization of the flare system." [14]

Industrial facilities were not immune to Winter Storm Uri and its power grid failures in early 2021. As temperatures plummeted in Texas, ExxonMobil shut down manufacturing units across its Baytown Complex due to power outages and decreased natural gas supply needed to operate the plant's petrochemical processes.

These last-minute shutdowns came at a cost, similar to Hurricane Harvey, as refineries across the region flared off large amounts of chemicals that they were unable to process properly, some exceeding their total annual emissions in previous years[15]. ExxonMobil Baytown released nearly a million pounds of air pollution during the Winter Storm, filling the air with carcinogenic Volatile Organic Compounds (VOCs), Sulfuric acid, Carbon monoxide, and Hydrogen sulfide.

These pollutants settled into nearby communities and homes, most of which lacked electricity to run fans, air conditioning, or proper ventilation systems. Moreover, residents could not enjoy fresh air due to the frigid outdoor temperatures and were afraid to open windows for fear of losing their limited indoor heat. As the freezing weather kept people inside, the tons of pollution emitted by these severely unprepared and unwinterized refineries added to their burdens with suffocating odors and headaches.[16]

Plume of smoke over Shell Deer Park. Photo: Texas Tribune.[18]

Shell Deer Park Chemicals

May 5, 2023, 3:00 PM

> 820,495.5 pounds of pollution
> 1.5% of all emission event-related air pollution from 2017 to 2024
> 68 permit limit violations recorded

"A fire started at the Deer Park Chemicals facility in the olefins unit (OP3), products involved in the fire included cracked heavy gas oil (CHGO), cracked light gas oil and gasoline. Planned maintenance activities were ongoing at the unit at the time."[17]

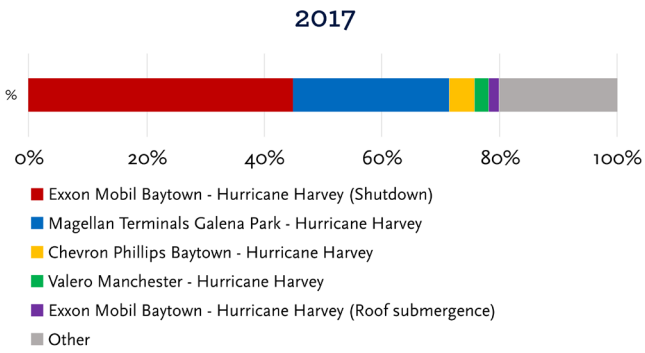
While workers performed routine maintenance at the Shell Deer Park plant, leaking petrochemicals ignited in a massive explosion, producing a flash fire that burned through vast quantities of oil and gasoline for 70 hours and released over 800,000 pounds of pollution into the air, according to the facility's self-reported numbers.

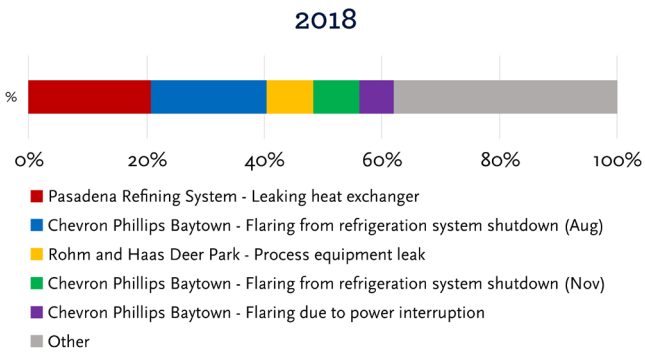
Although initially extinguished, the leftover flammable products on-site quickly reignited the fire. Nine plant workers and contractors at the facility were hospitalized after inhaling the fumes and smoke[19]. Prevailing winds carried the massive smoke plume northwest, resulting in increased levels of carcinogenic VOCs detected in Cloverleaf, Northshore, and nearby communities downwind of the fire.[20]

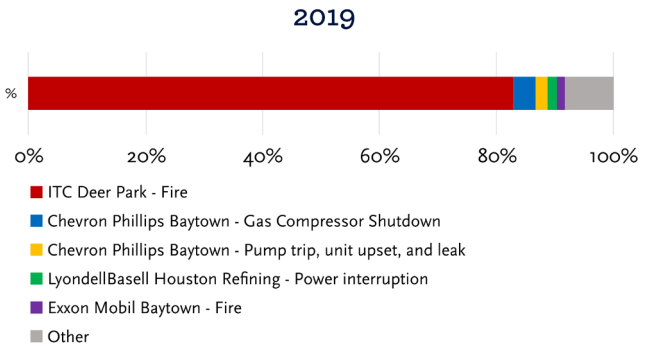
Over the following weeks and months, several injured workers, contractors, and the Texas State Attorney General, representing the Texas Commission on Environmental Quality (TCEQ), filed lawsuits against Shell for damage caused during the fire. Plant workers claimed that Shell knew about the fire risk but failed to warn or protect employees. The TCEQ stated that Shell had violated the Clean Air Act, Solid Waste Disposal Act, and Water Code during this incident. A review of the facilities' compliance history over the past 10 years showed nearly 2,000 environmental violations and 160 emission events.[21]

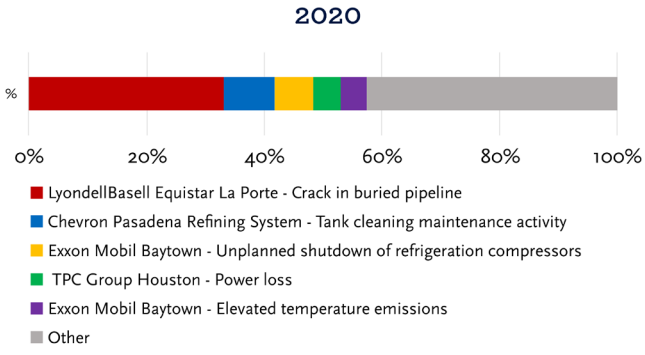
A CONSISTENT PATTERN OF INDUSTRIAL DISASTERS EVERY YEAR

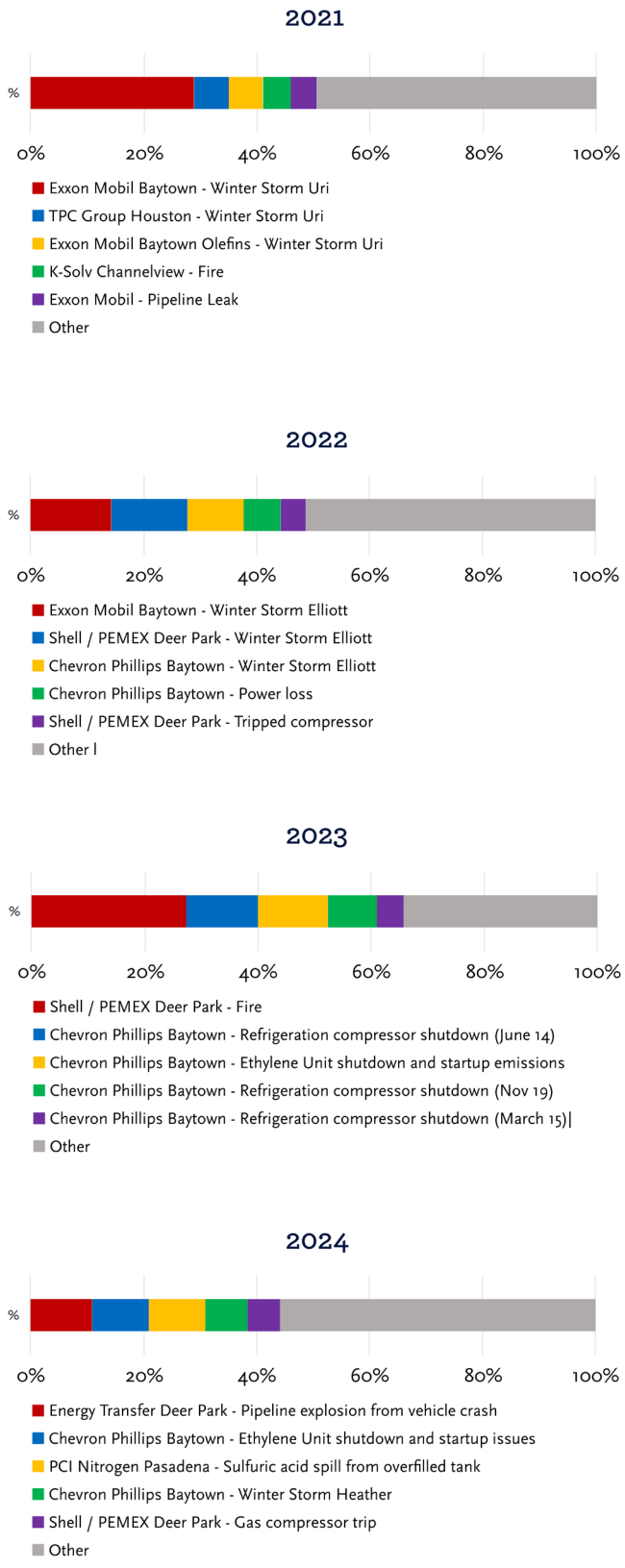
This trend of a few massive emission events that dominate an entire year's worth of emissions repeats itself every year in the Houston region. Over every year of the period studied, the pollution released from the five largest emission events contributed nearly half of all pollution from emission events reported over that year. In some years, that percentage even reached as high as 80-90% of the total annual emissions reported. To provide a broader context, over 200 different emission events are reported every year on average in Harris County. Five incidents thus represent only 2.5% of an entire year's emission events. The following graphs delve deeper into this trend, analyzing all reported emission events, with the largest emission event each year in **red**, the second largest in blue, the third in yellow, the fourth in green, and the fifth in purple. The remaining emission events were grouped together under the gray 'other' label.









