ORIENTATION PACKET

for those new to the PCAC Emissions Report

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Why Emissions Reports?

Learn what CAC plants release to air

- Including pollutants contributing to ozone

Help public learn about chemicals in the community

Tool for helping CAC hold plants accountable

Plants may learn from their own reports and others

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PCAC Plants Exempt from Reporting and Reasons Why

TCEQ Emissions Inventory (EI)

- Evonik: Site's "potential to emit" is below the threshold of a major source requiring reporting.
- Ethyl: Not a major source of VOC emissions per TCEQ definition.

EPA Toxics Release Inventory (TRI)

Reporting not required for type of industry

- Gulf Coast Authority

Terminals that do not produce products.

- ITC
- Kinder Morgan Export Terminal
- Kinder Morgan Pasadena Terminal

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Common *Acronyms*

EPA – U.S. Environmental Protection Agency

TCEQ – Texas Commission on Environmental Quality

EI – TCEQ Air Emissions Inventory

TRI – EPA Toxics Release Inventory

NOx – Nitrogen Oxides

VOCs – Volatile Organic Compounds

HRVOC – Highly Reactive Volatile Organic Compounds

SOx – Sulfur Oxides

TSP – Total Suspended Particulates

CO – Carbon monoxide

TAR – Turnaround

Additional Acronyms starting on Page 16

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Contents of Report

TCEQ Air Emissions Inventory (EI)

- Overall trends, plant-specific data, reasons for change

EPA Toxics Release Inventory (TRI)

- Overall trends, plant-specific data, reasons for change

Comparisons for EI and TRI

- 5 Year from 2020 to 2024
- 1 year from 2023 to 2024

5- and 10-year averages

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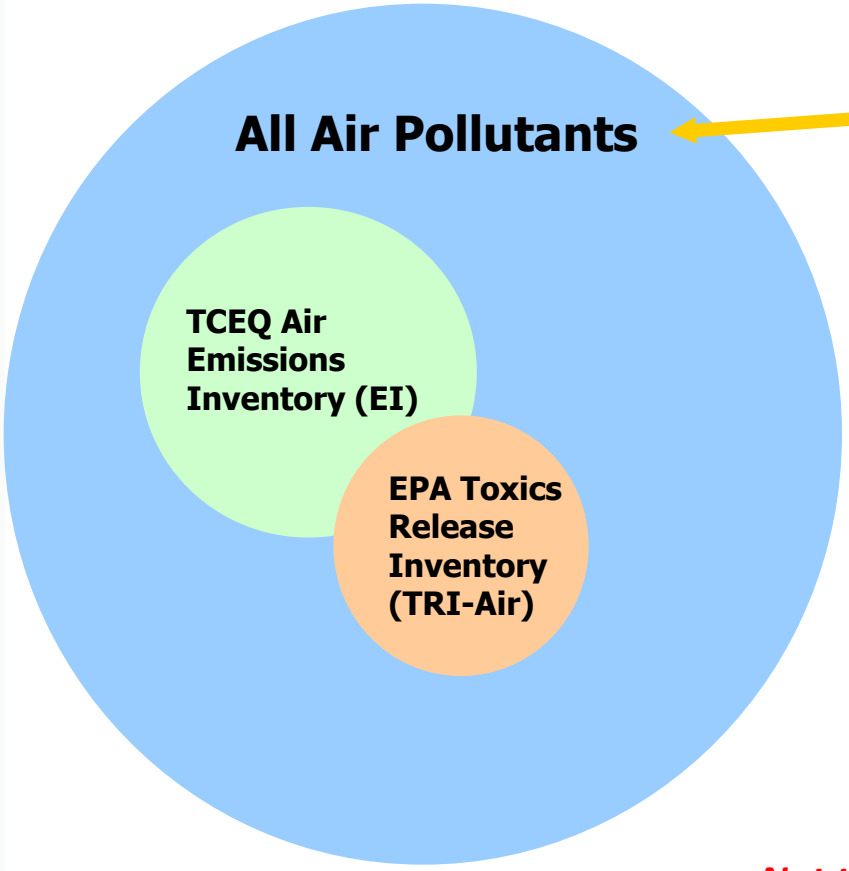
Sources of Air Pollution



Sources include…

- **Industry** -- Chemical, petroleum refining, electric generation
- **Transportation** -- Cars and trucks, marine, aviation and trains. Off-road vehicles (construction)
- **Other** -- Small Businesses, homes
- **Biogenic Sources** -- Vegetation, fires, dust

Not to scale

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Plant Sources of Air Emissions

From: boilers, heaters, cooling towers, flares, loading & unloading, process vents, tanks, engines, vessels, wastewater treatment . . .

