ONTARIO MINISTRY OF ENVIRONMENT MONITORING WORKSHOP NOV. 5-6, 2014

EXPERIENCE WITH COOPERATIVE COMMUNITY AIR MONITORING PROGRAMS & ENHANCED LDAR PROGRAMS

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Resources: Our use of the term "resources" in this presentation includes quantities of oil and gas not yet classified as SEC proved oil and gas reserves. Resources are consistent with the Society of Petroleum Engineers 2P and 2C definitions.

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OUTLINE

- Experience with cooperative regional monitoring programs
    - Houston Regional Monitoring program as an example

      (with acknowledgement that information on HRM has been provided by HRM with their permission)
- Experience with enhancing Leak Detection and Repair (LDAR) programs

HRM PURPOSE

HRM is a voluntary industry-funded technical resource dedicated to performing ambient air monitoring and related special studies to better understand air quality in the Houston area

With an annual operating budget of $2.3MM HRM accomplishes its goals through two program phases

- Monitoring Program
- Special Studies Program

HOW DOES HRM CONTRIBUTE TO THE UNDERSTANDING OF AIR QUALITY?

Provides monitoring data to assist member companies with permitting issues

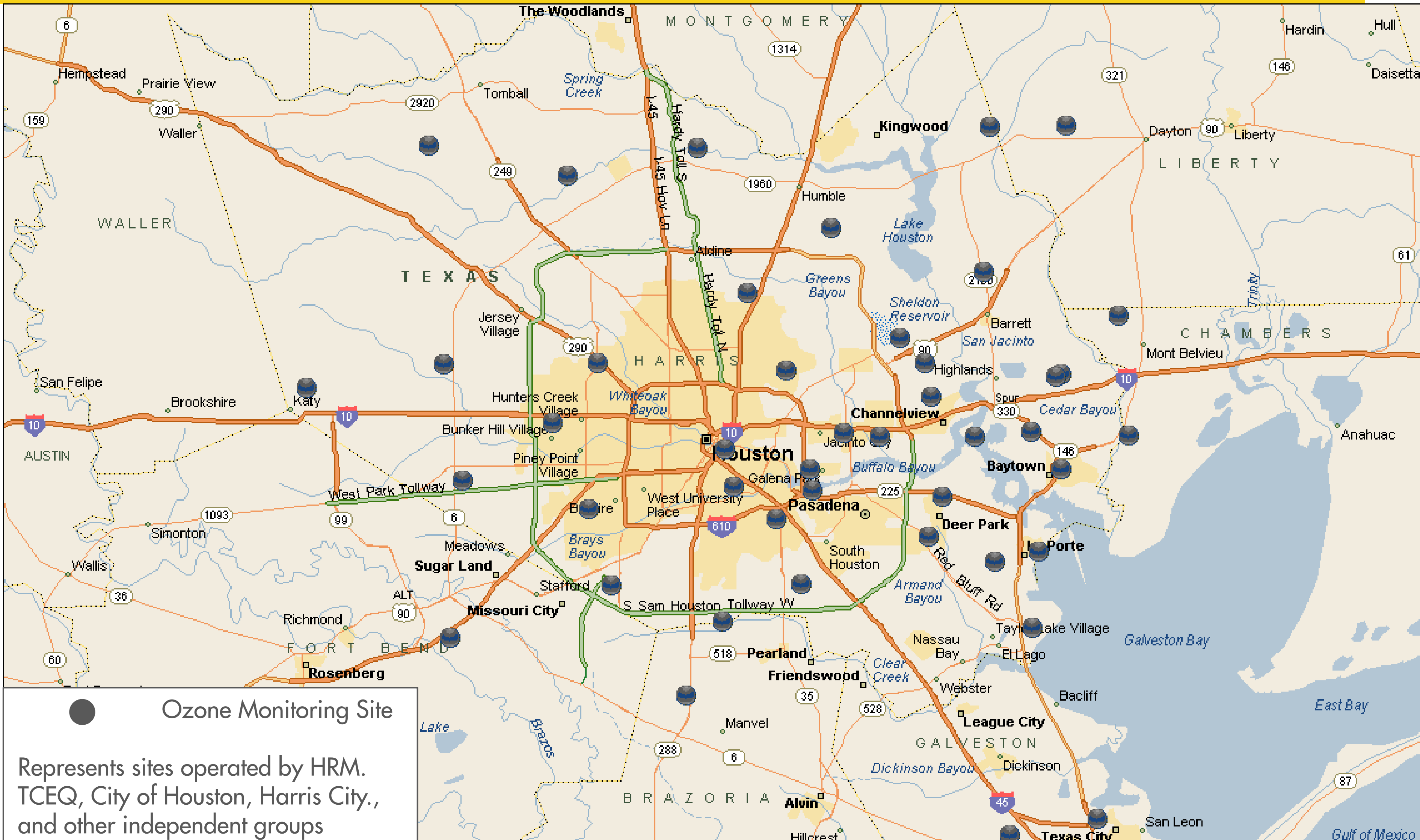
Provides data to improve the science basis for 8-Hour Ozone SIP

Provides HRM data to:

- Support Houston air quality studies
- Support advocacy on regulatory and policy changes
- Address technical air monitoring issues and opportunities