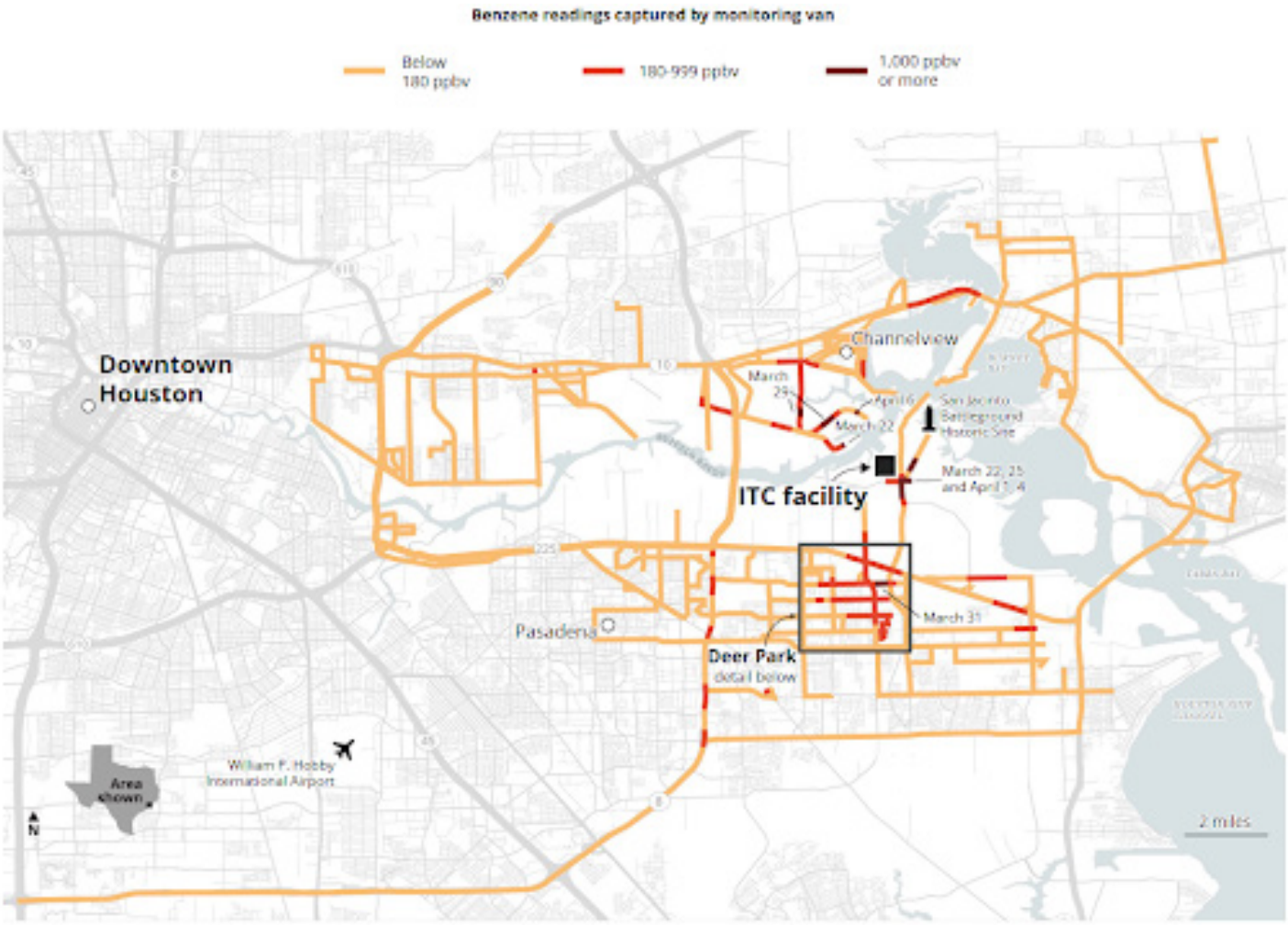


Highlighting the contribution that each year's top five emission events made to the total emission event related air pollution released over that year, 2017-2024. Source: TCEQ Air Emission Event Database

At first glance, 2019's highly skewed distribution is difficult to overlook. This is solely due to the significant amount of air pollution released during ITC's fire in Deer Park. Poor site design, crowded tank farms, and wrongly placed (sometimes nonexistent) emergency response systems made it extremely hard for firefighters to control the blaze quickly. Once ignited, the fire spread easily across the facility, burning through large tanks of petrochemicals one after another—each holding over a million gallons on average of flammable compounds. The fact that the fire lasted three days confirms this. However, emissions did not stop there; after the fire was put out, the remaining highly volatile chemicals, such as Benzene—now exposed in scorched, damaged, and collapsed tanks—began rapidly evaporating into the air over the following weeks.

Weeks after the fire, mobile Environmental Protection Agency (EPA) monitoring vans traveling through Deer Park still detected toxic levels of Benzene—nearly 1000 parts per billion—in the surrounding community.[22] Although these readings exceeded the safe threshold significantly, local officials and the industry did not issue any warnings to residents. This fire could have been prevented if ITC had implemented proper design measures and safeguards, such as gas detection systems, emergency isolation valves, and automatic sprinkler systems to control the spread, none of which were present in the tank that ignited the fire.

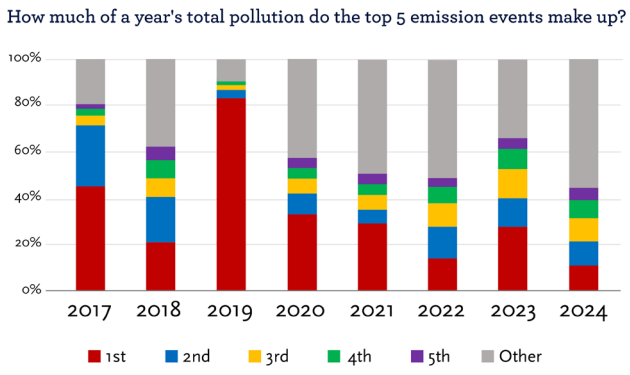
These findings emphasize the significant role that extreme weather events, lack of weatherization, malfunctioning equipment, and



A map highlighting routes through the community surrounding ITC, where elevated benzene readings were measured weeks after the fire. Source: The Texas Tribune