During: routine permitted activities (includes maintenance, startup and shutdown), upsets, spills. . .

Including:

- Point sources
- Fugitive emissions

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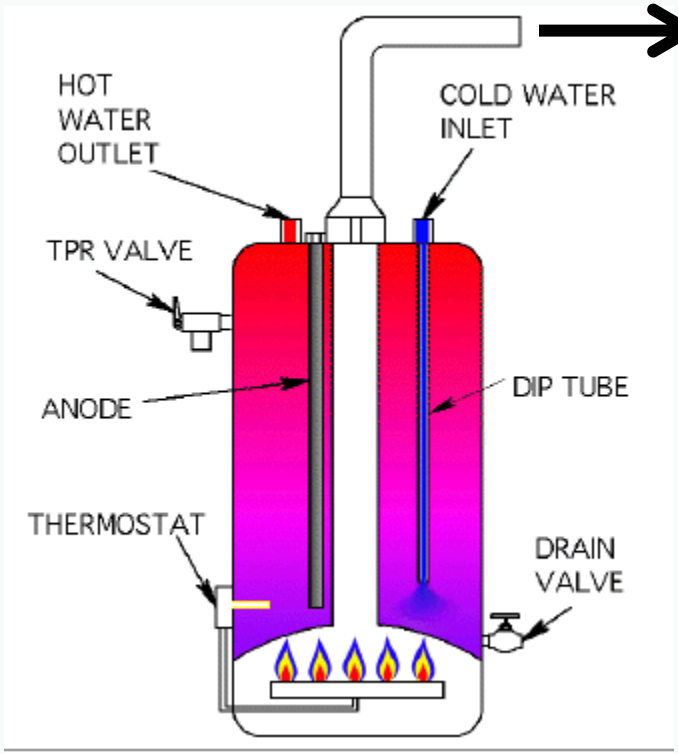
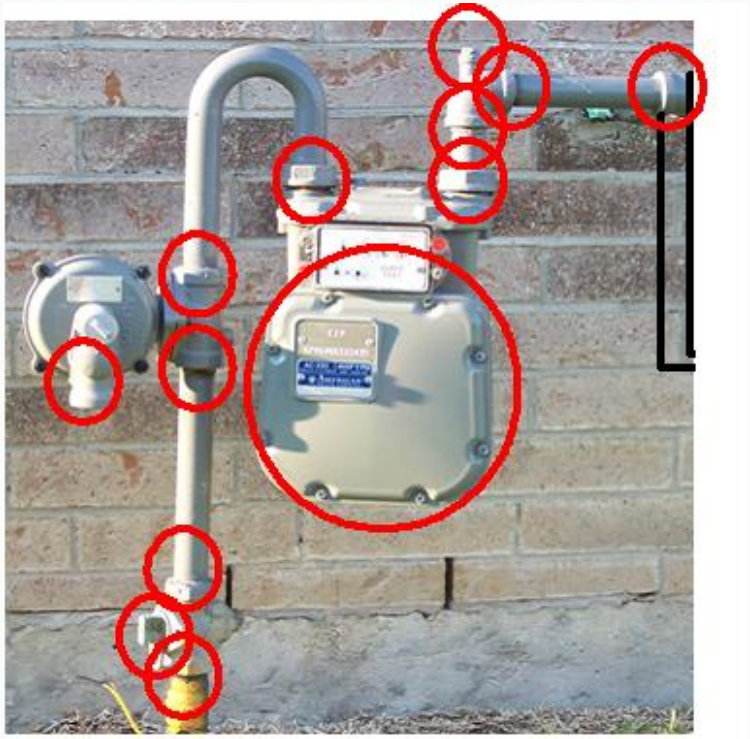
Point vs. Fugitive Emission Sources

