

ORIENTATION PACKET

for those new to the
PCAC Emissions Report

PCAC 10-22 EMISSIONS DRAFT ORIENTATION PACKET

1

Table of Contents

Why Emissions Reports?	<i>Page 2</i>
PCAC Plants Exempt from Reporting and Reasons Why	<i>Page 2</i>
Common Acronyms	<i>Page 3</i>
Report Contents	<i>Page 3</i>
Sources of Air Pollution	<i>Page 4</i>
Plant Sources of Air Emissions	<i>Page 4-5</i>
Where Data Come from	<i>Pages 6-9</i>
Where Numbers Come From	<i>Pages 10-13</i>
Numbers Change from Year-to-Year	<i>Page 13</i>
Houston-Galveston-Brazoria area NOx and VOC emissions	<i>Pages 14-15</i>
Resources	<i>Page 16</i>
Emissions and Air Monitoring Acronyms and Terms	<i>Pages 16-21</i>

PCAC 10-22 EMISSIONS DRAFT ORIENTATION PACKET

2

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

PCAC 10-22 EMISSIONS DRAFT ORIENTATION PACKET

3

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

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 Liquids Terminal

PCAC 10-22 EMISSIONS DRAFT ORIENTATION PACKET

4

Common Acronyms

EPA – US Environmental Protection Agency
TCEQ – Texas Commission on Environmental Quality
EI – TCEQ Air Emissions Inventory
TRI – EPA Toxics Release Inventory
NO_x – Nitrogen Oxides
VOCs – Volatile Organic Compounds
HRVOC – Highly Reactive Volatile Organic Compounds
SO_x – Sulfur Oxides
TSP – Total Suspended Particulates
CO – Carbon monoxide
TAR – Turnaround

Additional Acronyms starting on page 15

PCAC 10-22 EMISSIONS DRAFT ORIENTATION PACKET

5

Report Contents

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

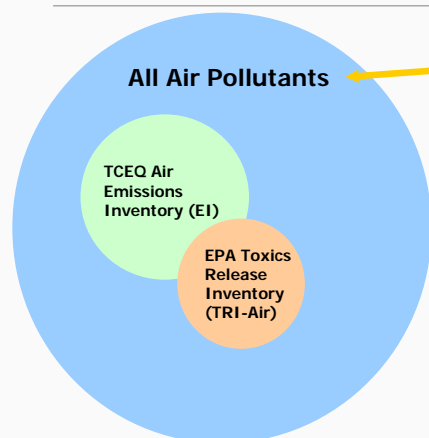
- 5 Year from 2017 to 2021
- 1 year from 2020 to 2021

NEW! Pollutant charts show 5- and 10-year averages

PCAC 10-22 EMISSIONS DRAFT ORIENTATION PACKET

6

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

7

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. . .

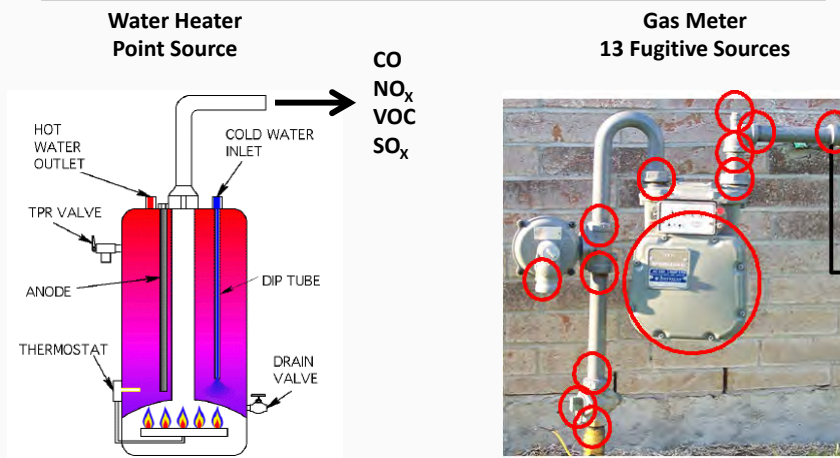
Including:

- Point sources
- Fugitive emissions

PCAC 10-22 EMISSIONS DRAFT ORIENTATION PACKET

8

Point vs. Fugitive Emission Sources



PCAC 10-22 EMISSIONS DRAFT ORIENTATION PACKET

9

Point vs. Fugitive Emission Sources



PCAC 10-22 EMISSIONS DRAFT ORIENTATION PACKET

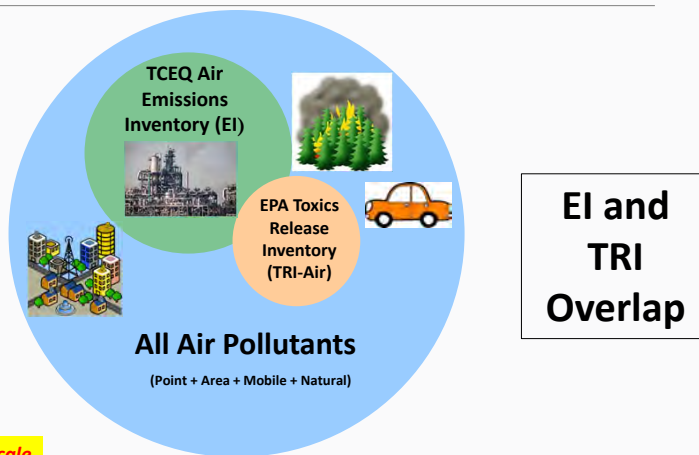
10

Where *Data* Come From

PCAC 10-22 EMISSIONS DRAFT ORIENTATION PACKET

11

Industry Reporting of Air Emissions



PCAC 10-22 EMISSIONS DRAFT ORIENTATION PACKET

12

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 business if plant has chemicals on 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

PCAC 10-22 EMISSIONS DRAFT ORIENTATION PACKET

13

Comparing EI vs. TRI

Air Emissions Inventory (EI)

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

● 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 exempted

PCAC 10-22 EMISSIONS DRAFT ORIENTATION PACKET

14

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

PCAC 10-22 EMISSIONS DRAFT ORIENTATION PACKET

15

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

PCAC 10-22 EMISSIONS DRAFT ORIENTATION PACKET

16

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

PCAC 10-22 EMISSIONS DRAFT ORIENTATION PACKET

17

TRI for EPA vs. PCAC

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

Plant reports to EPA also 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

PCAC 10-22 EMISSIONS DRAFT ORIENTATION PACKET

18

Where Numbers Come From

PCAC 10-22 EMISSIONS DRAFT ORIENTATION PACKET

19

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

PCAC 10-22 EMISSIONS DRAFT ORIENTATION PACKET

20

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



PCAC 10-22 EMISSIONS DRAFT ORIENTATION PACKET

21

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:

$$C_{\text{ppmvd}} * MW_{\text{lb/lb-mol}} * Q_{\text{dscfm}} * 60 \text{ min/hr} = \text{lb/hr}$$

$$V_{\text{ideal gas, cf/lb-mol}} * 10^6$$

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

$$386.5 * 10^6$$

PCAC 10-22 EMISSIONS DRAFT ORIENTATION PACKET

22

Measurement + Calculation

Fugitive VOC emissions calculation basis

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



TABLE 2-9. SOCM 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}

^aSV = Screening value in ppmv.

^bThese correlations predict total organic compound emission rates.

^cThe correlation for light liquid pumps can be applied to compressor seals, pressure relief valves, agitator seals, and heavy liquid pumps.



23

Published Emission Factors

Air Emissions Factors and Quantification

AP-42: Compilation of Air Emission Factors

On This Page:

- Compilation of Air Pollutant Emission Factors (AP-42)
 - Proposed/Revised/News Emission Factors
 - AP-42 Proposed Factors, But Not Finalized
 - AP-42 Fifth Edition Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources
- Additional AP-42 Resources
 - Historical AP-42 Information
 - AP-42 Frequent Questions
 - Older editions of AP-42, Volume 1

Compilation of Air Pollutant Emission Factors (AP-42)

AP-42: Compilation of Air Pollutant Emission Factors, has been published since 1972 as the primary...