- Makes air quality improvement presentations

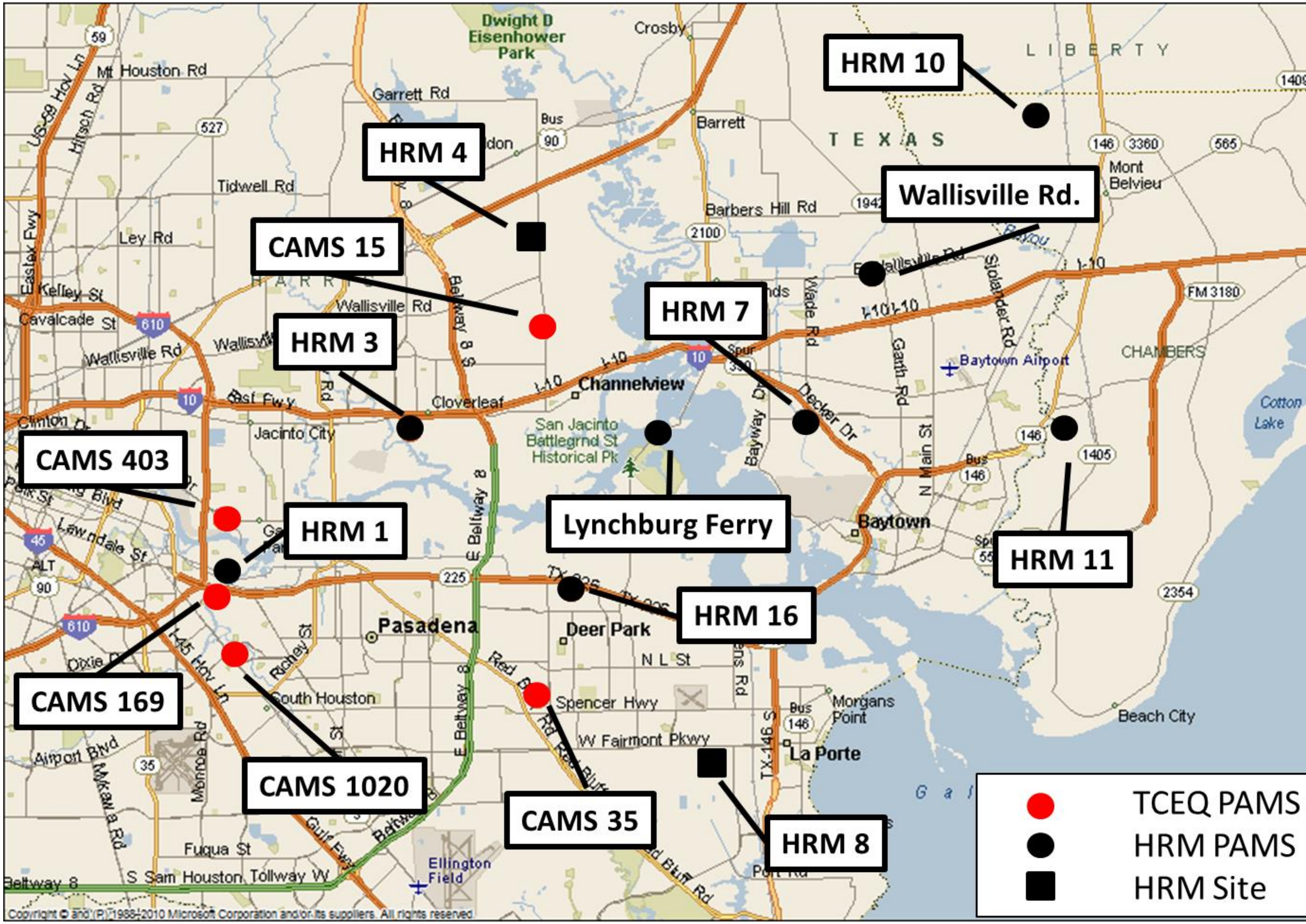
OZONE MONITORING IN HOUSTON AREA



Ozone Monitoring Site

Represents sites operated by HRM. TCEQ, City of Houston, Harris City., and other independent groups

HRM Service Area



HRM Monitoring Program

Site	Criteria Air Pollutants							Non Criteria Air Pollutants				
	SO_2	O_3	NO_2	CO	PM_{10}	$PM_{2.5}$	Pb	H_2S	VOC Canister	EARS	Automated GC	BZ FRA
HRM 1 Central St.	√	√	√	√	√		√	√	√	√		
HRM 3 Haden Road	√	√	√	√	√	√		√	√	√	√	
HRM 4 Sheldon Road		√	√	√					√	√		
HRM 7 West Baytown	√	√	√	√	√			√	√	√		
HRM 8 La Porte		√	√	√					√	√		
HRM 10 Mont Belvieu		√	√	√					√	√		
HRM 11 East Baytown	√	√	√	√					√	√		
HRM 615 Lynchburg Ferry		√	√								√	√
HRM 617 Wallisville Road		√	√								√	
HRM 16 Deer Park											√	

Legend:
SO_2 =Sulfur dioxide
O_3 =Ozone
NO_2 =Nitrogen dioxide
CO=Carbon monoxide
PM_{10} = Particulate Matter (10 micron)
$PM_{2.5}$ = Fine Particulate Matter (2.5 micron)
Pb=TSP Lead

H_2S = Hydrogen Sulfide
VOC Canister = Every 6th Day Canister Sample
EARS = Emergency Accidental Release System
Automated GC = Automated Gas Chromatography
BZ FRA = Benzene Fast Response Analyzer