Water Heater
Point Source



CO
NO_X
VOC
SO_X

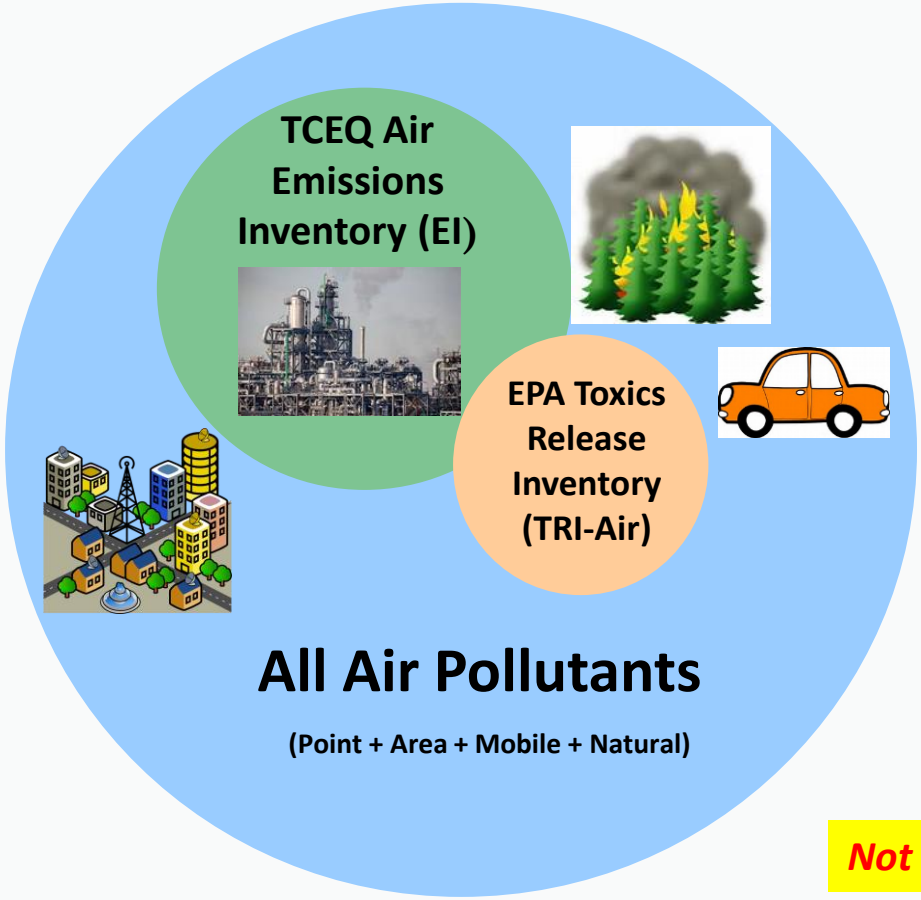
Gas Meter
13 Fugitive Sources



Point vs. Fugitive Emission Sources

Where *Data* Come From

Industry Reporting of Air Emissions



EI and TRI Overlap

Not to scale

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Data from Two Inventories

TCEQ Air Emissions Inventory (EI)

- Reported by major sources annually to Texas Commission on Environmental Quality (TCEQ)
- Just air -- all air releases of covered pollutants

EPA Toxics Release Inventory (TRI)

- Reported annually to Environmental Protection Agency (EPA) by plants in certain kinds of businesses if plant manufactures, processes, or otherwise uses a chemical on the TRI list above a set amount.
- Releases to environment (air, land, water) and transfers off the plant site for further waste treatment or disposal.
- PCAC report includes only TRI Releases to Air

Comparing EI vs. TRI

Air Emissions Inventory (EI)

- State requirement (TCEQ)
- *Contaminants released to Air*
- Required for permitting and compliance
- Almost all air contaminants (ever small quantities)

Toxics Release Inventory (TRI)

- Federal requirement (EPA)
- Contaminants released to *air, water, and land*
- Required for public right-to-know
- Approx. 800 chemicals that exceed specific thresholds in 33 chemical categories

- **Both reports**
  - **Include point source and fugitive emission values**
  - **Calculation methods, including direct measurements, engineering estimates, and agency factors**
  - **Include permitted and upset emissions**
  - **Can show useful trends**
  - **Small facilities are exempt**

Requirements for EI Reporting

A plant must submit an EI if it meets any one of the following:

- Major Source
- In Harris County and emits at least 10 tons per year (TPY) VOC, 25 TPY NOx, or 100 TPY of any other contaminant
- Emits more than 0.5 TPY of lead (Pb)
- Potential to emit 10 TPY of a single (25 TPY aggregate) hazardous air pollutant
- Subject to a special inventory

Criteria Air Pollutants in EI

4 of the criteria air pollutants - subject to National Ambient Air Quality Standards (NAAQS)

- Nitrogen Oxides (NOx) - ozone precursor
- Sulfur Oxides (SOx)
- Carbon Monoxide (CO)
- Total Suspended Particulates (TSP)/PM 2.5

Volatile Organic Compounds (VOCs) - ozone precursors subject to other rules

- Highly Reactive VOCs (HRVOCs), a subset of VOCs, contribute more to ozone formation

Requirements for TRI Reporting

Plants must report if:

- the chemicals used in their processes are covered by the TRI program (approximately 800 chemicals)
- the plant makes more than 25,000 lbs. of a TRI chemical in a year
- the plant uses more than 10,000 lbs. of the TRI chemical in a year

TRI for PCAC vs. EPA

PCAC looks only at TRI releases to *air t*o keep the report simple

Plant reports to EPA include

- Releases to environment (air, land, water)
- Transfers off the plant site for further waste management or disposal

  Ex: recycling or use as fuel, or landfilling

  Internal recycling, reduction of emissions at the source, etc.