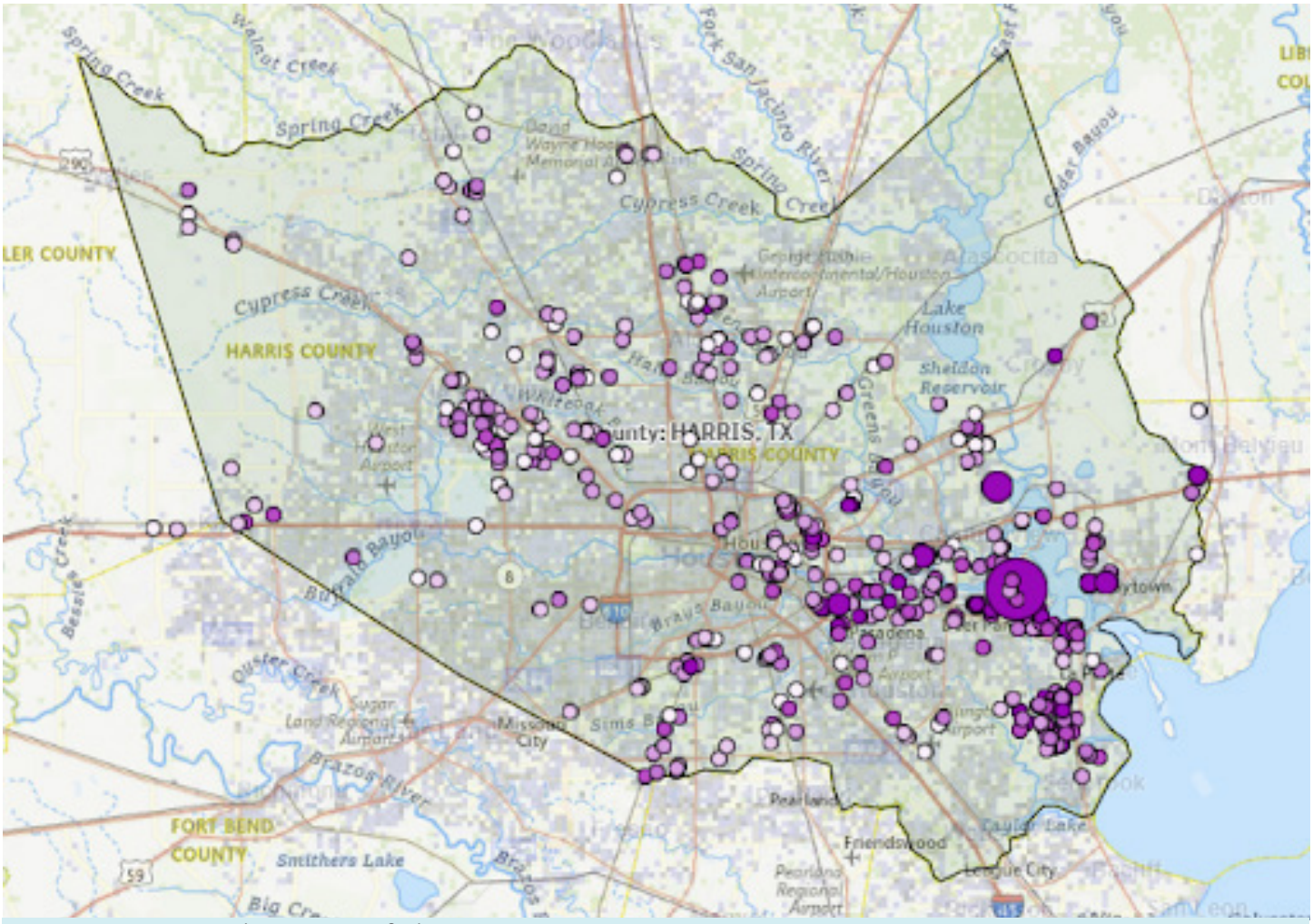
negligence-driven accidents contribute to the total pollution released each year. Such events and the pollution they produce stand in stark contrast to more predictable emission events from maintenance-related activities and other scheduled upkeep, which occur much more often but contribute considerably less to overall air pollution.

Furthermore, these data also demonstrate that emissions events in Harris County are not distributed equally among industrial facilities—either in how often they occur or the amount of pollution released. Instead, they are heavily concentrated among a small number of repeat offenders out of hundreds.



Source: TCEQ Air Emission Event Database

REPEAT OFFENDERS



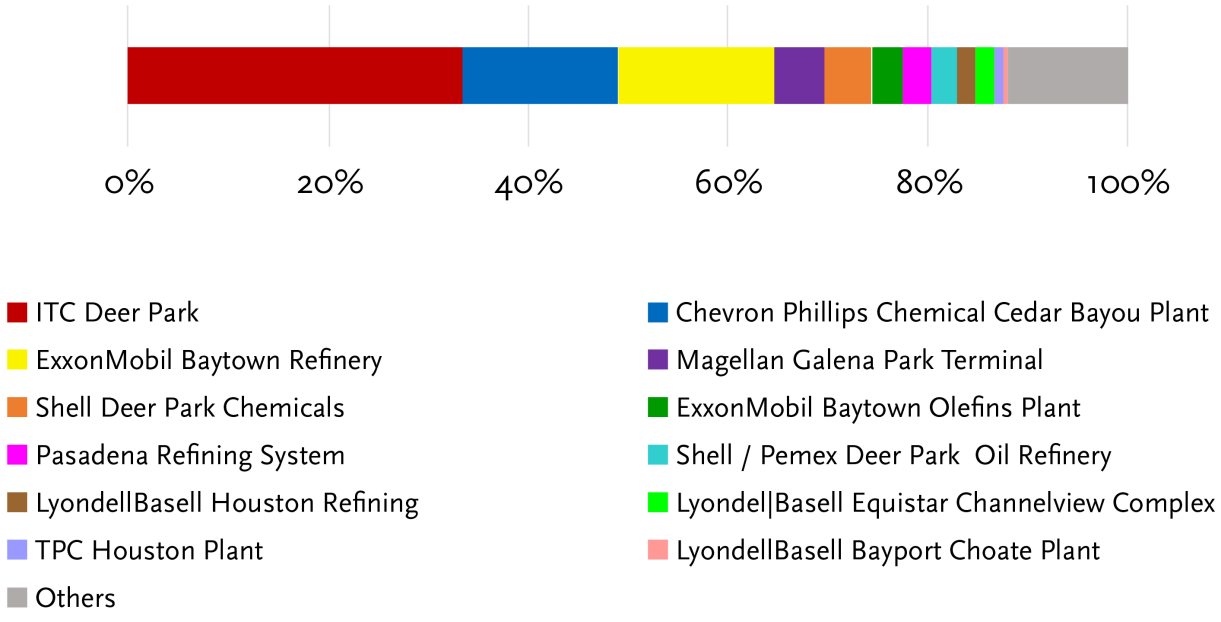
Harris County's Toxic Release Inventory facilities. Source: EPA

Harris County hosts over 42,000 facilities officially registered with the EPA that are subject to national environmental laws and regulations. Of these, nearly 500 facilities meet the specific criteria required to report to the EPA's Toxic Release Inventory. Some of these criteria include workforce size requirements and thresholds for the amount of chemicals manufactured, processed, or used.

Despite the county's numerous industries, only a small portion are responsible for most of the emissions and air pollution emitted. The graphs below illustrate this point in greater detail, highlighting the problematic nature of these facilities by showing their recurrence across different metrics used to assess the county's emission events. Each unique industrial facility or entity is represented with a different color for easy identification across categories.

From 2017 to 2024, more than 160 facilities across the county reported at least one emission event. However, over 88% of the total air pollution from all these events originated from just a dozen of them, listed below.