Meteorological Parameters: (All Sites)
Ambient Temperature
Wind Speed
Wind Direction
Standard Deviation of Wind Direction
Maximum Wind Gust
Precipitation (all sites, except Site 16)
Net Radiation
Barometric Pressure (only Site 16)

VIEW OF MONITOR SITE

Typical HRM Monitoring Site

ACCOMPLISHMENTS OVER THE PAST YEAR

Base Monitoring Program

- Continuously operated monitoring network (ten sites)
- Renewed HRM Supplemental Environmental Project (SEP)

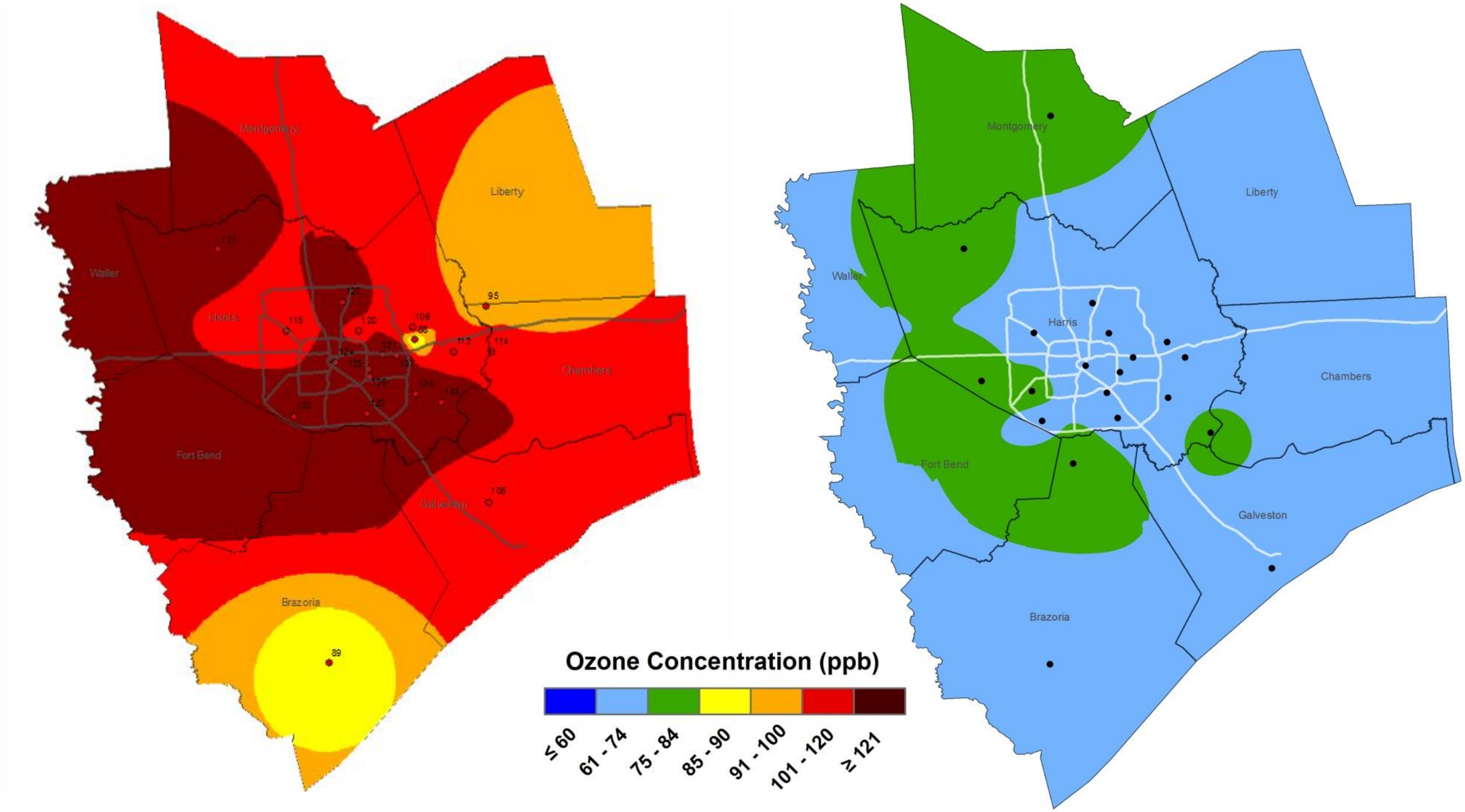
Special Studies

- Delivered PM2.5 source apportionment study
- Conducted a test of new equivalent method NO2 analyzer