- Pollution Prevention Information

Where *Numbers* Come From

Where Numbers Come From

Combination of ***measurements*** and ***estimates***

Measurements from Continuous Emissions Monitoring Systems (CEMS), stack and vent tests, lab analysis, and other direct measurements

Estimates from calculations based on fuel consumption, mass balance of process, engineering calculations, throughput formulas, flow measurements, inventory loss, production data, and field surveys

- Fugitives often estimated by EPA's AP-42 factors
- Direct measurements may be incorporated into calculations

Changing calculation methods

- Improves accuracy
- Affects emissions numbers positively or negatively

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Measurements

Continuous Emission Monitoring System (CEMS)

Only available for certain kinds of emissions

Most accurate way to quantify emissions

… and the most expensive to install & maintain

Emissions Measurement Example

NOx emissions calculations basis

- NOx and CO CEMS data (concentration, ppmvd)
- Exhaust gas flow rate (dscfm)
- Molecular weight (lb/lb-mol)

Boiler NOx example:

$$\frac{C_{ppmvd} * MW_{lb/lb\text{-}mol} * Q_{dscfm} * 60\ min/hr}{V_{ideal\ gas,\ cf/lb\text{-}mol} * 10^6} = lb/hr$$

$$\frac{17.86 * 46.1 * 19{,}150 * 60}{386.5 * 10^6} = 2.45\ lb/hr\ NOx$$

Measurement + Calculation

Fugitive VOC emissions calculation basis

- EPA Test Method 21 monitoring results
- EPA/TCEQ correlation equations
- Annual Leak Report

TABLE 2-9. SOCMI LEAK RATE/SCREENING VALUE CORRELATIONS

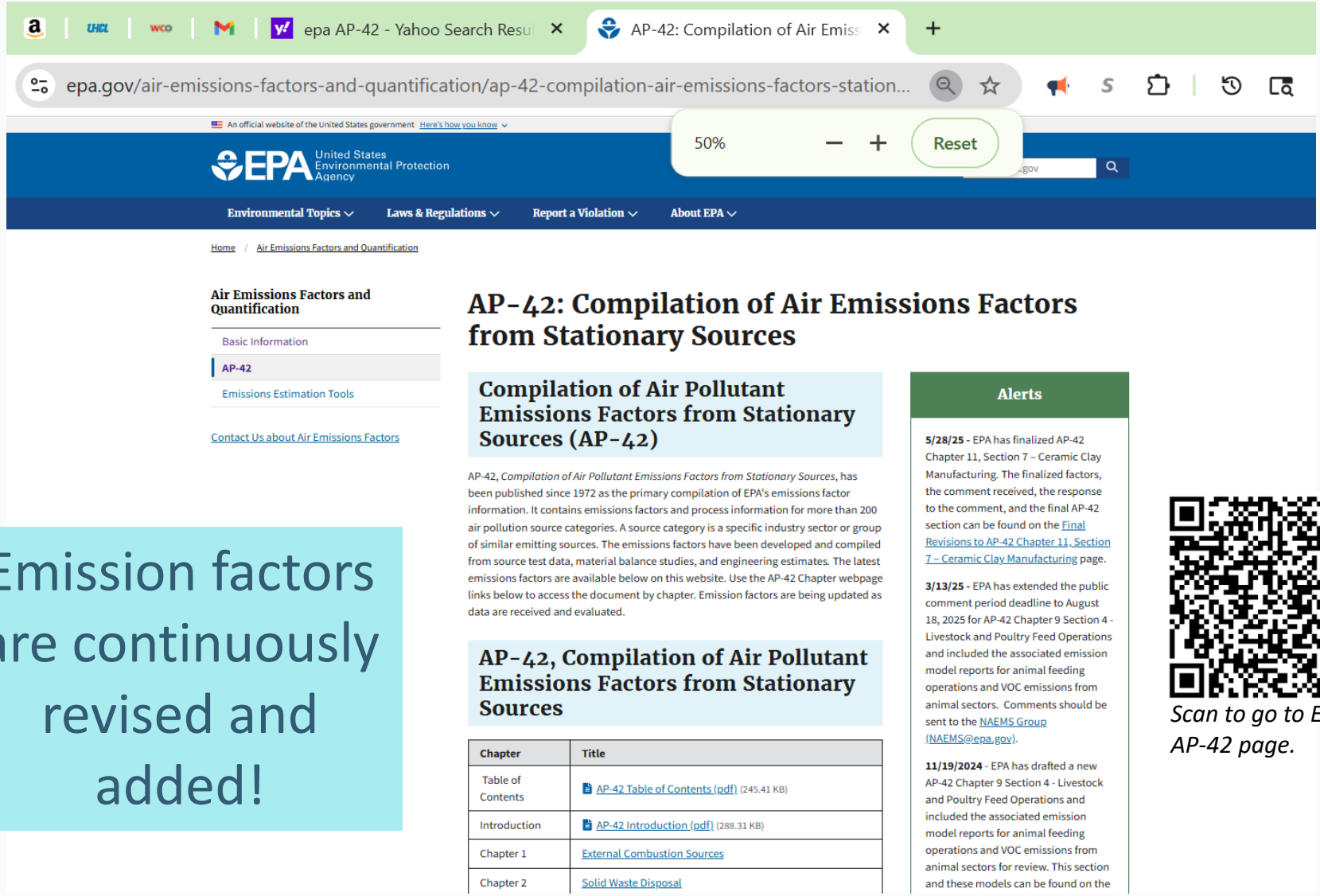
Equipment type	Correlation[a,b]
Gas valves	Leak rate (kg/hr) = 1.87E-06 × $(SV)^{0.873}$
Light liquid valves	Leak rate (kg/hr) = 6.41E-06 × $(SV)^{0.797}$
Light liquid pumps[c]	Leak rate (kg/hr) = 1.90E-05 × $(SV)^{0.824}$
Connectors	Leak rate (kg/hr) = 3.05E-06 × $(SV)^{0.885}$