Percentage of total emission event pollution from 2017-2024

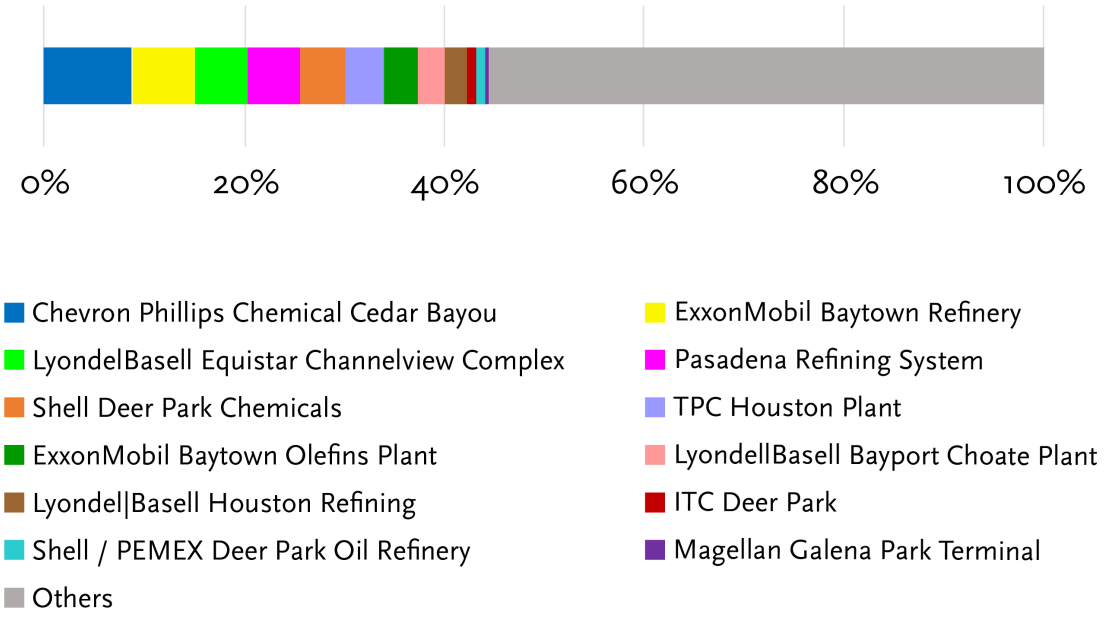


Source: TCEQ Air Emission Event Database

Despite reporting only 16 incidents since 2017, ITC Deer Park still ranked as the largest emitter over the past eight years (33.6%). This underscores the amount of air pollution released during the March 2019 disaster, causing ITC to surpass much larger facilities like Chevron Phillips and Exxon Mobil, which recorded over a hundred emission events. Another such facility is Magellan Galena Park, which has only documented three incidents since 2017 but contributed over 5% of all emission event-related air pollution during that period. This is due to the severity of its accident during Hurricane Harvey and the subsequent flaring, venting, and emissions. These examples demonstrate how major individual incidents can dominate a facility's emissions history, even over multiple years.

The frequency of reported emission events is another key metric that helps identify facilities at high risk of accidents, fires, explosions, malfunctions, shutdowns, and other incidents. It also helps to identify industries that have not improved operational safety despite facing numerous such events and those that would benefit most from increased investments in safety upgrades, emission reduction technology, and overall accident prevention measures. While the TCEQ's database recorded 1,735 different emission events over the past eight years, nearly 45% of these occurred at the same 12 facilities, as shown in the graph below.

Percentage of total incidents from 2017-2024



Source: TCEQ Air Emission Event Database

This shows that these 'repeat offender' facilities are responsible for releasing the largest amount of industrial air pollution from emission events in the county, and most of them are also highly accident-prone. Their emission events happen repeatedly, disrupting routine operations as well as the daily activities of nearby residents, schools, and businesses. The public is rarely informed about most of these emission events and often only learns about those that gain media attention or produce visible pollution plumes. These events represent only a small portion of the total emissions.

TPC Houston is another prime example of one of those facilities. An EPA investigation in 2022 found corroded equipment, aging infrastructure, and 63 dead-legs at the plant.[23] These dead-legs are out-of-service pipe segments that accumulate highly flammable 1,3-butadiene, which can lead to pipeline ruptures and massive explosions. An unaddressed dead-leg is what caused TPC's Port Neches facility to explode in November 2019, releasing thousands of gallons of butadiene into the environment, causing an explosion that was felt 30 miles away, and costing nearby property owners $153 million in damages and repairs. The US Chemical Safety Board deems dead legs as widely known safety hazards that can be fixed through routine safety checks and pipe flushes.[24] The presence of over 60 dead-legs at TPC Houston indicates inadequate investment in routine safety procedures, policies, and implementation - the facility's 68 different emission events since 2017 further support this.

Neglecting to maintain optimal working conditions inevitably causes routine emission events and, over time, leads to violations such as leaks, fires, and unexpected shutdowns due to insufficient safety measures and maintenance.

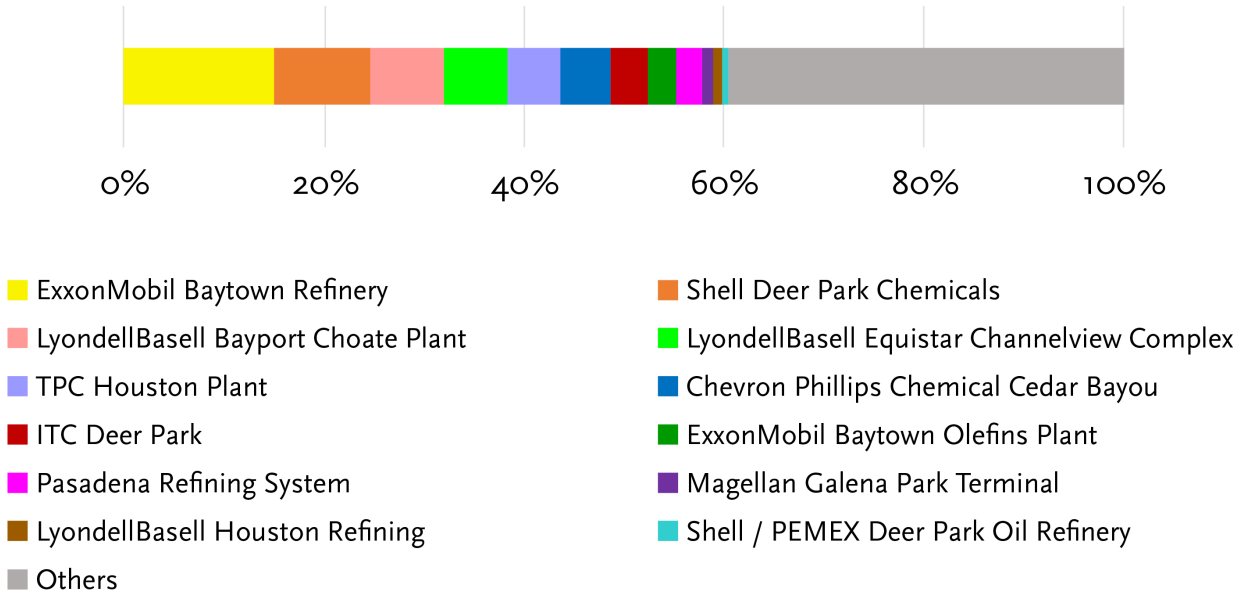
VIOLATIONS

Flaring at TPC Houston captured during a December 2023 emission event when the facility released over 12,000 pounds of air pollution. Source: AAH Staff

Most large industrial facilities are legally permitted to emit a specific rate or amount of pollution into the air during an emission event. However, these limits can vary depending on the facility, its air permit, the chemical being released, and the circumstances of the emission. When these limits are exceeded, it is considered an exceedance or violation of the authorization set by the air quality permit. Of the 161 facilities that recorded an emission event over the past eight years, 148 of them (more than 91%) reported at least one exceedance. Most facilities have been responsible for multiple exceedances, with some reporting several hundred, bringing the total number of permit limit violations to 6,349.

While the vast majority of facilities reporting emission events during the study period have recorded a violation of some sort, the overall distribution of these violations is far from uniform and is highly concentrated within a familiar set of facilities. The 12 "repeat offender" facilities previously identified have cumulatively recorded over 60% of all exceedances reported during emission events since 2017, as seen below. ExxonMobil's Baytown Refinery topped the list with 948 exceedances, averaging approximately 118 every single year.

Percentage of total violations from 2017-2024



Source: TCEQ Air Emission Event Database

These data highlight that these facilities are responsible not only for causing the most incidents and releasing the largest amount of pollution into Harris County's air but also for overwhelmingly exceeding their legal pollutant limits outlined in their air permits. ExxonMobil's Baytown Refinery remains one of these facilities known for ongoing violations, primarily due to poor operating conditions. The facility ranked highest nationwide among refineries with outdated heaters and boilers. These units emit the most air pollution in an industrial plant, especially as they age and lose efficiency.[24] ExxonMobil Baytown also ranked at the top for the most greenhouse gas emissions among refineries and remains a frequent violator of the Clean Air Act, spending 12 of the last 12 quarters in noncompliance.[25] All of these facts are not coincidental. As the facility continues to utilize outdated and inefficient systems, the number of emission events, the total air pollution, and permit violations will all continue to increase. Ultimately, these metrics are interconnected and influence each other.

Regulatory Landscape in Texas

It is worth noting that Texas has some of the least stringent industrial emissions regulations in the country, with significantly higher thresholds for reporting emissions than other states. The fact that large industrial facilities like those above still record tens to hundreds of permit exceedances each year despite the state's lenient regulatory framework reveals a deeper pattern of disregard and negligence for environmental protection laws and local air quality. Furthermore, Texas heavily relies on industrial self-reporting of emissions data through engineering calculations, particularly for emission events, and rarely verifies these values with real-time air monitoring. This suggests that the actual amount of pollution released and violations could likely be much higher than reported.