Communications

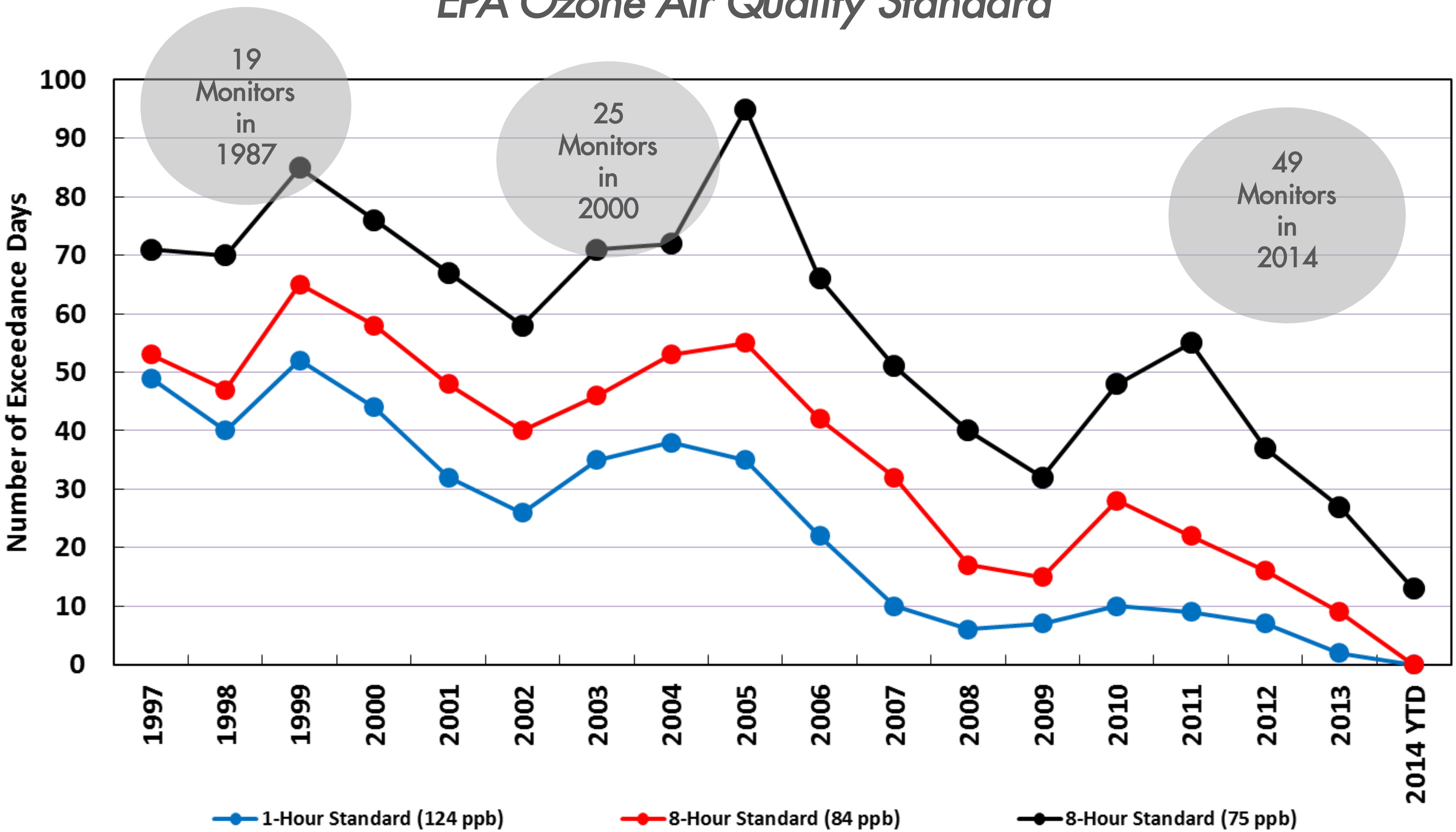
- Presented the air quality update to a number of organizations
- Provided data to www.houstonairquality.com

8-Hour Ozone Design Values
1985 to 2014 YTD



There Have Been Dramatic Air Quality Improvements in Houston since 1985

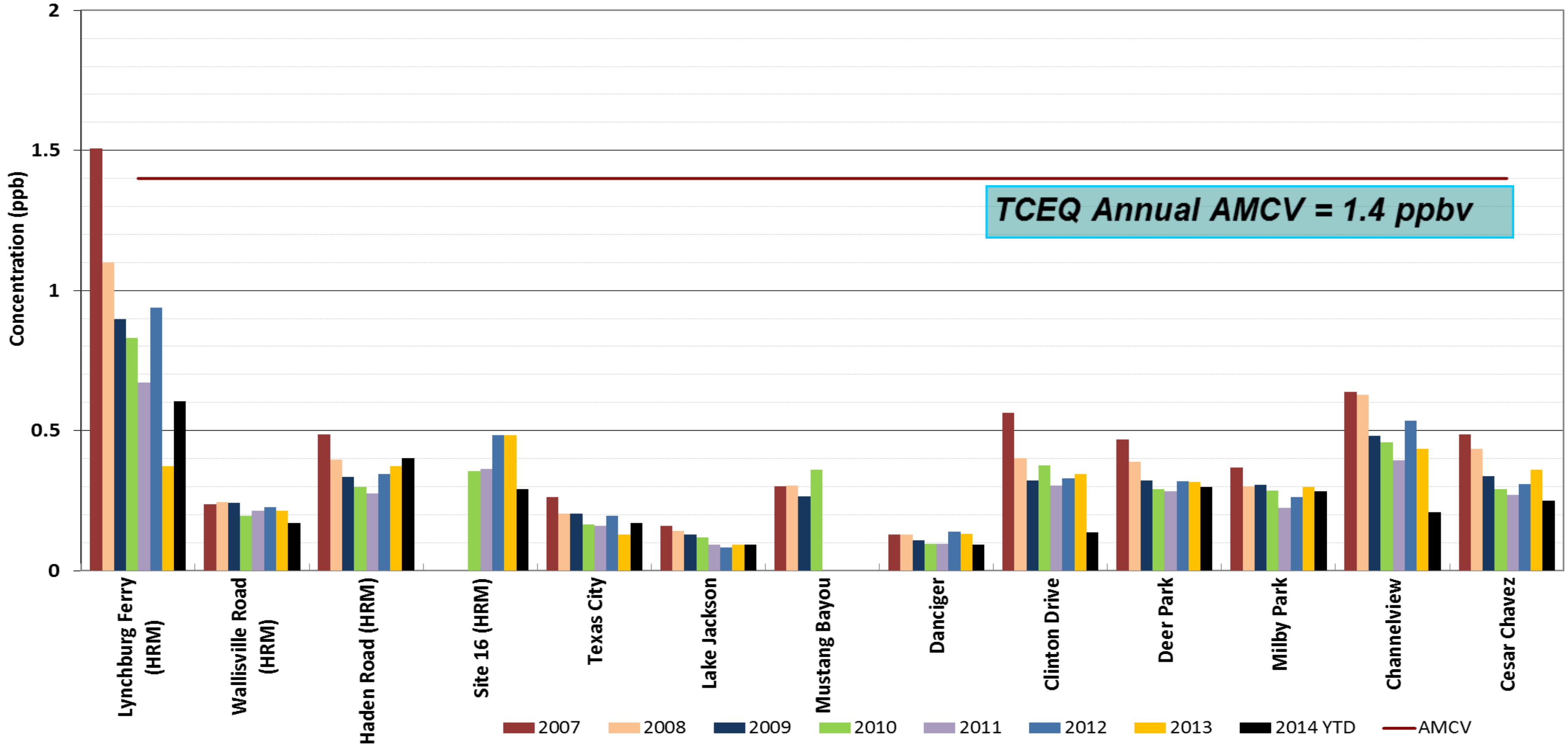
Days When Houston Area Monitors Exceeded EPA Ozone Air Quality Standard