[a]SV = Screening value in ppmv.

[b]These correlations predict total organic compound emission rates.

[c]The correlation for light liquid pumps can be applied to compressor seals, pressure relief valves, agitator seals, and heavy liquid pumps.

Published Emission Factors



Emission factors are continuously revised and added!

Scan to go to EPA's AP-42 page.

Emission Factor Example

Table 1.4-1. EMISSION FACTORS FOR NITROGEN OXIDES (NO_x) AND CARBON MONOXIDE (CO) FROM NATURAL GAS COMBUSTION[a]

Combustor Type (MMBtu/hr Heat Input) [SCC]	NO_x[b]		CO	
	Emission Factor ($lb/10^6$ scf)	Emission Factor Rating	Emission Factor ($lb/10^6$ scf)	Emission Factor Rating
Large Wall-Fired Boilers (>100) [1-01-006-01, 1-02-006-01, 1-03-006-01]				
Uncontrolled (Pre-NSPS)[c]	280	A	84	B
Uncontrolled (Post-NSPS)[c]	190	A	84	B
Controlled - Low NO_x burners	140	A	84	B
Controlled - Flue gas recirculation	100	D	84	B
Small Boilers (<100) [1-01-006-02, 1-02-006-02, 1-03-006-02, 1-03-006-03]				
Uncontrolled	100	B	84	B
Controlled - Low NO_x burners	50	D	84	B
Controlled - Low NO_x burners/Flue gas recirculation	32	C	84	B
Tangential-Fired Boilers (All Sizes) [1-01-006-04]				
Uncontrolled	170	A	24	C
Controlled - Flue gas recirculation	76	D	98	D
Residential Furnaces (<0.3) [No SCC]				
Uncontrolled	94	B	40	B

Factors Causing Year-to-Year Variations

Actual long-term changes in emissions

- Adding units or closing them
- Pollution prevention efforts – practices/equipment

Making or storing a different mix of products

- For example, more volatile materials may evaporate to the air

Production/customer demand -- up or down

Maintenance and related shutdowns and startups

Changing number of plants in PCAC

Emission events: upsets, leaks, and spills

Changing calculation methods & emission factors

Audits – continuous improvement

Agency interactions – identify deficiencies

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TCEQ NOx and VOC Emission Charts