Notably, this list of 12 is further narrowed down when listing the parent companies that own or co-own each facility, as seen below.

LyondellBasell Houston Refining

LyondellBasell Equistar Channelview Complex

LyondellBasell Bayport Choate Plant

ExxonMobil Baytown Olefins Plant

ExxonMobil Baytown Refinery

Pasadena Refining System

Chevron Phillips Chemical Cedar Bayou

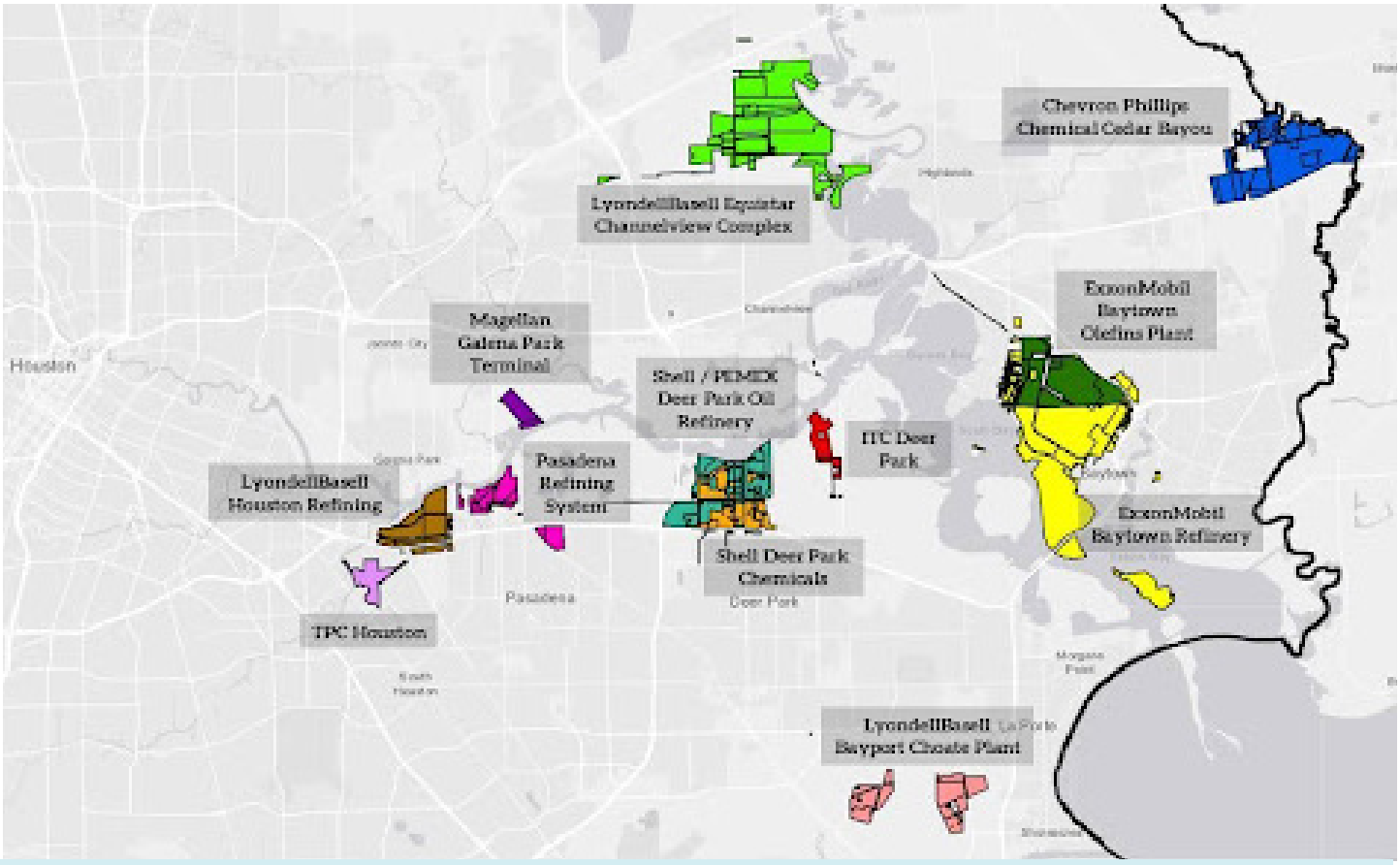
Shell / PEMEX Deer Park Oil Refinery

Shell Deer Park Chemicals

All four of these entities are massive multinational corporations with profit margins in the billions of dollars. They are not as financially constrained as many smaller industries and businesses in the County. Despite their large revenues, they have not invested enough in ensuring their facilities operate smoothly, as evidenced by frequent accidents, permit exceedances, and the substantial air pollution released during these events. In the case of LyondellBasell and ExxonMobil, their Houston-area facilities are their biggest plants in the country. The revenue generated by these facilities and their workers necessitates increased investment in workplace safety, ensuring operations run without incidents, excess pollution, or violations of environmental laws.

TCEQ's lax enforcement against major polluters, minimal penalties, and infrequent fines contribute to this problem, as investigations have shown the agency to disproportionately target smaller businesses for record-keeping errors.[27] Meanwhile, 97% of violations recorded by large industries go unpunished.[27] Even when fines are imposed, they are often just a slap on the wrist for such corporations, which more often than not prefer to pay the fine rather than make meaningful improvements to their facilities to prevent a repeat violation.[26] TCEQ's current system for ensuring compliance with environmental laws does not provide sufficient deterrence to repeat offenders. The agency's own Sunset Review Commission – a commission that evaluates government agencies/programs every 12 years to ensure efficiency and accountability - in 2023 labeled them a "reluctant regulator" that often leave "industry members to self-govern and self-police."[27] This hands-off approach has failed Harris County, as large industrial facilities continue to violate their permits at alarming rates, as shown by the agency's data above, inundating the region with hazardous pollution and health issues.

These statistics challenge the idea that industrial accountability conflicts with public health and environmental protection. Most registered industrial facilities in Harris County have not had a single emission event in the past eight years, and the majority also have no environmental violations. In Texas's industry-friendly regulatory environment, complying with air permits and environmental laws should be easier than in most other states, and evidence supports this. Therefore, efforts to reduce pollution should mainly focus on the industries most responsible. Safe operations and lower emissions benefit the community by improving air quality and also help the industry by reducing equipment damage costs, workforce injuries, and the waste of resources and raw materials released into the environment.