2014 data as of 09/15/2014

Significant Decline In Number of Ozone Exceedance Days

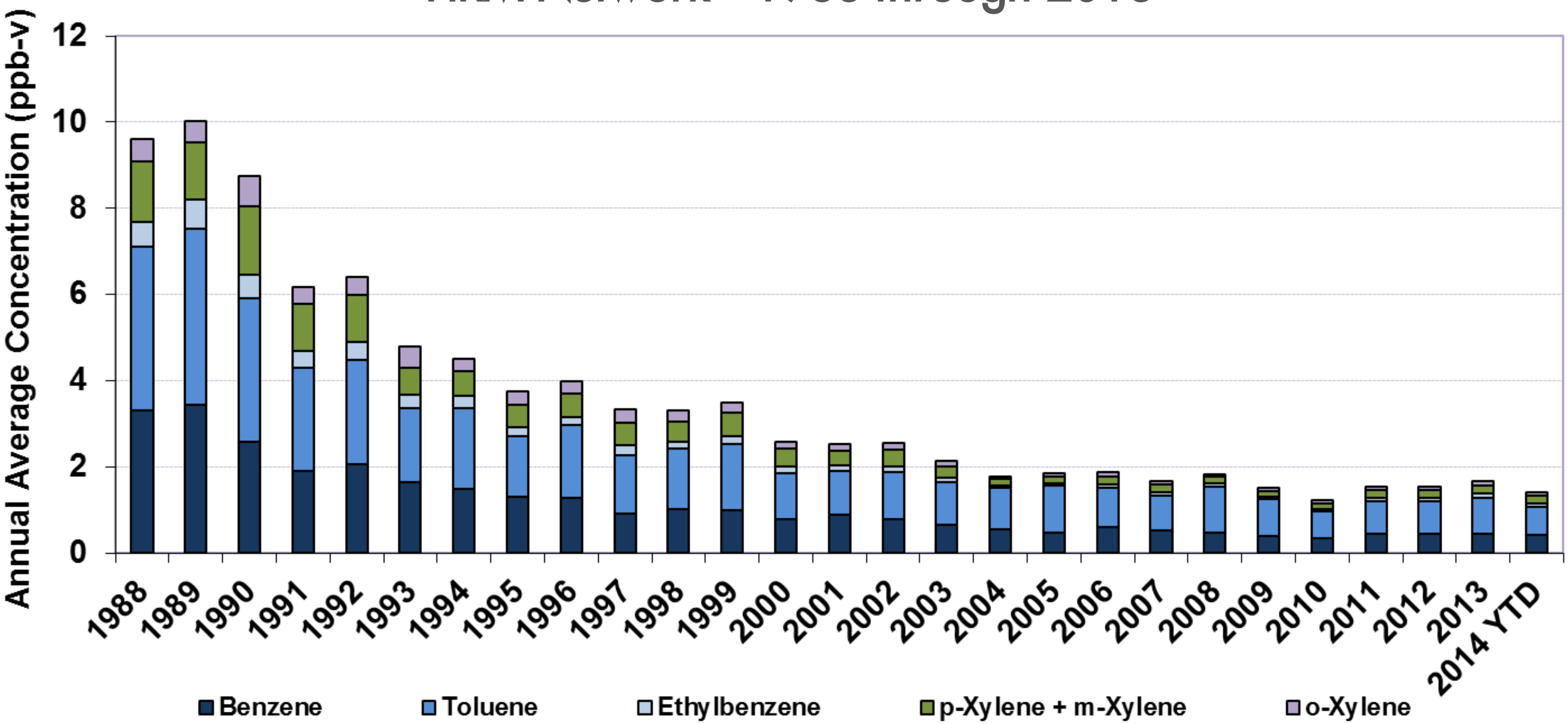
ANNUAL AVERAGE BENZENE CONCENTRATION AT AUTO-GC SITES IN HOUSTON AREA (2007 – 2014 YTD)