Emission factors are continuously revised and added!

24

Emission Factor Example

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

Combustor Type (MMBtu/hr Heat Input) [SCC]	NO _x		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) [†]	280	A	84	B
Uncontrolled (Post-NSPS) [†]	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

PCAC 10-22 EMISSIONS DRAFT ORIENTATION PACKET

25

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 or less volatile materials

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

PCAC 10-22 EMISSIONS DRAFT ORIENTATION PACKET

26

TCEQ NOx and VOC Emission Charts

PCAC 10-22 EMISSIONS DRAFT ORIENTATION PACKET

27

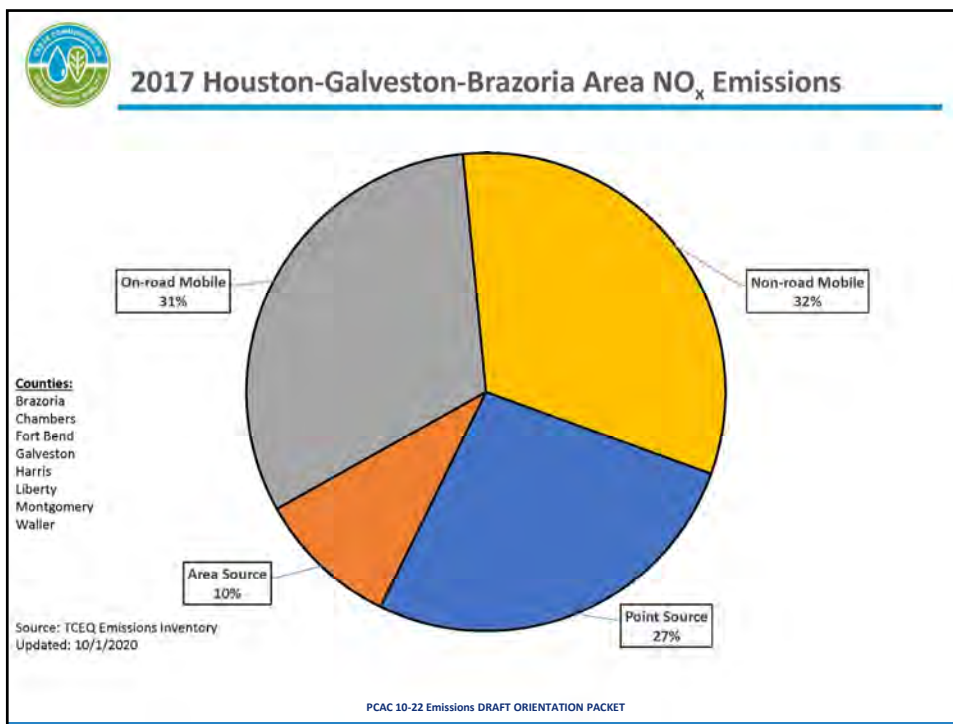
TCEQ NOx and VOC Emission Charts

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 2020.