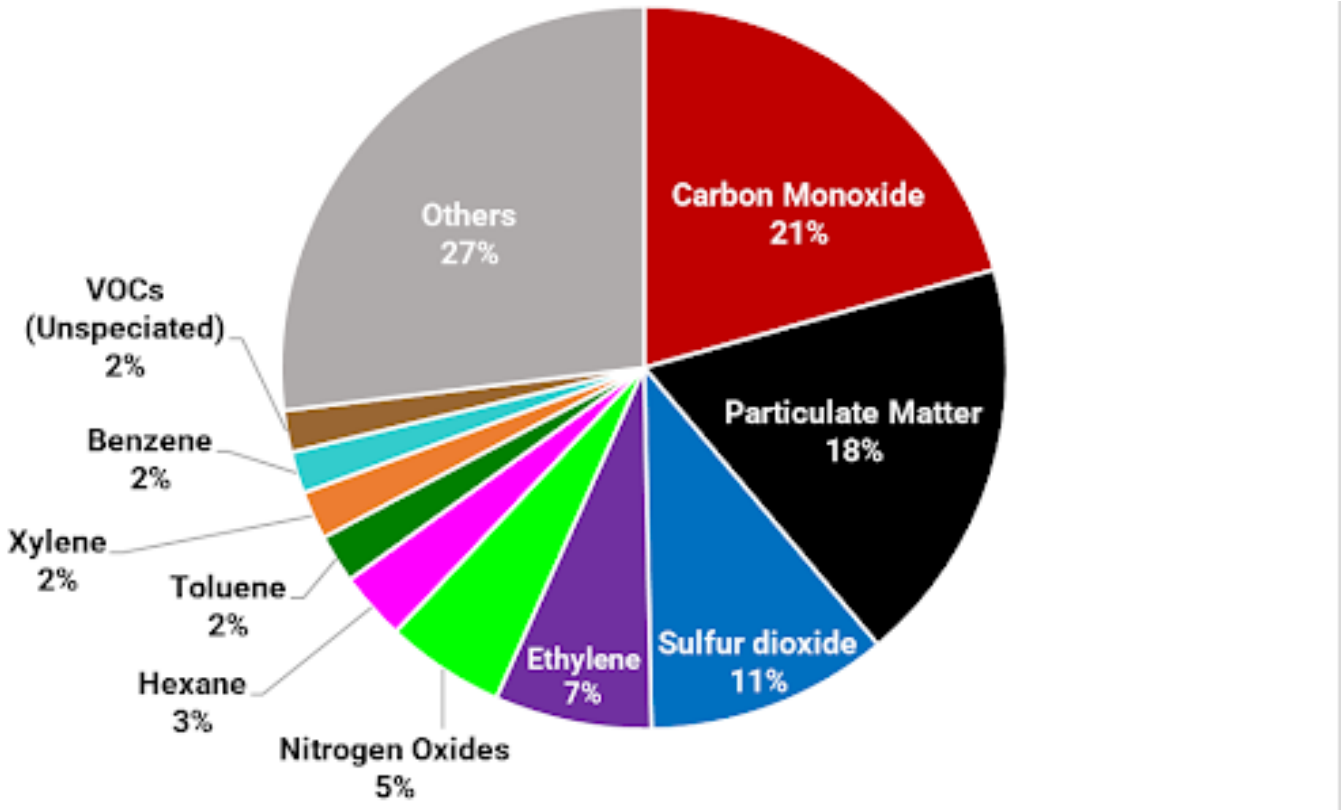


A map of the 12 industrial facilities that have cumulatively released the most significant amount of air pollution during emission events in Harris County, 2017-2024. Sources: TCEQ Air Emission Event Database, Harris Central Appraisal District Public Data, ESRI.

CHEMICALS RELEASED

The Energy Transfer Pipeline fire on Spencer Highway, captured on Monday, September 16, 2024.
Source: Houston Chronicle

A single emission event usually releases a combination of numerous different contaminants into the air as flares burn off excess gases, chemicals escape from pipeline leaks, or roofs collapse and vent their contents into the air. Over 700 unique air pollutants and contaminants have been released in some quantity during emission events during the period studied. Of these chemicals, the following comprised the most significant proportion:



Chemical composition of air pollution from all emission events between 2017-2024. Source: TCEQ Air Emission Event Database

The Inhalation Toxicity Weight measures a chemical's relative toxicity based on long-term human health effects, as developed by the EPA in its Risk-Screening Environmental Indicators (RSEI) Model.[28] It is important to note that these measures are specifically designed for chemicals reported under the Toxics Release Inventory (TRI) program. While some pollutants may not have this measure, it does not mean they lack health effects; instead, it reflects the limits of the TRI's criteria or gaps in available toxicity data and research.Hartman Bridge, was top of the list. The facility offers chemical and industrial manufacturers leased land with access to numerous services. In addition, they offer rail car storage inside and outside the secure facility. (LPR) Shell Deer Park Chemicals and ExxonMobil Baytown were second and third, respectively.

Due to the lack of numerical data to perform data analysis, we decided to plot the most repeated words in the violation allegations reports on a word cloud.

This word cloud allows us to explore and understand what types of violations facilities in Harris County have committed in the past five years. The word cloud represents the words repeated the most in larger font sizes. The words "failure," "failed," and "emissions," among others, were the words repeated the most in the violations reports.

Pollutant	Quantity (lbs)	Inhalation Toxicity Weight
Carbon monoxide	10,131,173.44	-
Particulate Matter	8,962,576.56	-
Sulfur dioxide	5,304,087.72	-
Ethylene	3,440,122.72	0.56
Nitrogen oxides (NOx)	2,604,342.70	-
Hexane	1,500,754.18	5
Toluene	1,068,188.05	0.7
Xylene	1,059,335.67	35
Benzene	917,772.23	28,000
VOCs (Unspeciated)	916,638.69	-
Propylene (Propene)	851,430.17	1.2
Ethanol	699,472.83	-
Propane	608,979.68	-
Distillates (petroleum), alkylate	575,752.83	-
Cumene	547,201.95	8.8
Isobutane	484,572.24	-
Ethylbenzene	461,523.67	890
C4+	458,334.91	-
Isopentane	444,366.65	-

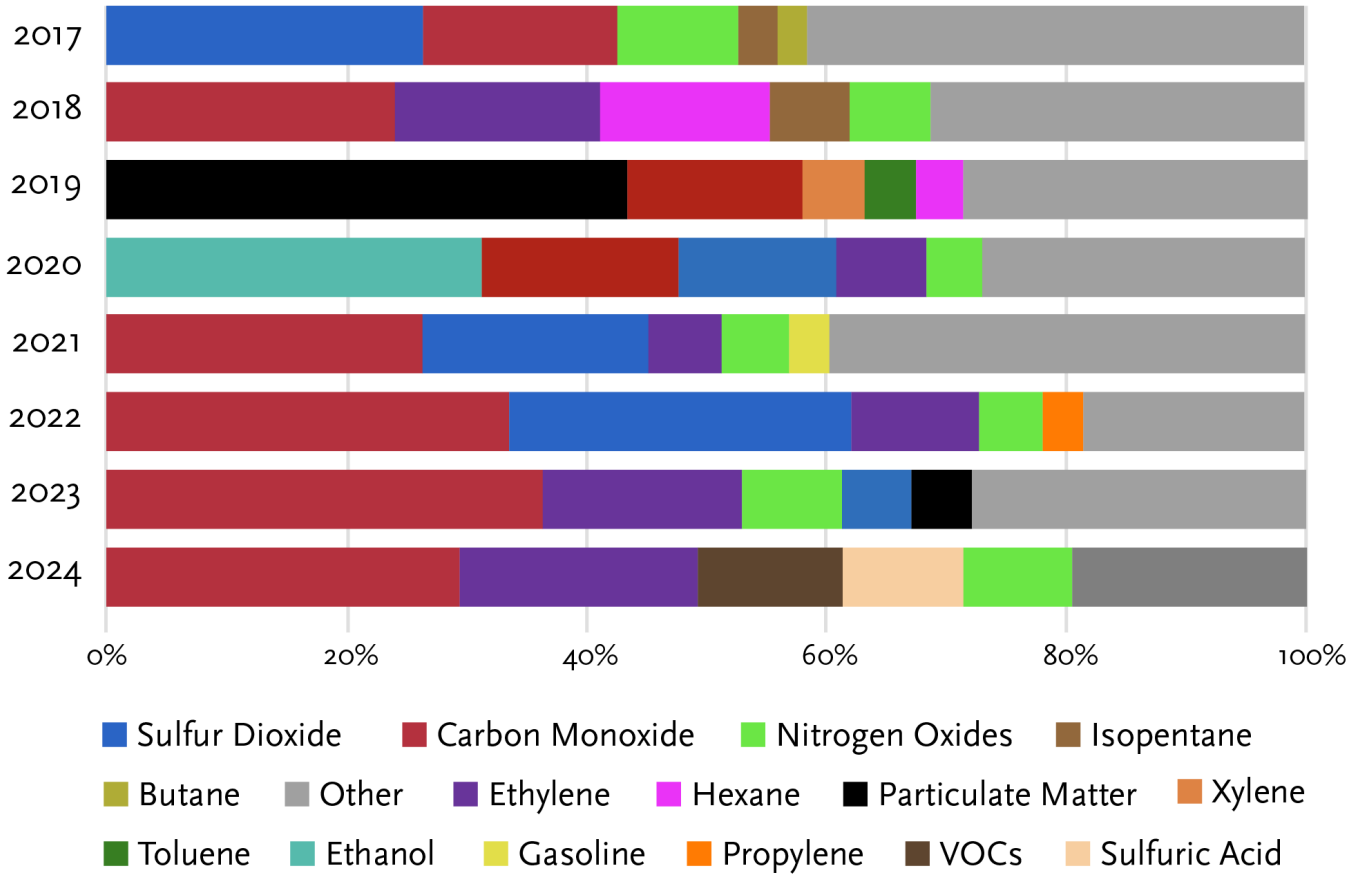
Sulfuric acid	413,445.48	3,500
Dicyclopentadiene	393,702.91	12,000
Naphthalene	364,888.98	12,000
1,3 Butadiene	355,270.73	110,000
Pentane, N-	351,120.26	-
Butane	344,255.74	-
Nitrogen	274,144.64	-
Others	5,577,375.84	N/A

As noted by the Inhalation Toxicity Weight above, certain hazardous chemicals are highly toxic even at relatively low quantities and concentrations, so their smaller percentage of total emissions should not be overlooked or viewed as an indicator of lower risk to human health. For example, 1,3-Butadiene—which is a known human carcinogen—while only comprising 0.72% of all emissions, has a total emitted quantity of over 355,000 pounds and a toxicity weight of 110,000.[30] Although less than 1%, that amount of pollution is roughly equivalent to a large Boeing 747 jet in weight and size. To emphasize how alarming this level of pollution is, we can look at the fact that 1,3-Butadiene has been released 120 times over the limits set by regulators to protect human health during the study period.