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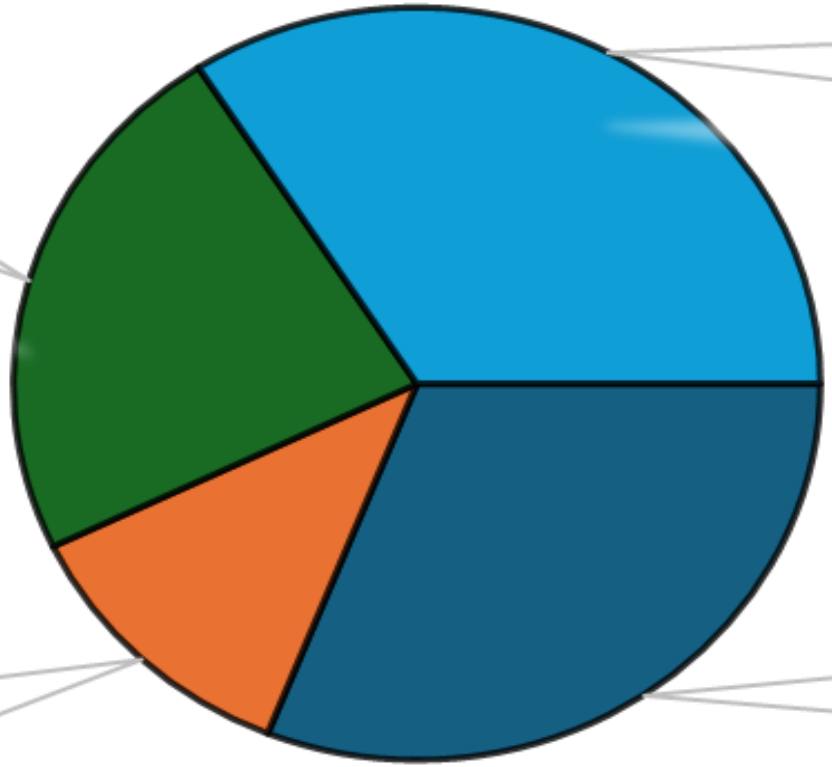
TCEQ NOx and VOC Emission Charts

The pie charts on the following pages show the relative emissions of nitrogen oxides (NOx) and volatile organic compounds (VOCs) by source category. The charts are developed every three years based on the National Emissions Inventory and were last updated in 2023.

- **Point source** - large stationary sources such as fossil fuel-fired power plants, smelters, industrial boilers, petroleum refineries, and manufacturing facilities
- **Area source** - small-scale industrial, commercial, and residential sources that generate emissions
- **mobile source** – 2 types
  - On-Road - automobiles, trucks, motorcycles, and other motor vehicles traveling on public roadways
  - Non-Road – agriculture & construction equipment, aircraft, trains, drilling rigs, etc.