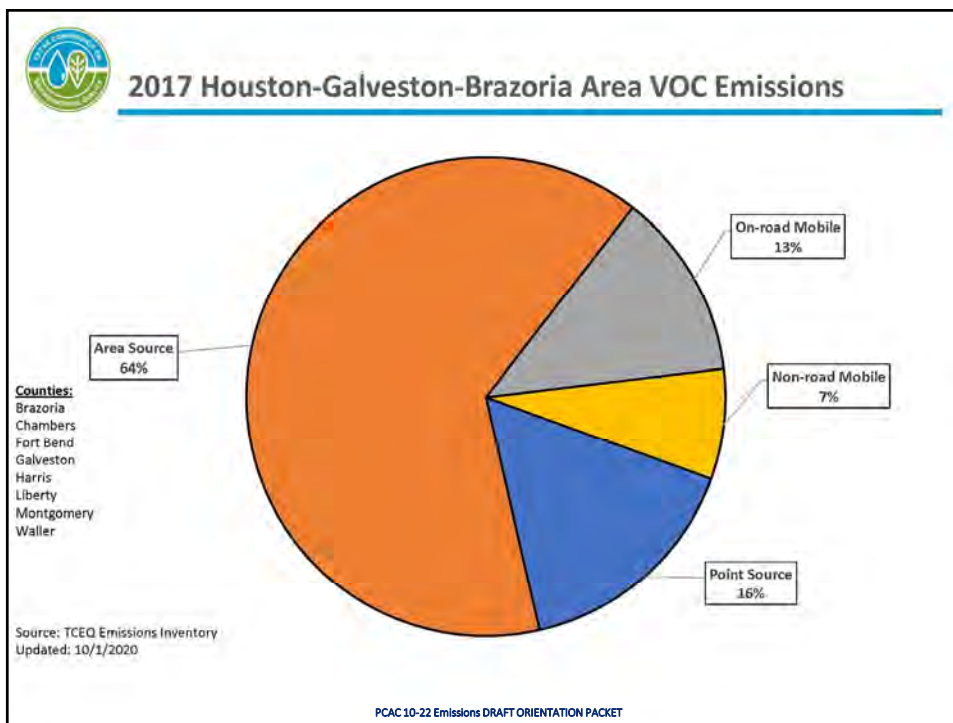
- **Point source** - large stationary sources such as fossil fuel fired power plants, smelters, industrial boilers, petroleum refineries, and manufacturing facilities
- **Area source** - small-scale industrial, commercial, and residential sources that generate emissions
- **mobile source** – 2 types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

PCAC 10-22 Emissions DRAFT ORIENTATION PACKET

28



29



30

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/>

PCAC 10-22 EMISSIONS DRAFT ORIENTATION PACKET

31

Emissions and Air Monitoring Acronyms and Terms

PCAC 10-22 EMISSIONS DRAFT ORIENTATION PACKET

32

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

PCAC 10-22 Emissions DRAFT ORIENTATION PACKET

33

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).*
Delay of Repair (DOR) - 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

PCAC 10-22 Emissions DRAFT ORIENTATION PACKET

34

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

PCAC 10-22 Emissions DRAFT ORIENTATION PACKET

35

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*)

PCAC 10-22 Emissions DRAFT ORIENTATION PACKET

36

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 focus is ethylene, propylene, 1,3-butadiene, and butenes.

PCAC 10-22 Emissions DRAFT ORIENTATION PACKET

37

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.

PCAC 10-22 Emissions DRAFT ORIENTATION PACKET

38

Emissions and Air Monitoring Acronyms and Terms

- HRM** Houston Regional Monitoring. Monitors air on behalf of industry members.
- HGB** Houston – Galveston – Brazoria region
- NAAQS** National Ambient Air Quality Standards. States are required to meet these standards or bear the consequences. In the HGB area, Texas meets all but the ozone standard.
- SIP** State Implementation Plan. 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 (**ppm-v**) or by parts per billion (**ppb-v**)
- AMCVs** Air Monitoring Comparison Values. Level of a chemical in air set to prevent short-term and long-term health effects and nuisance odor conditions. ESLs are used for evaluating air permitting models. AMCVs are used for evaluating air monitoring data

PCAC 10-22 Emissions DRAFT ORIENTATION PACKET

39

Emissions and Air Monitoring Acronyms and Terms

- ESLs** Effects Screening Levels. 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** Hazardous Air Pollutants, the “air toxics” on which EPA focuses
- CAMS** TCEQ Continuous Ambient Monitoring Station
- PAMS** Photochemical Assessment Monitoring Station
- Auto GC** Automated gas chromatograph, continuous air monitoring *equipment*
- FTIR** Fourier Transform Infra-Red spectrometer, continuous air monitoring *equipment*

PCAC 10-22 Emissions DRAFT ORIENTATION PACKET

40

Emissions and Air Monitoring Acronyms and Terms

BTEX Benzene, Toluene, Ethylbenzene, Xylenes. 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)*

PCAC 10-22 Emissions DRAFT ORIENTATION PACKET