When released into the air, pollutants disperse widely, depending on prevailing winds, meteorological conditions, and other factors. However, most of this pollution usually settles in areas surrounding the source. We found this to be true when we modeled the emissions of Harris County's biggest industrial polluters as well. Our results confirmed that the majority of pollution released by industries along the Houston Ship Channel is borne by fenceline neighborhoods in Baytown, Channelview, Cloverleaf, Galena Park, and Deer Park. Health impact calculations also showed how this same pollution directly worsens these communities' air quality and subsequently their health outcomes.[33]

Yearly patterns

Analyzing annual trends enables us to identify recurring patterns in the chemical composition of emission events and observe how major emission events disrupt these patterns. For example, the ITC disaster, which included a days-long fire, is easily noticeable in 2019 due to the tons of particulate matter released.



Chemical composition of air pollution from emission events, 2017-2024. Source: TCEQ Air Emission Event Database

By comparing these annual patterns, we can also identify certain pollutants that appear disproportionately in specific years. These anomalies include the following events, which largely went unnoticed, receiving little to no attention or coverage despite the massive amounts of air pollution released.

2018: Hexane and Pentane

In September 2018, a leak at the Pasadena Refining System Inc. (PRSI) within the Reformate Splitter exchanger released over 770,000 lbs of pollutants into the air, including more than 500,000 lbs of Hexane and 240,000 lbs of Pentane. Other released pollutants included over 8,300 lbs of carcinogenic Benzene, which caused spikes at the facility's fenceline Benzene monitor that exceeded several times the EPA safety standard limit.[34, 35]

2020: Ethanol

In January 2020, the LyondellBasell-owned Equistar chemical plant in Channelview detected a corrosion-related fracture in one of its underground Ethanol pipelines. The resulting leak released over 670,000 lbs of Ethanol and other VOCs into the air over several weeks, according to facility estimates. The event was considered a violation of the Texas Health and Safety Code by the TCEQ and prompted an enforcement order.[36]

2021: Gasoline

In May 2021, ExxonMobil reported a leak in a pipeline located in the South Pasadena area, caused by a failure of the pipeline material. The company did not provide a specific location in any of its reports. According to facility estimates, the leak released nearly 150,000 lbs of Volatile Organic Compounds into the air, which included thousands of pounds of gasoline, Benzene, Ethylbenzene, Toluene, and Xylene. Engineering calculations estimate that approximately 350 barrels of gasoline leaked into the surrounding land, water, and air over a period of 130 hours. The incident was deemed excessive and a violation of their permit authorizations, resulting in an enforcement order.[37] Despite this quantity of pollution released, no alert was sent to the surrounding community, and the incident itself did not receive any media attention.

2024: Sulfuric Acid

In November 2024, PCI Nitrogen spilled over 400,000 lbs of sulfuric acid while filling a storage tank beyond its capacity. The facility reports that most of the liquid was collected by a vacuum truck for reuse, and the remainder was neutralized using soda ash. No further information exists beyond the facility's emission event report.[38]

2024: Volatile Organic Compounds (VOCs)

In September 2024, a vehicle traveling on Spencer Highway in Deer Park drove through a fence and crashed into an above-ground valve owned and operated by the Energy Transfer pipeline company, rupturing the 20-inch Liquified Natural Gas (LNG) line and causing a massive explosion felt by residents miles away. Although the pipeline was quickly shut off, burning of its leftover contents lasted for four days, creating a towering column of fire that released nearly 440,000 pounds of pollution. The smoke from the fire, primarily composed of a mixture of VOCs, Carbon monoxide, and Nitrogen oxides, formed a dense plume. Facility estimates indicate that approximately 3,919 barrels of LNG were released. Emergency responders evacuated a half-mile radius around the scene, including nearly 1000 homes. Nearby schools, businesses, roads, and grocery stores were closed. The intense heat from the fire led to injuries, disrupted the local power supply, and damaged nearby homes, vehicles, and playgrounds in the area.[39, 40]

Energy Transfer claimed that the incident was an unforeseen event caused by a third party and not under their responsibility. However, a Houston Landing investigation found that at least five separate vehicles had crashed into their pipelines over the last five years. At least 36 pipeline collisions have occurred across the U.S. since 2019 (likely more, given the lax reporting requirements), indicating that this incident is part of a much larger issue concerning pipeline safety and is not entirely unforeseen.[41] In March 2025, a group of four residents sued the company for negligence, citing improper pipeline protections and its history of frequent similar collisions.

Permit limits

Many of the same pollutants listed above have been released beyond their permitted limits on numerous occasions. In fact, nearly 15% of all permit violations during emission events from 2017 to 2023 involve Carbon monoxide, Nitrogen oxides, and Ethylene.

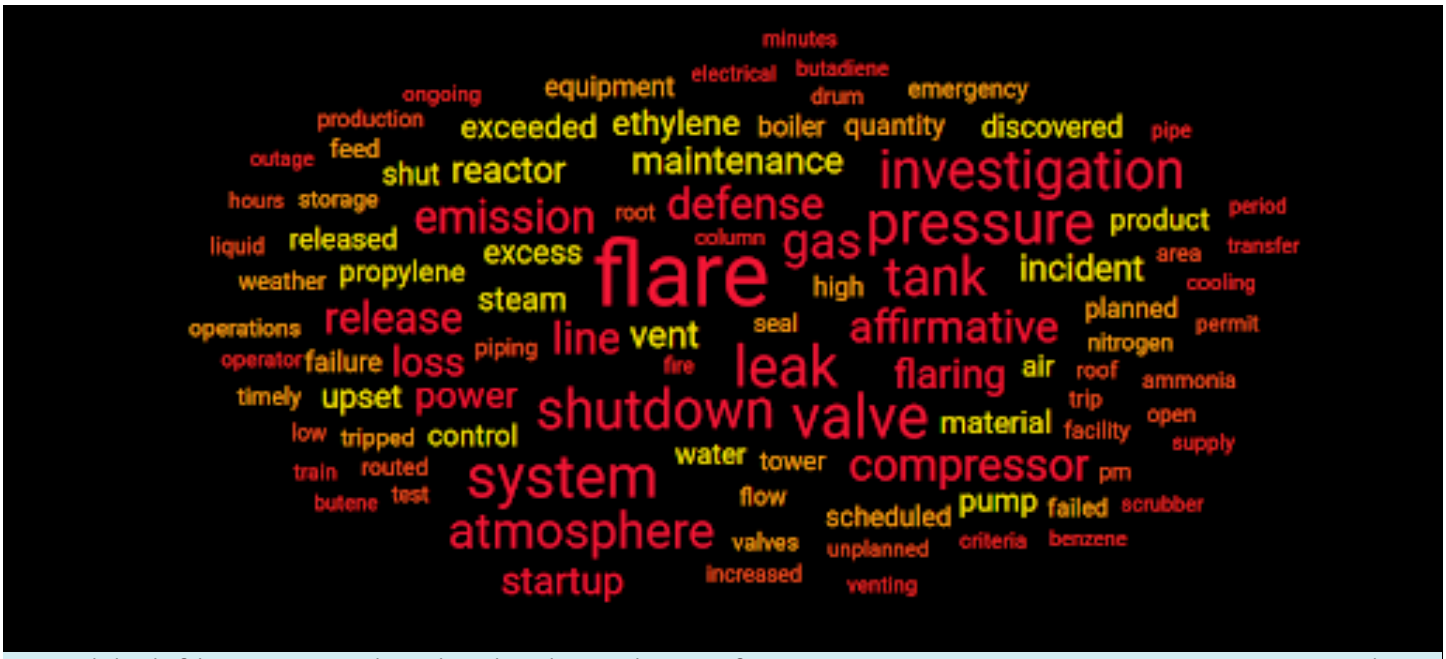
Furthermore, Benzene has been released 207 times more than the allowable limits, despite only constituting 1.87% of all emission event-related air pollution, indicating that existing releases of Benzene have been occurring at rates and quantities that endanger human health. Benzene is a deadly carcinogen, and long-term exposure can lead to cancer of the blood-forming organs, also known as leukemia. Benzene exposure has also been associated with a specific type of leukemia called Acute Myeloid Leukemia (AML), a rapidly growing cancer of the bone marrow.[42,43]

Chemicals with the most violations:

- Carbon monoxide: 387 violations
- Nitrogen oxides: 302 violations
- Ethylene: 267 violations
- Propane: 216 violations
- Benzene: 207 violations
- Sulfur dioxide: 178 violations

The existence of emission limits within industrial permits indicates that our regulators and policymakers are aware that these pollutants should be released into the air at very low rates and levels - significantly lower than they currently are. However, the sheer number of these violations demonstrates a routine industrial disregard for laws and regulations that protect our health and environment.