2023 Houston-Galveston-Brazoria Area NO_x Emissions



On-road Mobile
23%

Non-road Mobile
34%

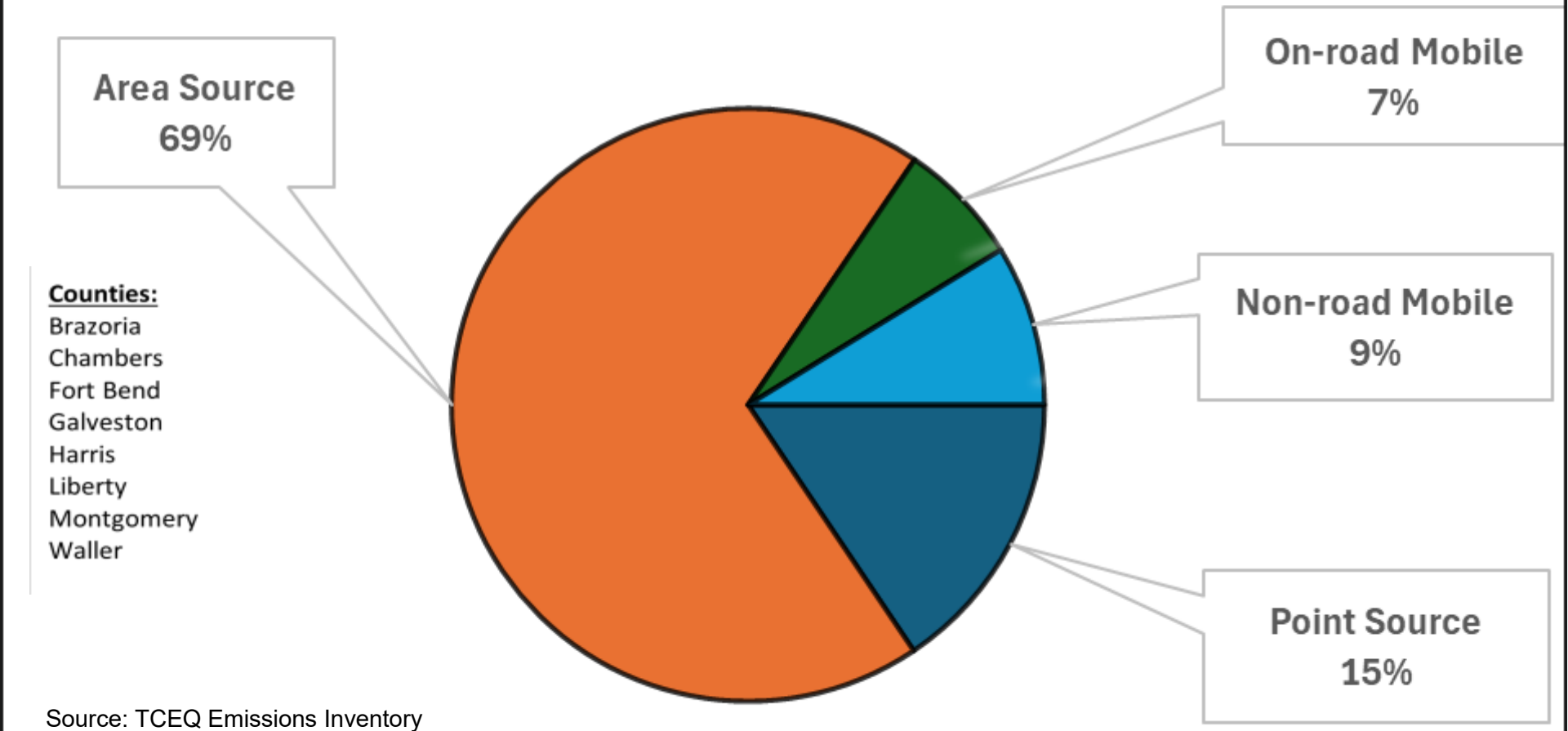
Counties:
Brazoria
Chambers
Fort Bend
Galveston
Harris
Liberty
Montgomery
Waller

Area Source
12%

Point Source
31%

Source: TCEQ Emissions Inventory
Updated: 9/12/25

2023 Houston-Galveston-Brazoria Area VOC Emissions



Counties:
Brazoria
Chambers
Fort Bend
Galveston
Harris
Liberty
Montgomery
Waller

Source: TCEQ Emissions Inventory
Updated: 9/12/25

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If You Want to Know More

TCEQ: www.tceq.Texas.gov

EPA TRI Website

TRI Program Home page: www.epa.gov/tri

Houston Regional Monitoring: http://hrm.aecom.com/

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Emissions and Air Monitoring Acronyms and Terms

Emissions and Air Monitoring Acronyms and Terms

EE: emissions event

RTO: regenerative thermal oxidizer to reduce emissions to the atmosphere.

FGRS: Flare Gas Recovery System

MSS: maintenance, shut down, and startup

SCR: Selective Catalytic Reduction

TO: thermal oxidizer

WWT: wastewater treatment

WWTP: wastewater treatment plant

Emissions and Air Monitoring Acronyms and Terms

EI: Emissions Inventory filed with TCEQ for all criteria pollutants (and their precursors) and hazardous air pollutants, such as benzene and 1,3-butadiene

TRI: Toxics Release Inventory, filed with EPA

Emission: Pollution discharged into the atmosphere from smokestacks, other vents, and surface areas of commercial or industrial facilities; from residential chimneys; and from motor vehicle, locomotive, or aircraft exhausts. *(EPA)*

Release: Any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment of a hazardous or toxic chemical or extremely hazardous substance. *(EPA)*

Environment: air, water, groundwater, and land

Emissions and Air Monitoring Acronyms and Terms

LDAR: Leak Detection and Repair. Fugitive emissions are controlled by looking for leaks and fixing them. *See gas meter (fugitives) vs. hot water heater (point sources).*

DOR: Delay of Repair. A common cause of fugitive emission increases when leaking component cannot be repaired without shutting down plant. More emissions would result from the shutdown than from delaying repair. Components can also be placed on DOR if it would be unsafe to attempt repair with chemicals in the process piping or equipment.

TPY: Tons Per Year

Emissions and Air Monitoring Acronyms and Terms

Criteria Pollutants and Precursors

Ozone: Respiratory irritant that may form in the atmosphere when NOx and VOCs come together on still, sunny days.