Results from All Monitors < TCEQ AMCV

Annual Average BTEX Trends

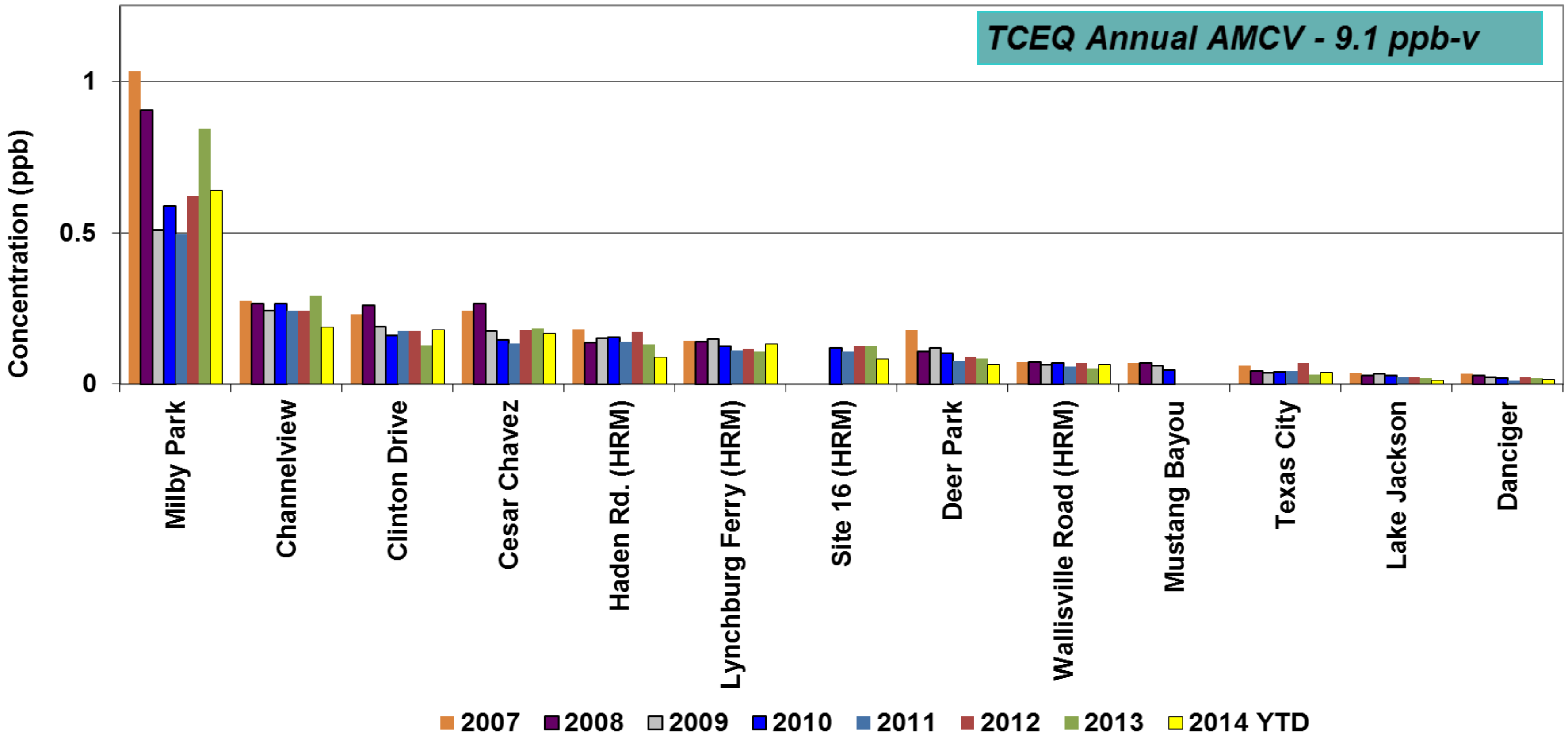
HRM Network - 1988 through 2013



1. BTEX – Benzene, Toluene, Ethylbenzene, Xylene
2. HRM every sixth day 24-hour composite canister sampling data

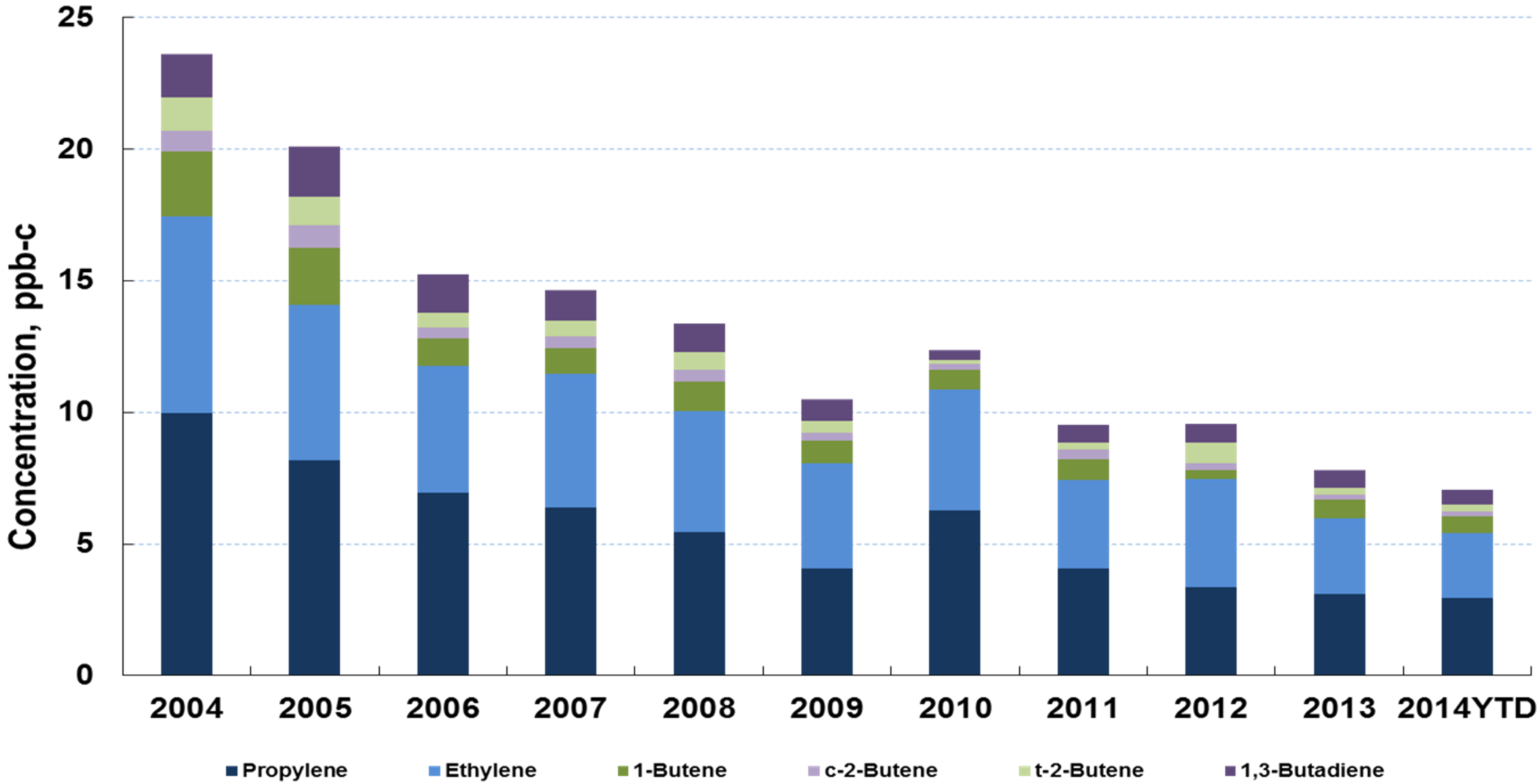
85% Reduction in BTEX Concentrations Since 1988

ANNUAL AVERAGE 1,3-BUTADIENE CONCENTRATION AT AUTO-GC SITES IN HOUSTON (2007 – 2014 YTD)



Results from All Monitors Significantly < TCEQ AMCV

AVERAGE ANNUAL HRVOC CONCENTRATIONS
HOUSTON SHIP CHANNEL PAMS-GC MONITORING SITES



74% Reduction of HRVOC Since 2004

CONCLUSIONS

- While the size and breadth of HRM system may be more complex than what is needed in the Sarnia airshed, it does demonstrate that an industry sponsored monitoring network can be a cost effective way to develop ambient air quality data that can be effectively utilized by policy makers and stakeholders
- Utilization of the data in communications with Community Area Councils and Panels concerning air quality have been very positive
- Data has been used effectively to impact air quality policy decision and have resulted in a long term and sustained improvements in observed ambient air quality improvements

ENHANCED LDAR

ENHANCEMENTS DEPEND UPON THE STARTING POINT

- Existing LDAR program
  - Audio/Visual/Olfactory (AVO)
  - Method 21 (FID/PID sniffers)
  - Optical Gas Imaging

What Is It ?

- Work practice regulation/fugitive emissions identification method
- Test leak interfaces on various types of plant processing equipment with hydrocarbon analyzer
- Did bagging studies to correlate volumetric (ppm) readings from analyzer to measured mass flow rates
- Used to set thresholds for repair under various regulations (NSPS, MACT, other)