CAUSES



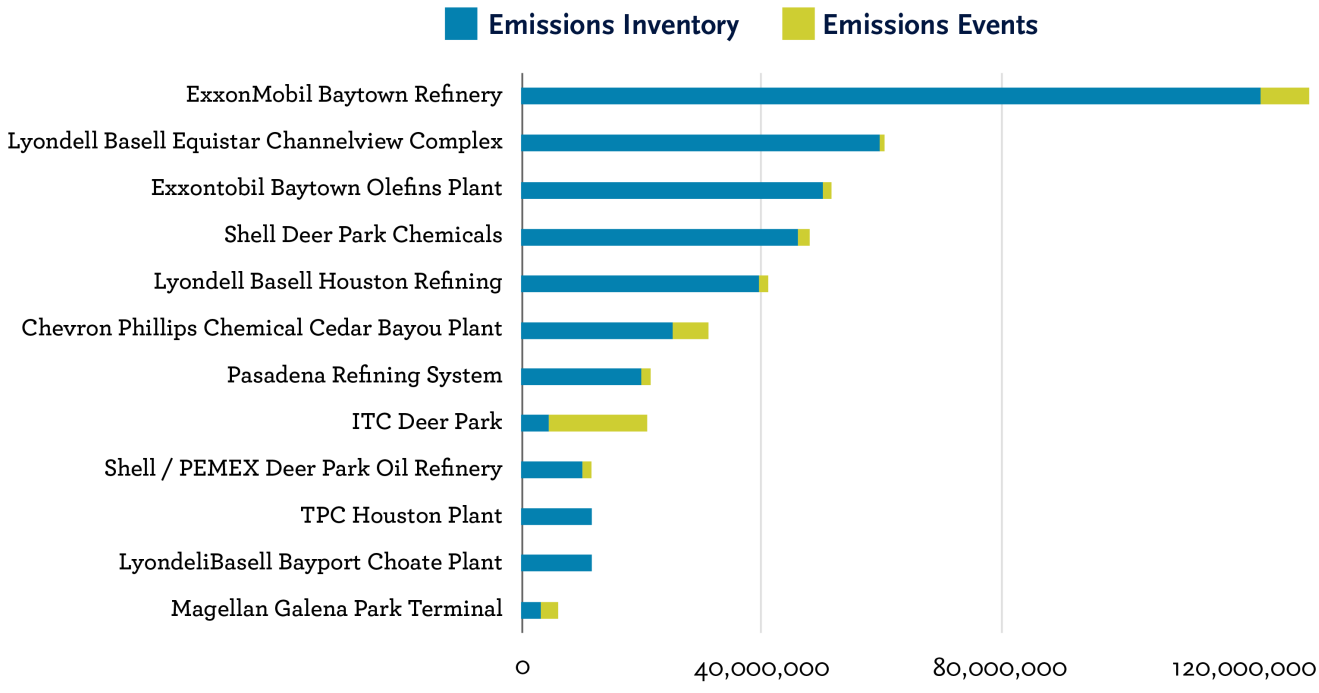
A word cloud of the most commonly used words in the stated causes of emission event reports. Source: TCEQ Air Emission Event Database

Flaring is a common action utilized by facilities during emergencies where excess gases are burned off to avoid explosions, fires, and leaks. Emissions from flares are not calculated from real-time measurements but rather engineering estimates that essentially assume an ideal 98 - 99% combustion efficiency. However, various factors influence combustion efficiency, including flame temperature, residence time, and flammability of gas in the combustion zone, availability of oxygen, and turbulent mixing of components. All of these can change during poor weather conditions, equipment failures, or flaring anomalies. In reality, most flares are neither operated correctly nor used under optimal conditions and therefore do not achieve 98 percent efficiency.[44] Operational failures and physical variables, such as high winds, can reduce flare efficiency, resulting in chemical releases and flare smoking.

In 2010, the Texas Commission on Environmental Quality (TCEQ) conducted a controlled study on industrial flare efficiency, finding that flares can be operated in compliance with federal regulations (see Regulatory Environment) yet still fail to achieve a 98% DRE (Destruction Removal Efficiency) due to operational issues.[45] The EPA has "found flares that were operated so poorly that there was likely no combustion taking place at all. In these circumstances, the flare was merely venting pollution directly to the atmosphere".[46] As such, actual quantities of pollution released are much higher, and this flaring-related pollution has already been associated with asthma, preterm births, respiratory-related hospitalizations, liver and bone marrow-related disease risks, and premature deaths.[47, 48, 49, 50, 51]

CONCLUSION

The TCEQ's emission event database is an underutilized resource; its extensive historical data made this report possible, and it should be examined more closely by regulators and policymakers. This report was inspired by a need to draw attention to industrial emission events, their high frequency, and the vast quantities of pollution they release into the air every year. While most of these pollutants are invisible, the pollution does not simply disappear once it exits a refinery's stack. It disperses throughout the city and county, entering our homes and schools, contaminating our food and water, and ultimately finding its way into our bodies, contributing to disease. One of the reasons why frequent emission events are concerning is that industrial facilities already release massive amounts of air pollution outside of these events during their normal day-to-day operations. The following graph highlights these routine emissions of the 12 repeat offender facilities in comparison to their total emission event pollution from 2017 to 2024:



Industrial air pollution released from routine emissions versus emission events from 2017-2024. Sources: TCEQ Central Registry, TCEQ Air Emission Event Database

For most facilities, the pollution released from emission events barely reaches 10% of the total quantity of routine emissions. Major industries in Harris County thus possess enough regulatory leeway as it is and must urgently curb their pollution from emission events, as well as work to address the circumstances that lead to these incidents.

Finally, there is a severe lack of long-term data on emission events beyond the individual explosions, fires, and incidents themselves, which typically subside after a week or two. However, by focusing attention on the most impactful emission events, we can identify opportunities not only for research but for regulation and policy change:

Recommendations

- Further research into the quantities and composition of chemicals released into the air during these emission events is urgently needed, including the concerning amounts of Ethylene and Benzene released annually and the steady, significant increase in emissions each year.
- Additionally, analyzing the annual causes of emission events shows how often a facility performs shutdown and startup procedures. For example, while most facilities only carry out these procedures during extreme weather or unforeseen incidents, Chevron Phillips Baytown appears to do so without a clear reason. Moreover, their reports consistently fail to explain the cause of these frequent shutdowns and startups, a practice not observed by their large industry counterparts.
- Regulatory and facility-level improvements to infrastructure must be fortified against extreme weather, including high wind, flooding, and loss of electrical power. Insufficient weatherization and a lack of preparedness for extreme weather events are routinely cited as the root causes of major emission incidents. The kinds of planning and infrastructure improvements outlined in the EPA's 2022 Safer Communities by Chemical Accident Prevention Rule would have prevented many of the emission events described in this report.
- Communities have a "right-to-know" what they are breathing during an emission event. However, when such events occur, community members are often told "there is no harm," even when visible fires and flares can be seen from miles around. Transparent and accountable communication from both facilities and regulators is urgently needed. This extends to the routine and rapid response air monitoring conducted by both facilities and regulators during these events as well.
- According to their own reports, flares are a routinely cited explanation for emission events, and flare inefficiency is a well-documented pollution control failure. The industry must implement far more protective flare management, repair, replacement, and maintenance practices to ensure that EPA standards for chemical combustion are met.
- Finally, a report on weather-related emission events would be remiss if it did not also acknowledge the role that emissions have on extreme weather itself. Ultimately, the root cause of extreme weather, i.e., fossil fuel-caused climate change, must also be reined in as a preparedness strategy. Without this, weather events will continue to intensify, making it increasingly challenging for preventive infrastructure, planning, and communication to keep pace.

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