Nox: Nitrogen Oxides. Nitrogen dioxide and other gases made of varying mixtures of nitrogen and oxygen. Formed when fuel is burned at high temperatures *(EPA).*

Emissions and Air Monitoring Acronyms and Terms

Criteria Pollutants and Precursors

VOCs: Volatile Organic Compounds. *Volatiles* evaporate rapidly. *Organic Chemicals or Compounds* are naturally occurring (animal or plant-produced) or synthetic substances containing mainly carbon, hydrogen, nitrogen, and oxygen. VOCs are any organic compounds that participate in atmospheric photochemical reactions except those designated by EPA as having negligible photochemical reactivity (*EPA*). Photochemical reactions are influenced or initiated by light. There are hundreds of VOCs, including common ones like ethylene, propylene, benzene, and formaldehyde. VOCs are found in many household products and are thus an indoor air-quality interest.

HRVOCs: Highly Reactive Volatile Organic Compounds. A subset of VOCs found to be more productive than other VOCs in forming ozone. TCEQ's focus is ethylene, propylene, 1,3-butadiene, and butenes.

Emissions and Air Monitoring Acronyms and Terms

Criteria Pollutants and Precursors

CO: Carbon Monoxide. Formed when fuel is not burned completely.

TSP: Total Suspended Particulates. Mixture of solid particles and liquid drops found in the air. Some particles, such as dust, dirt, soot, or smoke, are large or dark enough to be seen with the naked eye. Others are so small they can only be detected using a microscope.

SOx: Sulfur Oxides (including sulfur dioxide and others in the family). Sulfur is prevalent in crude oil, coal, and ore that contains common metals like aluminum, copper, zinc, lead, and iron. SOx gases are formed when fuel containing sulfur, such as coal and oil, is burned; when gasoline is extracted from oil; or metals are extracted from ore.

Emissions and Air Monitoring Acronyms and Terms

HRM: **H**ouston **R**egional **M**onitoring. Monitors air on behalf of industry members.

HGB: **H**ouston – **G**alveston – **B**razoria region.

NAAQS: **N**ational **A**mbient **A**ir **Q**uality **S**tandards. States are required to meet these standards or bear the consequences. In the HGB area, Texas meets all but the ozone standard.

SIP: **S**tate **I**mplementation **P**lan. State's plan for bringing an area into attainment of the NAAQS.

Concentration: The amount of pollutant detected by the monitors is reported in parts per million by volume or volume density.

(ppmv or ppmvd) or by parts per billion **(ppbv or ppbvd)**

AMCVs: **A**ir **M**onitoring **C**omparison **V**alues. Level of a chemical in air set to prevent short-term and long-term health effects and nuisance odor conditions. ESLs *(see next slide)* are used for evaluating air permitting models. AMCVs are used for evaluating air monitoring data.

Emissions and Air Monitoring Acronyms and Terms

ESLs: **E**ffects **S**creening **L**evels. If trends at an air monitor exceed the TCEQ ESL for a compound, the agency may place it on the Air Pollutant Watch List to determine the sources and how to bring about reductions.

HAPs: **H**azardous **A**ir **P**ollutants, the "air toxics" on which EPA focuses

CAMS: TCEQ **C**ontinuous **A**mbient **M**onitoring **S**tation

PAMS: **P**hotochemical **A**ssessment **M**onitoring **S**tation

Auto GC: Automated **G**as **C**hromatograph, continuous air monitoring *equipment*

FTIR: **F**ourier **T**ransform **I**nfra-**R**ed spectrometer, continuous air monitoring *equipment*

Emissions and Air Monitoring Acronyms and Terms

BTEX: **B**enzene, **T**oluene, **E**thylbenzene, **X**ylenes. Four HAPs serving as surrogates for tracking trends of HAPs

Benzene: is a colorless liquid with a sweet odor. It evaporates into the air very quickly and dissolves slightly in water. It is highly flammable and is formed from both natural processes and human activities.

Benzene is widely used in the United States; it ranks in the top 20 chemicals for production volume. Some industries use benzene to make other chemicals which are used to make plastics, resins, and nylon and other synthetic fibers. Benzene is also used to make some types of rubbers, lubricants, dyes, detergents, drugs, and pesticides.

Natural sources of benzene include emissions from volcanoes and forest fires. Benzene is also a natural part of crude oil, gasoline, and cigarette smoke. It is a known human carcinogen *(From the federal Agency for Toxic Substances and Disease Registration).*