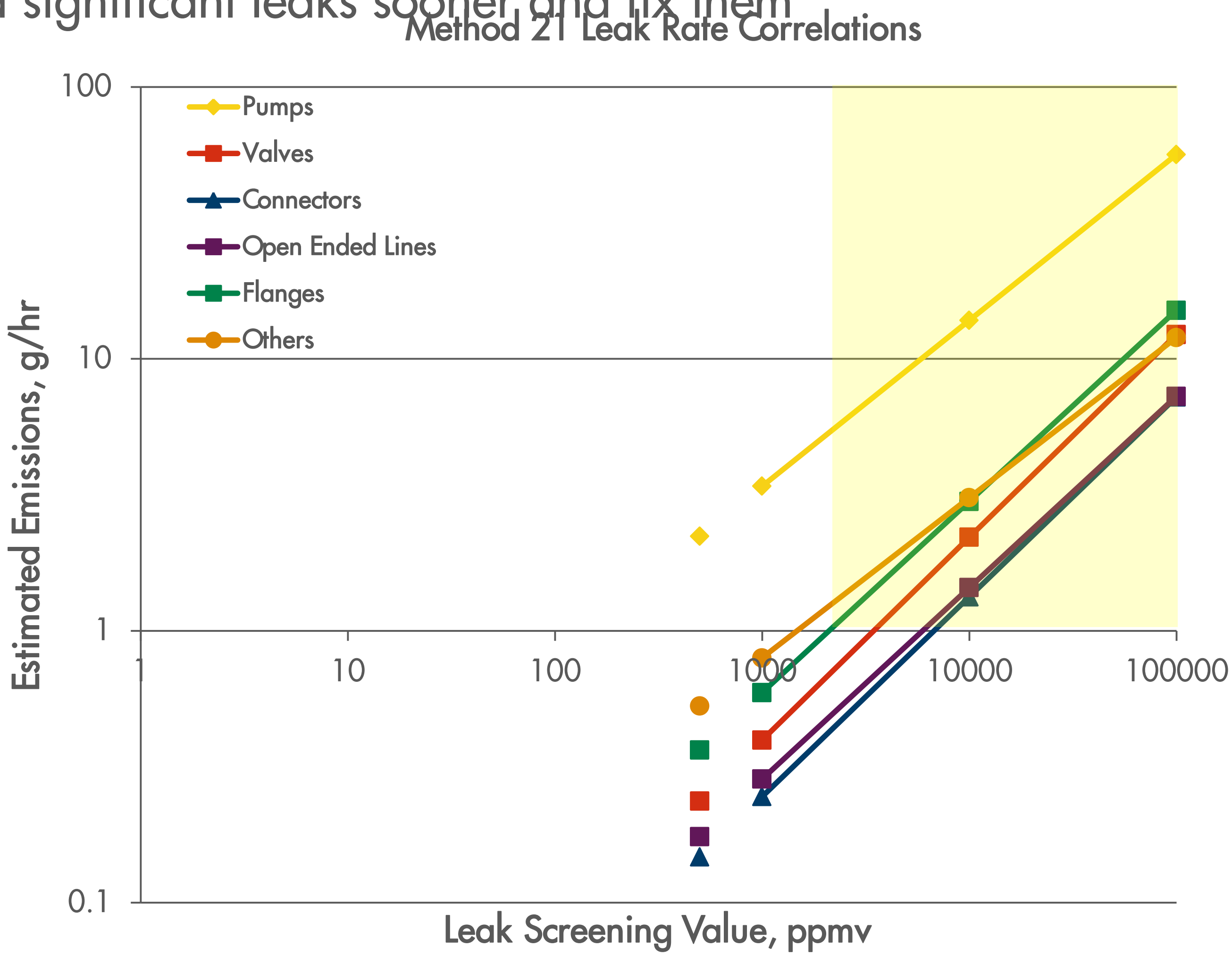
OPTICAL GAS IMAGING

What Is It?

- Cameras which are 'tuned' to wavelengths in which energy is absorbed by hydrocarbons
- Best-demonstrated field technology to date is passive IR
    - Many new entries in the market
- Detection is based upon mass flow
- Can quickly scan larger areas and optically confirm the presence and source of large leaks
- Can be fitted with longer lenses to easily spot large leaks from the facility perimeter

OBJECTIVE OF ENHANCED LDAR

Find significant leaks sooner and fix them



EPA MONTE CARLO EQUIVALENCY DEMONSTRATIONS

Table 3-2: Comparison of AWP Leak Definitions (kg/hr) at Different Monitoring Frequencies Equivalent to Three CWP Leak Definitions at Quarterly Monitoring

CWP Leak Definition at Quarterly Monitoring	Equivalent AWP Leak Definition for Specified Monitoring Frequency (kg/hr) [a]					
	Leak Rate/ Screening Value Correlation	Quarterly	Bi-monthly	Semi-quarterly	Monthly	Semi-monthly
500 ppmv	Petroleum	0.00023	0.060	0.085	0.10	0.17
	SOCMI	0.00026	0.062	0.085	0.10	0.16
1,000 ppmv	Petroleum	0.00041	0.061	0.085	0.11	0.17
	SOCMI	0.00043	0.060	0.085	0.11	0.17
10,000 ppmv	Petroleum	0.0049	0.069	0.090	0.13	0.18
	SOCMI	0.0050	0.069	0.089	0.13	0.18

[a] Equivalent AWP leak definitions were determined from 1,000 simulations using the U.S. EPA's Monte Carlo software and revised assumptions specific to Gas Imaging Technology .[4]

COMPARISON CHART OF LEAK DETECTION AND ESTIMATION METHODOLOGIES FOR METHOD 21, OPTICAL IMAGING & HIGH FLOW SAMPLING

LDAR Parameter	Method 21	Optical Imaging	High Flow Sampling
Equipment Cost	$10-15k USD	$80-100k USD	$15-25K USD
Monitoring Speed	300-400 comp/D	2-4,000 comp/D	20-40 leaks/D
Estimating Emissions*	Correlation Equations or Emission Factors	Leak/No Leak Emission factors	Direct Measurement
Accuracy of Estimated Emissions	Medium	Medium to Low	High for Sampled Components
Acceptance of Emissions Estimation Methods	High	Improving	High

* All methods require allocation of estimated emissions over time if more than one monitoring/sampling event exists.

CONCLUSIONS

- OGI LDAR continues to be proven to be equivalent or more effective in reducing emissions than Method 21 programs
- OGI targets the leaks that have the largest impacts on ambient air quality at a fraction of the manpower that is required by Method 21
- OGI programs have an added benefit of providing information on emissions from both regulated and unregulated components, as well as, source location (avoiding false positives), and difficult/unsafe to monitor components
- There are still elements of the design of OGI programs that are being developed and optimized, therefore consultation with the regulated community during the development of these programs is essential

Q & A